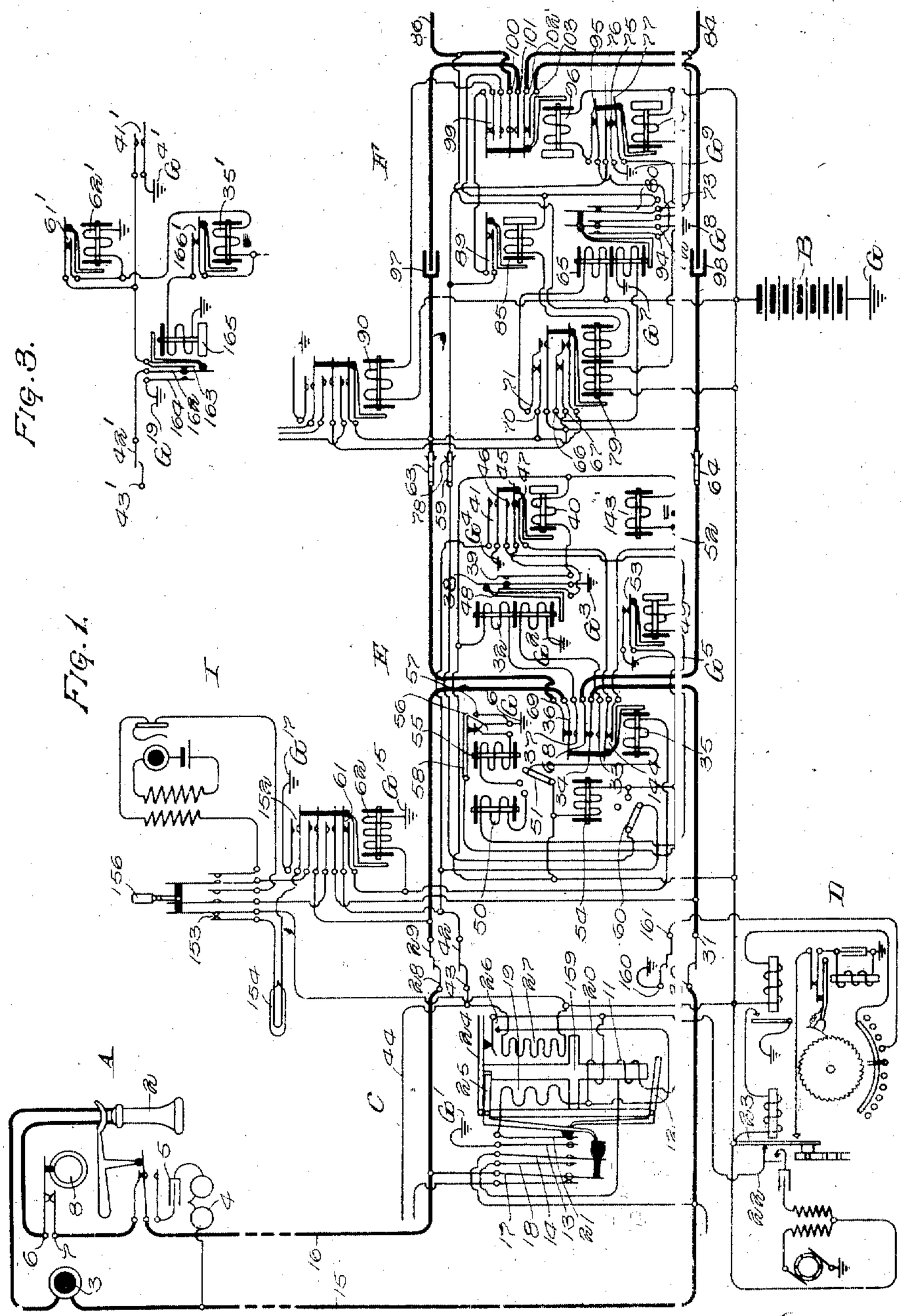
G. A. YANOCHOWSKI & H. E. HERSHEY.

AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED NOV. 28, 1913.

1,216,534. Patented Feb. 20, 1917.

2 SHEETS—SHEET 1.



WITNESSES

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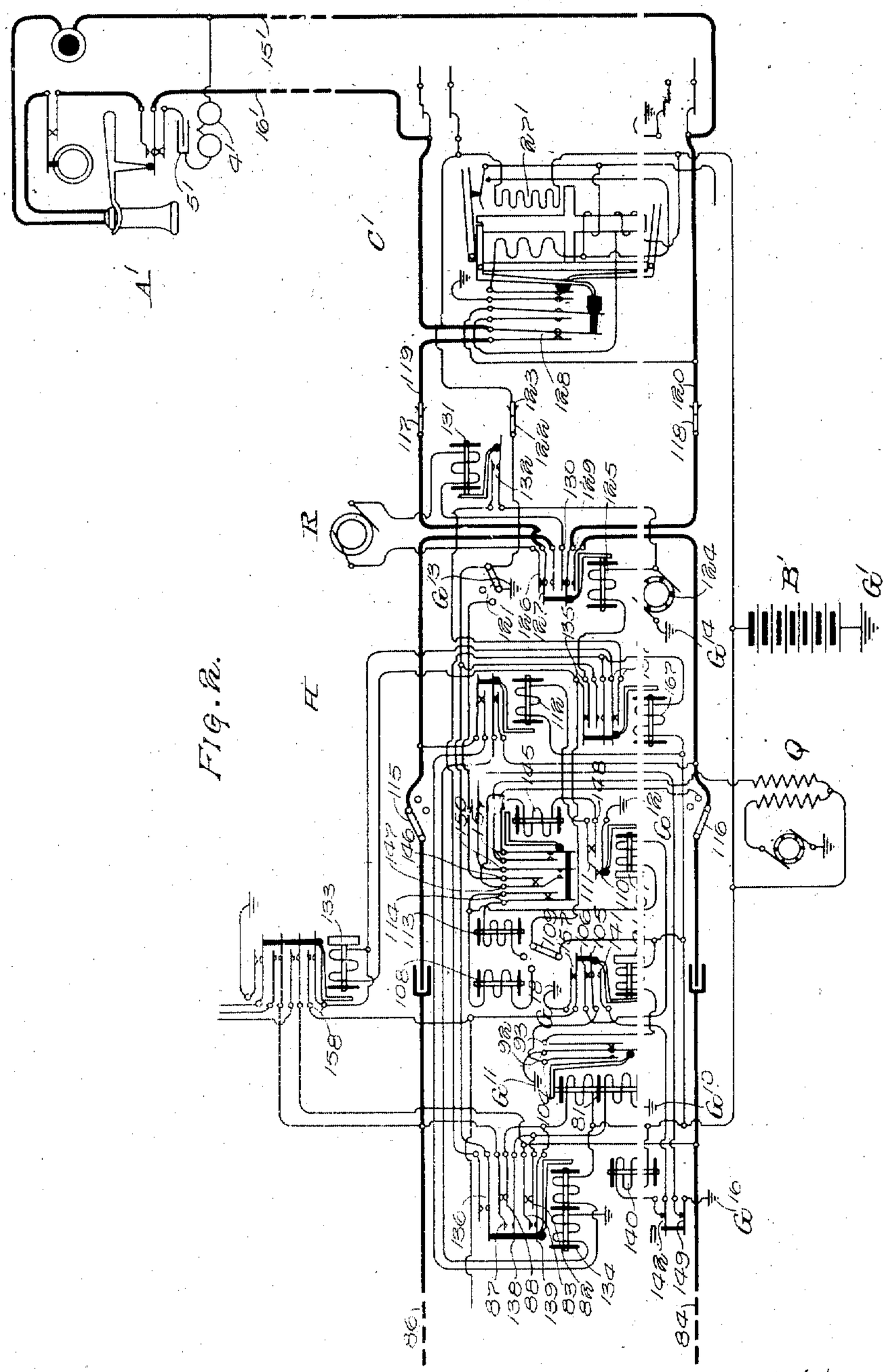

FIG. 2.

WITNESSES

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UNITED STATES PATENT OFFICE.

GEORGE A. YANOCHOWSKI, OF CHICAGO, ILLINOIS, AND HARRY E. HERSHEY, OF WHITEWATER, KANSAS, ASSIGNORS TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

1,216,534. Specification of Letters Patent. Patented Feb. 20, 1917.

Application filed November 28, 1913. Serial No. 803,126.

To all whom it may concern:

Be it known that we, GEORGE A. YANOCHOWSKI and HARRY E. HERSHEY, both citizens of the United States of America, and residents of Chicago, Cook county, Illinois, and Whitewater, Butler county, Kansas, 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 has for its object the provision of means for automatically switching a connection to an operator in case any one of the switches employed in establishing the connection lands on a trunk which is out of order.

In the accompanying drawings we have illustrated our invention in connection with an automatic telephone system employing line switches, selectors, repeaters and connectors of well-known types, and have shown how the connection will be automatically switched to an operator's position, first, if the selector strikes a trunk which is open between the selector and the repeater; second, if the trunk is open between the repeater and the next succeeding switch; and, third, if the connector lands on an open line.

This last feature is particularly useful in cases not only where the subscriber's line has become accidentally open, but also in cases where a substation has been disconnected. Heretofore, in such cases, it has been customary to provide special means for switching the connection from such a disconnected line to an operator's board in order that the operator can inform the calling subscriber that the telephone of the desired called subscriber has been disconnected. By our invention, however, such switching of the connection is accomplished automatically.

Referring to the drawings, Figures 1 and 2 show a complete connection between a calling substation A and a called substation A′ in a system embodying the principles of our invention.

Fig. 3 is a modified arrangement of a portion of the circuits.

The substation A and the apparatus shown in Fig. 1 are assumed to be located in a branch exchange, while the apparatus shown in Fig. 2 is assumed to belong to the main exchange. The connection shown is extended through the subscriber's individual switch C and the selector E at the branch exchange and through the repeater F, which latter is included in a trunk line leading to the main exchange from whence the connection extends through the connector H to the called substation. The selector E in the branch exchange, besides having access to trunk lines leading to the main exchange, is also assumed to have access to connectors in its own exchange for the purpose of completing connection with the branch exchange subscribers. It will be clearly understood by those versed in the art that so-called selector switches may be inserted between the main office terminal of the trunk line and the connector H, the said selectors to be similar to the one shown at E. At I is shown an operator's set, together with a lamp associated with a key, the same being assumed to be mounted on a complaint or trouble desk.

The substation A shown herein may be of any suitable or approved type and comprises the usual receiver 2, transmitter 3, ringer 4 and condenser 5. 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 6 and 7 and an impulse wheel 8, which latter is assumed to be controlled through the medium of a finger hole dial (not shown) in such a manner that the impulse springs 6 and 7 may be momentarily separated a number of times corresponding to each digit of the number to be called.

The subscriber's individual switch C is of the general type of subscriber's switch shown in British patent to R. W. James No. 26,301 of 1906, being, however, of the particular type disclosed in British patent to T. G. Martin No. 1419 of 1910. This line switch comprises, among other details, a plunger (not shown) attached to the end of a so-called plunger arm 24 which is controlled by the magnet 159. The magnet 159 comprises four windings, namely, a pull-down winding 19, a cut-off or holding winding 27, a line winding 11 and an auxiliary winding 20. The core of the magnet 159 is so constructed that the magnetic circuit of

the windings 19 and 27 is separate from that of the windings 11 and 20. The winding 19 operates both the plunger arm 24 and the armature 25, while the winding 27 is strong enough only to operate the cut-off armature 25 and to hold the plunger arm 24 in its operated position. When the plunger arm 24 is operated, the plunger is forced into a bank of contact springs, forcing the springs 28, 43, 160 and 30 into engagement with the springs 29, 42, 161 and 31, respectively. Although only one set of springs is shown, each line switch is provided with a plurality of such sets, each set forming the terminal of a trunk line leading to a first selector switch E. Each trunk line is connected in multiple with the corresponding springs of all the line switches of the group which is controlled by the master switch D. The switch C is controlled by the subscriber through the medium of the line winding 11, as will hereinafter be more fully explained.

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

The first selector switch E is of the general type of selector switch disclosed in United States Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson, except that the circuits are modified to adapt the switch to operate in a system in which it is controlled by impulses delivered over two sides of the line in series. Among other details, the selector E comprises a bank of contacts arranged in horizontal rows or levels, which contacts are adapted to be engaged by a set of wipers 63, 59 and 64 carried upon a shaft (not shown) which has a vertical movement controlled by the vertical magnet 50 and a rotary movement controlled by the rotary magnet 55. The operations of the various parts of the switch are controlled through the medium of the double-wound line relay 32. The usual side switch comprising the wipers 51 and 60 is controlled by the private magnet 54 in the usual and well-known manner. Means for permitting the switch to be restored to normal position are provided in the release magnet 143, which, upon energizing, withdraws the retaining pawls from the shaft. The springs 52 close only when the switch shaft has been raised one or more steps from its lowest position. The relays 40 and 49 are slow acting—that is, they deënergize slowly after their energizing circuits are broken.

The repeater F comprises a combination of relays which are for the purpose of receiving impulses from the calling substation and repeating them over the trunk conductors 84 and 86 to the connector H in the main exchange. These relays are controlled directly by means of the double-wound line relay 65. The relays 74, 85 and 96 are slow acting—that is, they deënergize slowly after their energizing circuits are broken.

The connector switch H is of the same general type of connector switch as that disclosed in 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 two sides of the line in series. Like the selector the connector is provided with a shaft (not shown) carrying the wipers 117, 122 and 118 which is controlled by the vertical magnet 108 and the rotary magnet 113. The usual side switch comprising the wipers 115, 116, 109 and 121 is controlled by the private magnet 112 in the usual and well-known manner. The magnet 140 is the usual release magnet. The line relay 81 is connected with the line through the reversing springs of a so-called back-bridge relay 134, through the winding of which latter relay the called line is provided with talking current. The ringing relay 125 is the means through which ringing current is applied to the called line.

At Q is shown a busy signaling machine which provides a busy signal, said busy signal being applied to the calling line through the medium of the busy relay 145 in case the called line is in use. The substation shown at A′ and the line switch C′ are similar in all respects to the substation A and the line switch C.

For the purpose of supplying battery current for operating the apparatus at different exchanges and for talking purposes, there are shown throughout the drawings batteries B and B′ having one terminal grounded at G and G′. At R is shown a ringing current generator for supplying ringing current to the called line.

A general description of the apparatus having been given, it will now be explained how a connection is extended from a calling substation A to a called substation A′. We will assume the number of the substation A′ to be 222. 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 A preparatory to making a call, an energizing circuit is closed through the line winding 11 of the

individual switch C, whereby the switch is operated to connect with an idle trunk which it will be assumed extends to the selector E. As this operation is well understood in the art and is fully described in the patents referred to, it is not thought necessary to describe this operation in detail.

The line relay 32 of the first selector E is thereupon energized. The calling subscriber now operates his calling device for the first digit 2 of the called number, whereby the substation impulse springs 6 and 7 are operated twice momentarily, each time breaking the circuit of the selector line relay 32. The relay 40 of the selector being slow acting does not deënergize during the momentary interruptions of its circuit by the line relay 32 and consequently, each time the latter relay deënergizes, an impulse is transmitted over the circuit extending from ground G^3 through the springs 38 and 48, springs 45 and 46, relay 49, vertical magnet 50 and the side switch wiper 51 (in first position) to battery B. The vertical magnet receives two impulses over the circuit and operates to raise the switch shaft and wipers two steps to a position opposite the second row or level of bank contacts. The off-normal springs 52 close as soon as the shaft is raised one step, but the circuit of the release magnet 143 still remains open at the springs 45 and 47. The relay 49, which is included in circuit with the vertical magnet, is energized by the first impulse, but being a slow acting relay does not allow its armature to fall back until after the last impulse has been delivered. In its energized position the relay 49 closes a circuit from ground G^5 through the springs 53 and the private magnet 54 to battery B. This circuit is broken when the relay 49 deënergizes after the last impulse has been delivered to the vertical magnet, the breaking of said circuit causing the private magnet 54 to deënergize, thus permitting the side switch to pass to second position.

In passing from first to second position the side switch wiper 51 disconnects the battery from the vertical magnet 50 and closes a circuit through the rotary magnet 55. The circuit extends from ground G^6 through the interrupter springs 56, rotary magnet 55 and the side switch wiper 51 (in second position) to battery B. The rotary magnet 55 will then continue to operate in a manner similar to that of a buzzer to rotate the wipers step by step as long as the side switch remains in second position. As soon as the rotary magnet energizes the first time, a circuit is closed from ground G^6 through the contact point 57, armature 58 and the private magnet 54 to battery B. The private magnet 54 is energized over this circuit and is again deënergized when the rotary magnet 55 deënergizes after having rotated the wipers the first step provided the first trunk line upon which the selector wipers are rotated is idle. If the trunk is busy, however, the private wiper 59 finds the contact which it engages provided with a guarding ground potential. A new circuit is then closed through the private magnet 54 extending from said grounded contact through the wiper 59, side switch wiper 60 (in second position) and the private magnet 54 to battery B. Therefore the private magnet 54 does not deënergize when the rotary magnet armature falls back and the side switch is locked in second position. The rotary magnet 55 then continues to advance the wipers step by step until the contacts of an idle trunk are reached, whereupon the private magnet deënergizes, permitting the side switch to pass to third position and thus break the circuit of the rotary magnet 55. When the side switch wiper 51 reaches third position, a circuit is closed from ground G^4 through the springs 41, springs 61 of the relay 62, relay 35 and the side switch wiper 51 (in third position) to battery B. It will be seen that the relay 62 will not be energized at this time on account of being shunted by ground G^4. The relay 35, upon energizing, operates to disconnect the line relay 32 from the line and extend the connection through the wipers 63 and 64 to the repeater F. When the circuit is thus extended to the repeater, the line relay 65 is energized over a circuit extending from ground G^7 through the lower winding of the line relay 65, springs 66 and 67, wiper 64, springs 68 and 34, springs 31 and 30, line conductor 15 to and through the substation A, line conductor 16, springs 28 and 29, springs 36 and 69, wiper 63, springs 70 and 71 and the upper winding of the line relay 65 to battery B. The line relay 65, upon energizing, closes a circuit from ground G^8 through the springs 72 and 73 and the relay 74 to battery B. The relay 74, upon energizing, provides a new circuit for the relay 35 of the selector E and the cut-off winding 27 of the line switch C for maintaining the relay 35 and the cut-off coil 27 energized after their original circuit is broken by the deënergization of the slow acting relay 40. This circuit extends from ground G^9 through the springs 75 and 76, contact 78, wiper 59 and the side switch wiper 60 (in third position), at which point the circuit divides, one part continuing through the springs 61 of the relay 62 and the relay 35 to battery B. The other branch extends from the side switch wiper 60 (in third position) through the springs 42 and 43 and the cut-off coil 27 of the line switch C to battery B. The circuit also divides at the spring 43 and the conductor 44 connects ground to the connector private bank contacts which are associated with the line

switch C. The relay 62 does not pull up at this time due to the fact that it is shunted out by ground G^9. The trunk leading to the repeater F is also protected from seizure over any of its multiple contacts by a guarding potential extending from ground G^9 to the private bank contact 78 and the multiples thereof. Another result of the energization of the relay 74 is the closure of a circuit from ground G^9 through the springs 75 and 77 and the left-hand winding of the relay 79 to battery B. The relay 79 is so constructed and adjusted that it cannot be operatively energized by one winding alone, but requires the combined energization of both its windings to cause it to attract its armature. The engagement of the springs 80, upon the energization of the repeater line relay 65, closes a circuit, through the line relay 81 of the connector H, said circuit extending from ground G^{10} through the lower winding of the relay 81, springs 82 and 83, over the trunk conductor 84, through the springs 80, relay 85, right-hand winding of the relay 79, trunk conductor 86, springs 87 and 88 and the upper winding of the line relay 81 to battery B. Although both windings of the relay 79 of the repeater now carry current, the relay is not operated because the current flows through the two windings in opposite directions. It will be seen that the energization of the relay 85 causes the springs 89 to be separated, thus keeping the circuit of the relay 90 open. The energization of the line relay 81 of the connector serves to close a circuit through the slow acting relay 91. This circuit extends from ground G^{11} through the springs 92 and 93 and the relay 91 to battery B.

The apparatus is now in position for the reception of impulses for the second digit 2. The line relay 65 of the repeater F is deënergized twice by the impulses for this digit, each time breaking the circuit of the connector line relay 81 at the springs 80. The relay 74 of the repeater being slow acting does not deënergize between impulses. Consequently, each time the line relay 65 deënergizes it also closes a circuit from ground G^8 through the springs 72 and 94, springs 95 and the relay 96 to battery B. The relay 96 is energized by the first impulse and remains in its energized position until after the last impulse has been delivered. In its energized position the relay 96 disconnects the condensers 97 and 98 from the trunk lines 86 and 84 and short-circuits the right-hand winding of the relay 79 and the relay 85 and thus removes their resistance from the circuit of the connector line relay 81 while it is operating. The relay 96, upon energizing, also opens the springs 99 to prevent the circuit of the relay 90 from being closed when the relay 85 deënergizes, due to being short-circuited. Upon deënergizing, the springs 100 and 102 make contact with the springs 101 and 103, respectively, before the springs 99 come in contact, thus insuring that the relay 85 will have separated the springs 89 before the springs 99 are again in contact.

Each time the line relay 81 of the connector deënergizes in response to the breaking of its circuit by the line relay of the repeater, a circuit is closed from ground G^{11} through the springs 92 and 104, springs 105 and 106 (the slow acting relay 91 remaining energized between impulses), relay 107, vertical magnet 108 and the side switch wiper 109 (in first position) to battery B′. The vertical magnet 108 is energized twice over this circuit and operates to raise the shaft wipers two steps. The slow acting relay 107 is energized in series with the vertical magnet 108 and does not deënergize until after the last impulse is delivered. Upon energizing, the relay 107 closes a circuit from ground G^{12} through the springs 110 and 111 and the private magnet 112 to battery B′. When this circuit is broken after the last vertical impulse has been delivered to the vertical magnet 108, the private magnet 112 deënergizes and the side switch passes to second position. By this action the side switch wiper 109 transfers the battery connection from the vertical magnet 108 to the rotary magnet 113. When the calling device is operated for the last digit, the repeater F operates in the same manner as for the previous digit. Each time the connector line relay 81 deënergizes in response to the impulses, a circuit is closed from ground G^{11} through the springs 92 and 104, springs 105 and 106, relay 107, springs 114, rotary magnet 113 and the side switch wiper 109 (in second position) to battery B′. The rotary magnet 113 is energized twice over this circuit and operates to rotate the wipers onto the contacts of the desired line. The relay 107 operates in the same manner as for the previous digit to close the circuit of the private magnet 112, while the rotary magnet is operating. If the called line is idle, the private magnet 112 deënergizes when its circuit is broken by the relay 107 after the last impulse is delivered to the rotary magnet 113 and the side switch passes to third position, completing the connection with the called line through the side switch wipers 115 and 116, shaft wipers 117 and 118 and conductors 119 and 120. The movement of the side switch wiper 121 to third position provides a guarding potential for the connector private bank contacts of the called line and closes an energizing circuit for the cut-off winding of the line switch C′. This circuit extends from ground G^{13} through the side switch wiper 121 (in third position), private wiper 122, private bank contact 123 and thence to all multiples of the same.

This circuit also extends through the cut-off winding 27′ of the line switch C′ to battery B′. The winding 27′, upon energizing, operates to disconnect the line switch C′ from the line. At the instant the side switch wiper 109 of the connector H reaches third position, a circuit is closed from ground G^{14} through the interrupter 124, ringer relay 125, springs 135 and the side switch wiper 109 (in third position) to battery B′. Since this circuit includes the interrupter 124, the relay 125 is energized intermittently, each time operating to close a signaling circuit from one terminal of the generator R through the springs 126 and 127, line wiper 117, conductor 119, springs 128, line conductor 16′, condenser 5′, ringer 4′, line conductor 15′, conductor 120, line wiper 118, springs 129 and 130 and the relay 131 to the other side of the generator. In addition to ringing the bell at the substation A′, the generator current also energizes the relay 131, causing it to separate the springs 132 and thus keeping the circuit of the relay 133 open. The purpose of this relay 133 will be hereinafter more fully described. The relay 133 is made slow acting, *i. e.*, slow to deenergize after its circuit is broken, and likewise slow to energize upon its circuit being made, so that it will not energize during the instant between the time that ground G^{14} is placed upon its circuit by the interrupter 124 and the time that its circuit is broken by the springs of the relay 131, due to the generator current being projected on the line. When the called subscriber removes his receiver, the calling substation is provided with talking current through the windings of the back-bridge relay 134, which relay, upon energizing, closes the circuit of the ringing cut-off relay 167, said circuit extending from ground G^{13} through the side switch wiper 121 (in third position), springs 136 and the relay 167 to battery B′. The relay 167, upon energizing, interrupts the circuit of the ringing relay 125 at the springs 135 and closes a locking circuit for itself through its own springs independent of the springs 136 of the back-bridge relay 134. It may be mentioned here that in addition to the above, the relay 167 also opens the springs 137, thus permanently opening the circuit of the relay 133. A further result of the energization of the back-bridge relay 134 upon the response of the called subscriber is the shifting of the springs 138 and 139, which transposes the connections between the windings of the relay 81 and the trunk conductors 84 and 86, whereby the current in the trunk between the repeater F and the connector H is reversed in direction. This reversal of the current causes the two windings of the relay 79 of the repeater F to assist each other, whereby the relay itself is energized and in turn operated to reverse the direction of the current in the line leading to the calling substation.

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 hook-switch springs destroys the energizing circuit of the repeater line relay 65, which, upon deënergizing, breaks the circuit of the relay 81. The line relay 81 of the connector, upon deënergizing, breaks the circuit of the relay 91, which in turn deënergizes and closes the circuit of the release magnet 140. This circuit extends from ground G^{11} through the springs 92 and 104, springs 105 and 141, off-normal springs 142 and the released magnet 140 to battery B′. The release magnet 140, upon energizing, operates to release the connector, whereupon its own circuit is broken at the off-normal springs 142 when the switch shaft reaches its lowest position. The relay 85 of the repeater F being slow acting will not deënergize immediately upon its circuit being broken at the springs 80, but will remain energized a length of time sufficient for the relay 74 to deënergize and remove ground from the spring 76, so that when the relay 85 does deënergize, allowing the springs 89 to come into contact, the circuit of the relay 90 will be open at the spring 76. When the relay 74 of the repeater F deënergizes it breaks the circuit of the relay 35 of the selector E and also of the cut-off winding of the line switch C. A circuit is now formed from ground G^{15} through the relay 62 and the relay 35 to battery B. The resistance of the relays is such that the relay 62 becomes energized, but the relay 35 deënergizes, closing the circuit of the release magnet 143 from ground G^{3} through the springs 38 and 48, springs 45 and 47, springs 144, off-normal springs 52 and the release magnet 143 to battery B. The release magnet 143, upon energizing, operates to release the selector, whereupon its own circuit is broken at the off-normal springs 52 when the switch shaft reaches its lowest position. At the same time a circuit is formed from ground G^{15} through the relay 62, springs 61, springs 42 and 43 and the cut-off coil 27 to battery B. The resistance of the coils is such that the cut-off coil 27 deënergizes, thereby allowing the plunger arm 24 to return to normal. It will be seen that as soon as the switches C and E are released by their release magnets 27 and 143 the circuit of the relay 62 is also opened and the said relay in turn deënergizes.

If, when the connector switch wipers come in contact with the called line, this line is busy, then there will be the usual guarding potentional upon the connector private bank contact. Upon the private wiper en-

gaging this guarding potential, a busy signal will be sent back to the calling subscriber from the busy machine Q in the well-known manner. The calling subscriber, upon receiving the busy signal, hangs the receiver upon the hook, thereby releasing the connection in the manner above described.

A general description of the operation of the system having been given, the feature of our invention will now be explained whereby, should a subscriber in making a call meet with a trunk or line which is out of order, the said subscriber will be automatically connected with a trouble or complaint operator.

The first case to be considered is that in which the shaft wipers of the selector E come to rest upon a set of contacts having an opening in either the positive trunk, the negative trunk, the release trunk or combinations of the same. Under any of the above conditions the connection from ground G^9 in the repeater F to the private wiper 59 will be broken. If the release trunk itself is broken, this, of course, breaks this ground connection, while if either the positive or negative trunk is broken, the circuit of the line relay 65 of the repeater will be broken and the relay 74 will not be energized to connect ground G^9 to the private wiper 59. As before pointed out, the relay 62 is first short-circuited through the ground connection G^4 controlled by the relay 40 and then, after connection is established with the repeater, this relay 62 is short-circuited by the ground connection through the private wiper 59. Therefore, when there is no such ground on the private wiper 59, due to the trunk being open, then as soon as the relay 40 falls back, in the manner previously described, ground G^4 is removed from the spring 41, the relay 62 will no longer be shunted out and a circuit will be closed from ground G^{15} through the relay 62, relay 35 and the side switch wiper 51 to battery B. The resistance of the relays is such that the relay 62 energizes, while the relay 35 deënergizes. The energization of the relay 62 closes a circuit from ground G^{17} through the springs 152, lamp 154 and the springs 153 to battery B. The deënergization of the relay 35 again connects the line relay 32 with the substation A, which relay 32 therefore energizes and again closes the circuit of the relay 40, whereby ground G^4 is again placed upon the spring 41, thus affording a holding circuit for the cut-off coil 27 of the line switch C. The plunger of the line switch C is not withdrawn from the bank springs during the period of time that ground G^4 is broken for the following reason: When ground G^4 is removed, a second holding ground for the cut-off coil 27 of the line switch C is provided from ground G^{15} through the relay 62, springs 61, springs 42 and 43 and the cut-off coil 27 to battery B. However, when the relay 62 energizes, the springs 61 are separated, leaving the cut-off coil 27 without a holding ground. The cut-off coil 27 therefore deënergizes, but the armature 25 being a light armature and carrying heavy spring tension falls back before the plunger arm 24 has overcome its inertia. The armature 25, upon falling back, again places the line relay 11 in the circuit of the substation A. The receiver at the substation A being removed at this time causes a flow of current through the line relay 11. This line relay 11, upon pulling up, closes a circuit through the pull-in winding 19, which attracts the armature 25, again breaking the circuit of the line relay 11. This buzzing action will keep up, without the plunger being removed from the bank, until the ground is again connected from G^4 to again energize the cut-off winding 27, which then holds the armature 25 in an operated position. The ground G^4 at this time does not afford a holding circuit for the relay 35 on account of the springs 61 being opened by the relay 62. The complaint operator, upon seeing the lamp 154 lighted, throws the key 156 to the right, thereby opening the circuit of the lamp 154 and bridging the secondary of her induction coil in series with her receiver across the line conductors of the selector E. The operator can now converse with the subscriber at the substation A and inform him that the trunk is out of order. Also, it will readily be seen that should the subscriber hang up his receiver, the selector E will not be released on account of the secondary winding of the operator's induction coil being bridged across the line conductors of the selector E until the key 156 is restored. This is of value in that the operator can hold the connection up until the attendant at the automatic exchange has located the trunk which is in trouble.

A modified arrangement for obtaining the above result is shown in Fig. 3, in which are shown a number of relays which may be embodied in a selector, such as the selector E. The same reference numbers are used in Fig. 3 to indicate like parts in Fig. 1, except that the prime mark is added in each instance. In this modification a slow acting relay 165 has been added, its circuit being controlled by the springs 166′ of the relay 35′. The conductor from the spring 42′ passes through the springs 162 and 163 and from thence to the spring 61′. When the relay 35′ becomes energized, due to ground from G^4, in a manner similar to that described in connection with Fig. 1, a circuit is closed through the relay 165, which relay, upon energizing, places ground from G^{19} through the springs 164 and 162 to the spring

42′, which affords a holding circuit for the cut-off winding 27 of the line switch C. The spring 162 of the relay 165 is adjusted to make contact with the spring 164 before it breaks contact with the spring 163. Now when a holding ground fails to come back from the switch ahead, and when the ground G^4 is removed from the spring 41′, the relay 62′ is no longer shunted out and the relay 35′ falls back and the relay 62′ pulls up, as above explained in connection with Fig. 1. The relay 165 being slow acting will not deënergize immediately upon its circuit being broken, but will continue to hold the ground G^{19} upon the spring 42′ for an instant, by which time the line relay 32 will again have become energized and in so doing close the circuit of the relay 40, which will again place ground from G^4′ upon the springs 41′ to again afford a holding circuit for the cut-off winding 27 of the line switch C, when the relay 165 deënergizes. In this way the buzzing action of the line switch in Fig. 1 is prevented.

We will next consider the case in which the selector E comes to rest upon the contacts of a repeater F whose trunk to the distant exchange is out of order, either by reason of being short-circuited, or the positive trunk open, or the negative trunk open or the negative trunk grounded, or combinations of the above. Under any of the above conditions the current from the line relay of the switch ahead will fail to flow through the trunk conductors, and for this reason the relay 85 will not be energized. Therefore, as soon as the relay 74 becomes energized and places ground upon the spring 76, a circuit will be formed from ground G^9 through the springs 75 and 76, springs 89 of the relay 85, springs 99 of the relay 96 and the relay 90 to battery B. The relay 90 will thereupon energize and light a lamp associated with an operator's key, similar to the lamp 154 and the key 156, in front of the complaint operator I. The operator will then throw her key and converse with the subscriber in the manner and with the results described above.

The third case to be considered is that in which the shaft wipers of the connector H come to rest upon a set of contacts having an opening in the line circuit. Under these conditions, when the ringer relay 125 energizes and connects ringing current to the line, the circuit of the relay 131, which is connected in series with the ringing current, will not be closed due to the opening in the line and this relay will accordingly not energize. With the ringer relay 125 in an energized position and the relay 167 deënergized, a circuit is formed from ground G^{14} through the interrupter 124, springs 132, springs 137 of the relay 167, relay 133 and the side switch wiper 109 (in third position) to battery B′. The energization of the relay 133 closes a locking circuit for itself from ground G^{18} through the springs 157, springs 158, relay 133 and the side switch wiper 109 (in third position) to battery B′. The energization of the relay 133 will light a lamp associated with an operator's key, similar to the lamp 154 and the key 156, in front of the complaint operator. Thereupon the operator throws her key and converses with the subscriber in the manner and with the results described above. This is of particular value in that should a telephone be removed it is unnecessary to place the number of said telephone upon a traffic trunk, for in case any one should call that number, the fact that the connector will ring upon an open line causes the calling party to be automatically connected with a complaint operator, who, upon inquiring the number being called, can inform the calling subscriber that that telephone has been removed.

It will thus be seen that we have devised a very efficient means for automatically switching the connection to an operator's board in case any one of the switches strikes a trunk line which is open.

While we have illustrated our invention in connection with an automatic telephone system of a well-known type employing certain well-known forms of line switches, selectors, repeaters and connectors, it will, of course, be understood that it is equally as well adapted for use in connection with other automatic or semi-automatic systems in which different types of automatic switches are employed, as our invention is not in any way limited to the particular type of switch employed.

What we claim as our invention is:—

1. In a telephone system, a calling and a called subscriber's line, means including selector and connector switches for establishing connection between said lines, and means for signaling an operator if said selector strikes an open trunk, or said connector strikes an open line.

2. In a telephone system, a calling and a called subscriber's line, means including trunk lines, selector switches, repeaters and connectors for establishing connection between said lines, and means for signaling an operator if said selector strikes a trunk which is open on either side of said repeater, or if said connector strikes a called line which is open.

3. In a telephone system, a group of trunk lines, an automatic switch adapted to connect with any one of said trunks, each of said trunks comprising a plurality of conductors, a ground normally adapted to be connected with one of said conductors when connection is established with said trunk, means for removing said ground in case any

of the conductors of said trunk is open, an operator's position, and means controlled by the removal of said ground for signaling said operator.

4. In a telephone system, a group of trunk lines, an automatic switch adapted to connect with any one of said trunks, each of said trunks comprising a plurality of conductors, a ground normally adapted to be connected with one of said conductors when connection is established with said trunk, means for removing said ground in case any of the conductors of said trunk is open, an operator's position, a relay associated with said operator's position, energizing circuits for said relay, a short-circuit for said relay including said ground connection, whereby when said ground connection is removed said relay is energized, and an operator's signal controlled by the energization of said relay.

5. In a telephone system, a line, an automatic switch adapted to establish connection with said line, an operator's position, a relay associated with said position, means for energizing said relay when said switch strikes a line which is open, an operator's signal controlled by said relay, and means by which the operator may then establish connection with said switch.

6. In a telephone system, a line, a switch adapted to establish connection with said line, means for applying ringing current to said line, a relay connected in series with said ringing current circuit, an operator's position, a relay associated with said position, means controlled by said first relay for opening the circuit of said second relay, means for closing the circuit of said second relay when said switch establishes connection with a line which is open, an operator's signal controlled by said second relay, and means by which said operator can then establish connection with said switch.

7. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic progressively movable switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, said control circuit controlled in turn over a circuit having a section individual to said last mentioned section and which conducts current which does not flow over the talking circuit.

8. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic progressively movable switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, and an auxiliary relay in said last mentioned section for controlling said control circuit, said relay energized by current which does not flow over the talking circuit.

9. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, and an auxiliary relay individual to said last mentioned section for controlling said control circuit, said relay energized by current which does not flow over the talking circuit.

10. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, an auxiliary relay in said last mentioned section for controlling said control circuit, said relay energized by current which does not flow over the talking circuit, and a circuit for said current controlled over said first mentioned section.

11. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, and a supervisory relay for controlling said equipment, said relay controlled in turn by said last mentioned section and energized by current which does not flow over the talking circuit.

12. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, and an auxiliary relay in said last mentioned section for controlling said supervisory relay, said auxiliary relay energized by current which does not flow over the talking circuit.

13. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, and an auxiliary relay individual to said last mentioned section for controlling said supervisory relay, said auxiliary relay energized by current which does not flow over the talking circuit.

14. In a telephone system, means for estab-

lishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, an auxiliary relay in said last mentioned section for controlling said supervisory relay, said auxiliary relay energized by current which does not flow over the talking circuit, the circuit for said current controlled over said first mentioned section.

15. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, and a supervisory relay for controlling said equipment, said relay under the control of both of said sections and energized by current which does not flow over the talking circuit.

16. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, and a supervisory relay for controlling said equipment, said relay energized by current which does not flow over the talking circuit and under the control of said last mentioned section for rendering it inoperative.

17. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, and a supervisory relay for controlling said equipment, said relay energized by current which does not flow over the talking circuit and under the control of said last mentioned section for preventing the actuation of said supervisory equipment.

18. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, and an auxiliary relay in said last mentioned section for controlling said supervisory relay for preventing the actuation of said supervisory equipment, said auxiliary relay energized by current which does not flow over the talking circuit.

19. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, and an auxiliary relay individual to said last mentioned section for controlling said supervisory relay for preventing the actuation of said supervisory equipment, said auxiliary relay energized by current which does not flow over the talking circuit.

20. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, an auxiliary relay individual to said last mentioned section for controlling said supervisory relay, and a circuit for said auxiliary relay controlled over said first mentioned section for preventing the actuation of said supervisory equipment, the circuit for said auxiliary relay being energized by current which does not flow over the talking circuit.

21. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, and a supervisory relay for controlling said equipment, said relay energized by current which does not flow over the talking circuit and under the control of both of said sections for preventing the actuation of said supervisory equipment.

22. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, and a supervisory relay for controlling said equipment, said relay energized by current which does not flow over the talking circuit and under the control of said last mentioned section for rendering it inoperative for preventing the actuation of said supervisory equipment.

23. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay individual to said switch for controlling said equipment, and a control circuit for said supervisory relay provided with current that does not flow over

the talking circuit, said control circuit under the control of said last mentioned section.

24. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay individual to said switch for controlling said equipment, a control circuit for said relay, and an auxiliary relay in said last mentioned section for controlling said control circuit, said auxiliary relay energized by current which does not flow over the talking circuit.

25. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay individual to said switch for controlling said equipment, a control circuit for said relay, and an auxiliary relay individual to said last mentioned section for controlling said control circuit, said auxiliary relay energized by current which does not flow over the talking circuit.

26. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, a control circuit for said relay, an auxiliary relay individual to said last mentioned section for controlling said control circuit, and a circuit for said auxiliary relay controlled over said first mentioned section, the circuit for said auxiliary relay provided with current which does not pass over the talking circuit.

27. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, and a control circuit for said relay, said circuit under the control of both of said sections and supplied with current which does not flow over the talking circuit.

28. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, and a control circuit for said supervisory relay provided with current which does not flow over the talking circuit, said control circuit under the control of said last mentioned section for rendering it inoperative.

29. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached conductor sections, an automatic switch for closing one of said sections with another, a supervisory equipment, a circuit for operating said equipment, a magnet controlled over said last mentioned section energized by current which does not flow over the talking circuit, said supervisory equipment circuit under the control of said magnet whereby if the last mentioned section is in normal condition when the automatic switch operates said magnet is operated to control the supervisory equipment to prevent its operation.

30. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached conductor sections, an automatic switch for closing one of said sections with another, a supervisory equipment, a circuit for operating said equipment, a magnet controlled over said last mentioned section energized by current which does not flow over the talking circuit, said supervisory equipment circuit under the control of said magnet whereby if the last mentioned section is in normal condition when the automatic switch operates said magnet is operated to control the supervisory equipment to prevent its operation, and whereby if the said last mentioned section is not in normal condition, when the automatic switch operates, said magnet leaves the supervisory equipment free to operate, and means for operating the same.

31. In a telephone system, a calling line, a called line, means for establishing a talking circuit connection between the two, said means divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, means for operating said switch, a supervisory circuit associated with said first mentioned section, a signal in said circuit and automatic means for operating said signal when the said last mentioned section is out of normal working condition when said switch is operated, said automatic means operated by current that does not flow over the talking circuit.

32. In a telephone system, a calling line, a called line, a link circuit for establishing a connection with the called line, an automatic switch for extending the connection from the link to the circuit beyond, means for operating said switch, a supervisory circuit associated with said link, and automatic means for connecting said link to said su-

pervisory circuit if the circuit beyond is defective at the time the switch is operated.

33. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a control circuit for said equipment independent of said talking circuit and having a section individual to each of said talking circuit sections, said control circuit under the control of said other section.

34. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, said control circuit under the control of said last mentioned section, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

35. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, and an auxiliary relay in said last mentioned section for controlling said control circuit, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

36. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, an auxiliary relay individual to said last mentioned section for controlling said control circuit, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

37. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, an auxiliary relay in said last mentioned section for controlling said control circuit, a circuit for said auxiliary relay controlled over said one section, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

38. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, said circuit under the control of both of said sections, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

39. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, said control circuit under the control of said last mentioned section for rendering it inoperative, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

40. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, said relay under the control of said last mentioned section, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

41. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, an auxiliary relay in said last mentioned section for controlling said supervisory relay, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

42. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay

for controlling said equipment, an auxiliary relay individual to said last mentioned section for controlling said supervisory relay, release eequipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

43. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, an auxiliary relay in said last mentioned section for controlling said supervisory relay, a circuit for said auxiliary relay controlled over said first mentioned section, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

44. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, said relay under the control of both of said sections, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

45. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, said relay under the control of said last mentioned section for rendering it inoperative, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

46. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, said relay under the control of said last mentioned section for preventing the actuation of said supervisory equipment, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

47. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, an auxiliary relay in said last mentioned section for controlling said supervisory relay for preventing the actuation of said supervisory equipment, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

48. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, an auxiliary relay individual to said last mentioned section for controlling said supervisory relay for preventing the actuation of said supervisory equipment, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

49. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, an auxiliary relay individual to said last mentioned section for controlling said supervisory relay, a circuit for said auxiliary relay controlled over said first mentioned section for preventing the actuation of said supervisory equipment, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

50. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, said relay under the control of both of said sections for preventing the actuation of said supervisory equipment, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

51. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment indi-

vidual to said switch, a supervisory relay for controlling said equipment, said relay under the control of said last mentioned section for rendering it inoperative for preventing the actuation of said supervisory equipment, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

52. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, a control circuit for said relay, said control circuit under the control of said last mentioned section, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

53. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, a control circuit for said relay, an auxiliary relay in said last mentioned section for controlling said control circuit, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

54. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, a control circuit for said relay, an auxiliary relay individual to said last mentioned section for controlling said control circuit, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

55. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, a control circuit for said relay, an auxiliary relay individual to said last mentioned section for controlling said control circuit, a circuit for said auxiliary relay controlled over said first mentioned section, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

56. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another supervisory equipment, a relay for controlling said equipment individual to said switch, a control circuit for said relay, said control circuit under the control of both of said sections, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

57. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, a control circuit for said relay, said control circuit under the control of said last mentioned section for rendering it inoperative, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

58. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached conductor sections, an automatic switch for closing one of said sections with another, a supervisory equipment, a circuit for operating said equipment, a magnet controlled over said last mentioned section, said supervisory equipment circuit under the control of said magnet whereby if the last mentioned section is in normal condition when the automatic switch operates said magnet is operated to control the supervisory equipment to prevent its operation release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

59. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached conductor sections, an automatic switch for closing one of said sections with another, a supervisory equipment, a circuit for operating said equipment, a magnet controlled over said last mentioned section, said supervisory equipment circuit under the control of said magnet whereby if the last mentioned section is in normal condition when the automatic switch operates, said magnet is operated to control the supervisory equipment to prevent its operation, and whereby if the said last mentioned section is not in normal condition, when the automatic switch operates,

said magnet leaves the supervisory equipment free to operate, and means for operating the same, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

60. In a telephone system, a calling line, a called line, means for establishing a circuit connection between the two, said means divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, means for operating said switch, a supervisory circuit associated with said first mentioned section, a signal in said circuit and automatic means for operating said signal when the said last mentioned section is out of normal working condition when said switch is operated, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

61. In a telephone system, a calling line, a called line, a link circuit for establishing a connection with the called line, an automatic switch for extending the connection from the link to the circuit beyond, means for operating said switch, a supervisory circuit associated with said link, automatic means for connecting said link to said supervisory circuit if the circuit beyond is defective at the time the switch is operated, release equipment for said automatic switch, and a release circuit for said switch, said supervisory circuit controlled over said release circuit.

62. In a telephone system, means for establishing a talking circuit connection between two points, said circuit connection divided into normally detached sections, an automatic switch for extending a talking circuit from one of said sections to another, electromagnetically controlled supervisory mechanism associated with said switch, a circuit for said mechanism, means for operatively energizing said circuit for operating said mechanism if the automatic switch finds the talking circuit of one of the sections open, means for rendering the circuit of said mechanism inoperative if the switch finds the talking circuit of one of the sections closed, release equipment for said automatic switch, and a release circuit for said switch, said supervisory mechanism controlled over said release circuit.

63. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a control circuit for said equipment, said control circuit under the control of said last mentioned section, release equipment for said automatic switch, and a release circuit for said switch, said supervisory equipment controlled over said release circuit.

64. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, said control circuit under the control of said last mentioned section, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

65. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, an auxiliary relay in said last mentioned section for controlling said control circuit, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

66. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, an auxiliary relay individual to said last mentioned section for controlling said control circuit, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

67. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, an auxiliary relay in said last mentioned section for controlling said control circuit, and a circuit for said auxiliary relay controlled over said first mentioned section, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

68. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, said circuit under the control of both of said sections, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

69. In a telephone system, means for establishing a circuit connection between two

points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a control circuit for said equipment, said control circuit under the control of said last mentioned section for rendering it inoperative, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

70. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, and a supervisory relay for controlling said equipment, said relay under the control of said last mentioned section, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

71. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, an auxiliary relay in said last mentioned section for controlling said supervisory relay, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

72. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, an auxiliary relay individual to said last mentioned section for controlling said supervisory relay, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

73. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, an auxiliary relay in said last mentioned section for controlling said supervisory relay, a circuit for said auxiliary relay controlled over said first mentioned section, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

74. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, said relay under the control of both of said sections, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

75. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, said relay under the control of said last mentioned section for rendering it inoperative, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

76. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, said relay under the control of said last mentioned section for preventing the actuation of said supervisory equipment, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

77. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, an auxiliary relay in said last mentioned section for controlling said supervisory relay for preventing the actuation of said supervisory equipment, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

78. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, an auxiliary relay individual to said last mentioned section for controlling said supervisory relay for preventing the actuation of said supervisory equipment, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

79. In a telephone system, means for es-

tablishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, an auxiliary relay individual to said last mentioned section for controlling said supervisory relay, a circuit for said auxiliary relay controlled over said first mentioned section for preventing the actuation of said supervisory equipment, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

80. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, said relay under the control of both of said sections for preventing the actuation of said supervisory equipment, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

81. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment individual to said switch, a supervisory relay for controlling said equipment, said relay under the control of said last mentioned section for rendering it inoperative for preventing the actuation of said supervisory equipment, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

82. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, a control circuit for said relay, said control circuit under the control of said last mentioned section, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

83. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, a control circuit for said relay, an auxiliary relay in said last mentioned section for controlling said control circuit, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

84. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, a control circuit for said relay, an auxiliary relay individual to said last mentioned section for controlling said control circuit, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

85. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, a control circuit for said relay, an auxiliary relay individual to said last mentioned section for controlling said control circuit, a circuit for said auxiliary relay controlled over said first mentioned section, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

86. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, a control circuit for said relay, said circuit under the control of both of said sections, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

87. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a relay for controlling said equipment individual to said switch, a control circuit for said relay, said control circuit under the control of said last mentioned section for rendering it inoperative, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

88. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached conductor sections, an automatic switch for closing one of said sections with another, a supervisory equipment, a circuit for operating said supervisory equipment, a magnet controlled over said last mentioned section, said supervisory

equipment circuit under the control of said magnet whereby if the last mentioned section is in normal condition when the automatic switch operates said magnet is operated to control the supervisory equipment to prevent its operation, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

89. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached conductor sections, an automatic switch for closing one of said sections with another, a supervisory equipment, a circuit for operating said equipment, a magnet controlled over said last mentioned section, said supervisory equipment circuit under the control of said magnet whereby if the last mentioned section is in normal condition when the automatic switch operates said magnet is operated to control the supervisory equipment to prevent its operation, and whereby if the said last mentioned section is not in normal condition, when the automatic switch operates, said magnet leaves the supervisory equipment free to operate, means for operating the same, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

90. In a telephone system, a calling line, a called line, means for establishing a circuit connection between the two, said means divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, means for operating said switch, a supervisory circuit associated with said first mentioned section, a signal in said circuit and automatic means for operating said signal when the said last mentioned section is out of normal working condition when said switch is operated, and a busy test circuit for said switch, said supervisory circuit controlled over said busy test circuit.

91. In a telephone system, a calling line, a called line, a link circuit for establishing a connection with the called line, an automatic switch for extending the connection from the link to the circuit beyond, means for operating said switch, a supervisory circuit associated with said link, automatic means for connecting said link to said supervisory circuit if the circuit beyond is defective at the time the switch is operated, and a busy test circuit for said switch, said supervisory circuit controlled over said busy test circuit.

92. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached sections, an automatic switch for extending a talking circuit from one of said sections to another, electromagnetically controlled supervisory mechanism associated with said switch, a circuit for said mechanism, means for operatively energizing said circuit for operating said mechanism if the automatic switch finds the talking circuit of one of the sections open, and means for rendering the circuit of said mechanism inoperative if the switch finds the talking circuit of one of the sections closed, and a busy test circuit for said switch, said supervisory mechanism controlled over said busy test circuit.

93. In a telephone system, means for establishing a circuit connection between two points, said circuit connection divided into normally detached circuit sections, an automatic switch for closing one of said sections with another, supervisory equipment, a control circuit for said equipment, said control circuit under the control of said last mentioned section, and a busy test circuit for said switch, said supervisory equipment controlled over said busy test circuit.

Signed by us at Chicago, Illinois, this 20th day of November, 1913.

GEORGE A. YANOCHOWSKI.
HARRY E. HERSHEY.

Witnesses:
H. W. FRAEKE,
ALICE OSWALD.