

A. E. KEITH & J. G. BLESSING.
 AUTOMATIC TELEPHONE SWITCHING APPARATUS.
 APPLICATION FILED SEPT. 25, 1914.

1,295,175.

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 3 SHEETS—SHEET 1.

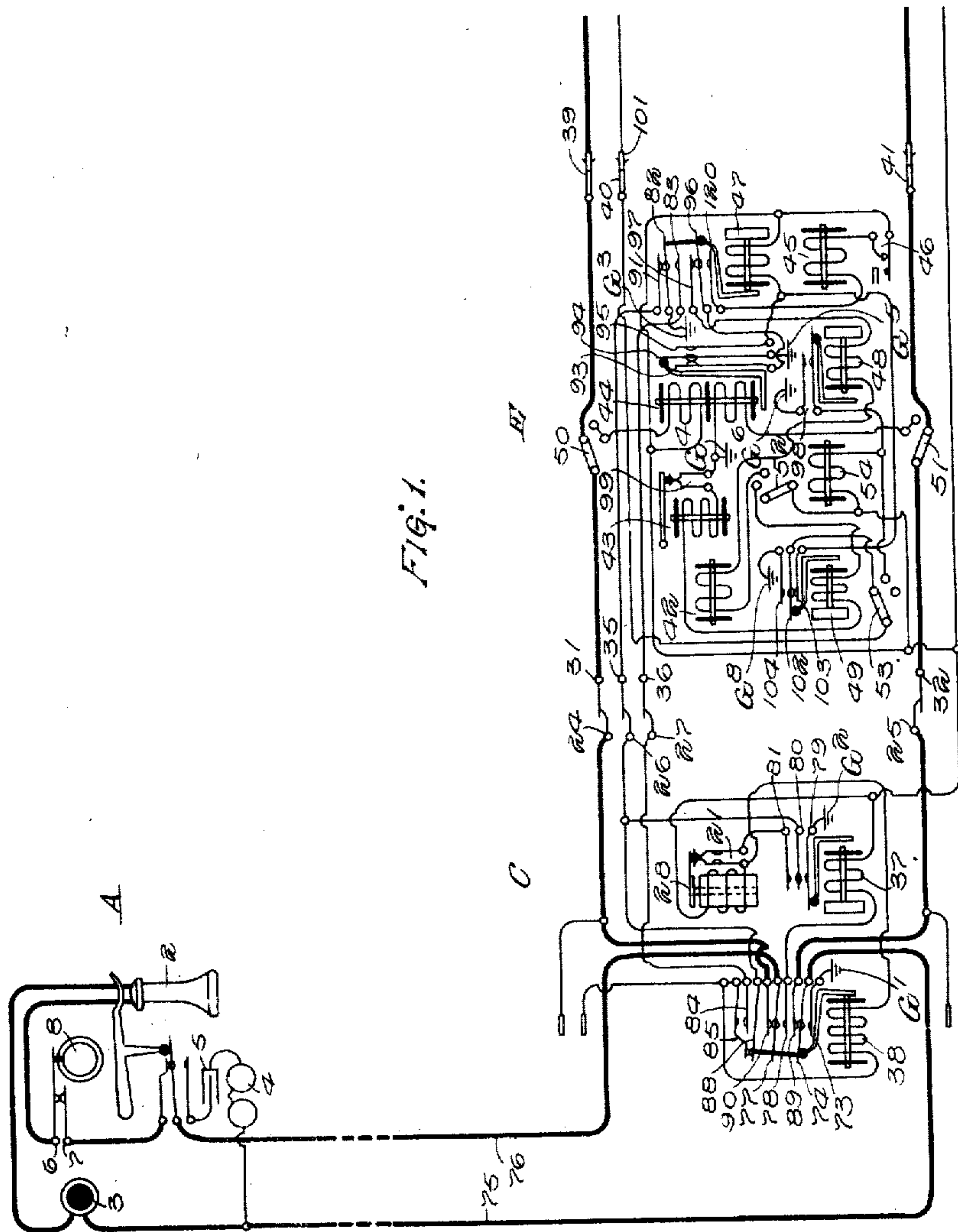


Fig. 1.

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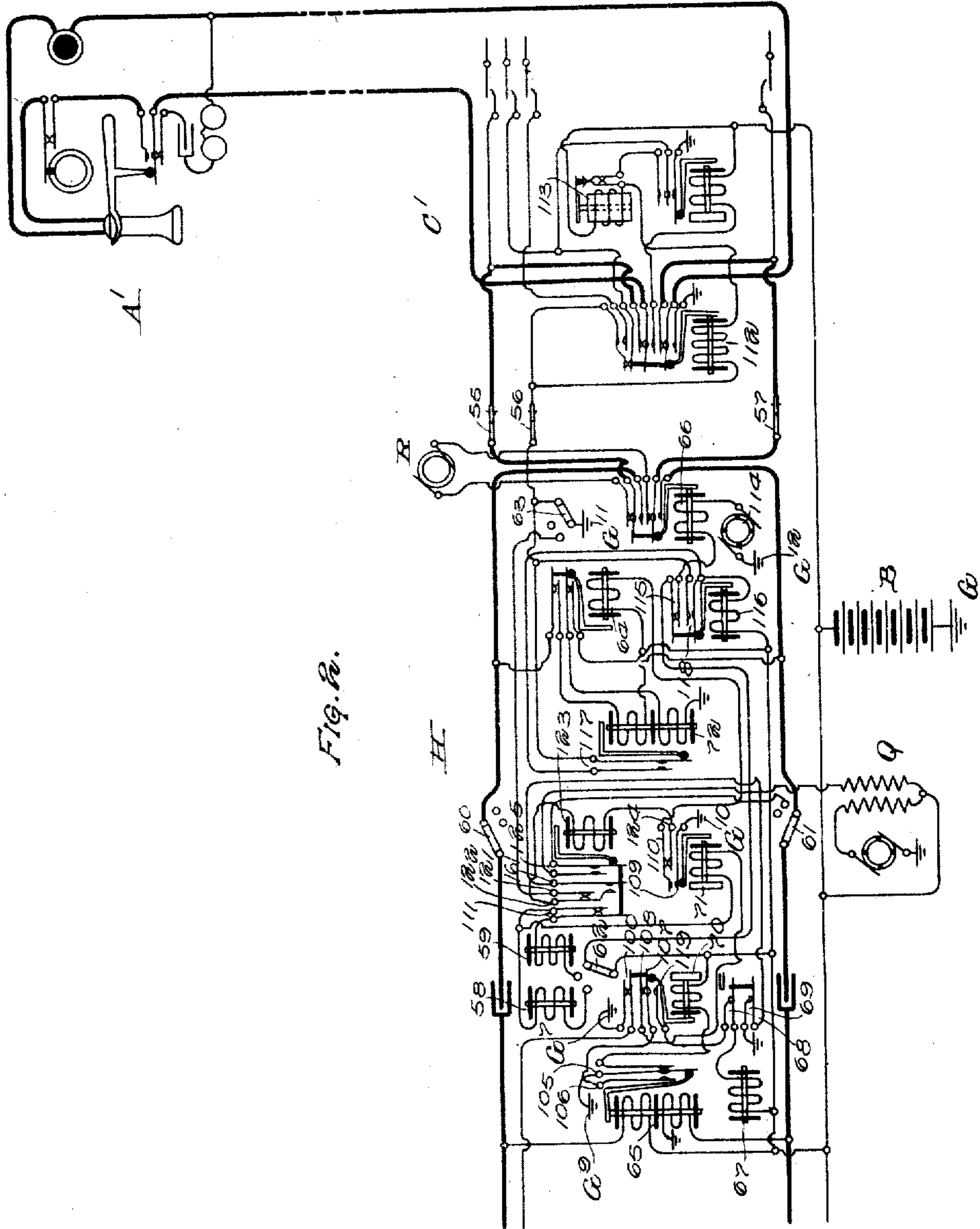
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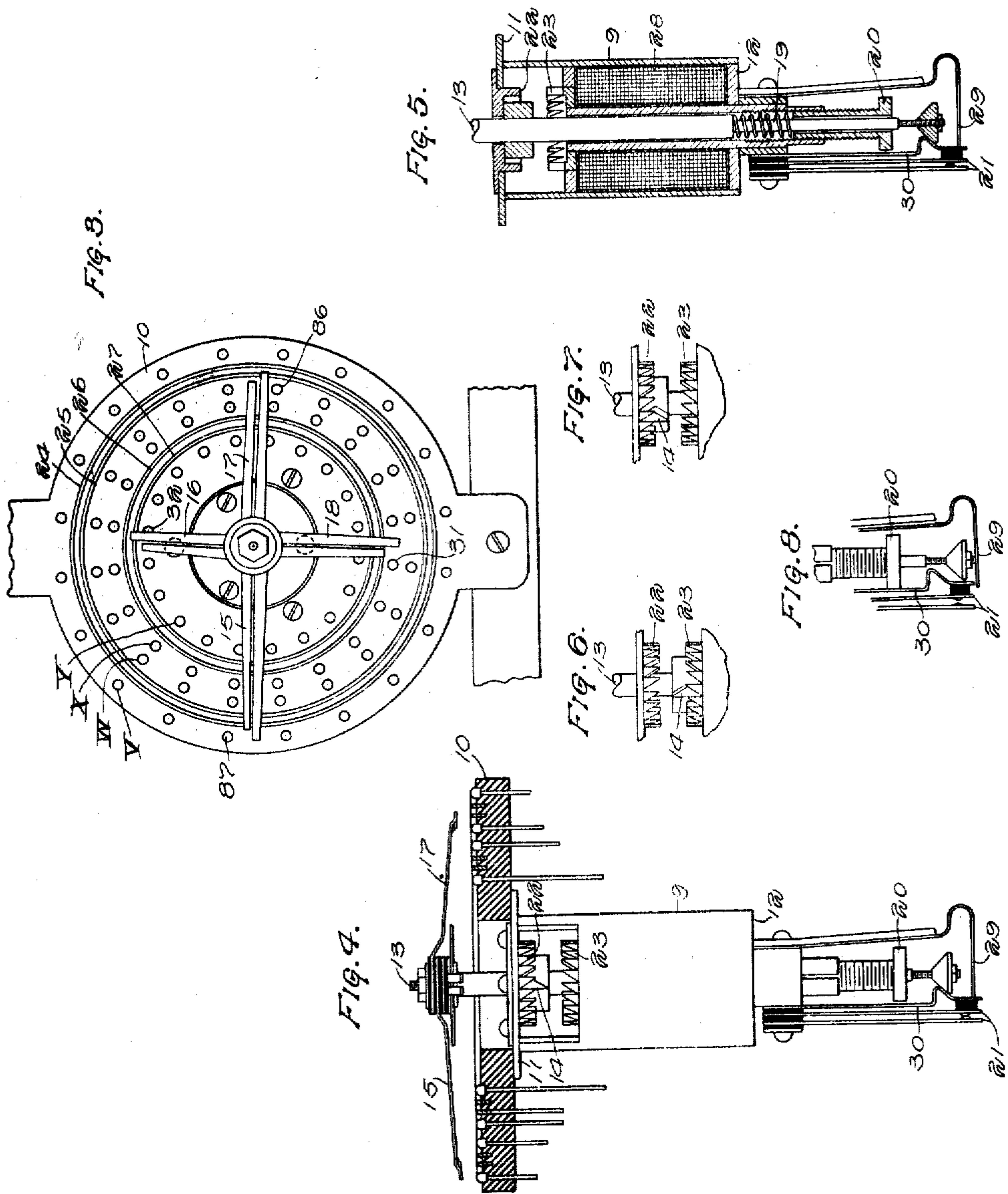
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AUTOMATIC TELEPHONE SWITCHING APPARATUS.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that we, ALEXANDER E. KEITH and JOHN G. BLESSING, citizens of the United States of America, and residents of Hinsdale, Dupage county, Illinois, and Chicago, Cook county, Illinois, respectively, have invented certain new and useful Improvements in Automatic Telephone Switching Apparatus, of which the following is a specification.

Our invention relates to automatic telephone apparatus. It relates furthermore to automatic switching apparatus, through the medium of which one line is brought into connection with another in response to electrical impulses. Among the special objects of our invention are the following: to provide an improved form of switch specially adapted for use as what is ordinarily known as a rotary switch, or also as what is ordinarily known as a non-numerical switch. These switches may be used for individual switches to the subscribers' lines. Another object of our invention is to provide certain details and features of improvement tending to increase the efficiency and serviceability of apparatus of the above character. To these ends our invention consists in the foregoing and certain combinations as hereinafter described and more particularly set forth and claimed.

In the accompanying drawings Figures 1 and 2 show a complete connection in an automatic telephone system embodying the principles of our invention.

Fig. 3 shows a top view of the individual or line switch C.

Fig. 4 shows a side view of switch C, and a cross-section of the bank 10.

Fig. 5 shows a cross-section of the switch C.

Figs. 6, 7 and 8 show in detail various parts of the switch C.

The automatic substation A (Fig. 1) comprises the usual receiver 2, transmitter 3, ringer 4 and condenser 5. Being an automatic substation, it is also provided with a suitable call sending mechanism for controlling the automatic switches, which mechanism is represented diagrammatically by a

pair of impulse springs 6 and 7 and an impulse wheel 8, which latter may be controlled by a dial provided with finger holes, in such a way that the impulse springs may be momentarily separated a number of times corresponding to the respective digits of the number of the called subscriber.

As illustrated, the line switch C comprises a frame 9, supported by the bank 10, and to which are attached the end plates 11 and 12. The shaft 13 is supported by the said end plates in such a way as to allow for vertical movement, a pallet 14 is rigidly connected to the shaft 13. Attached to the upper extremity of the shaft 13 is a hub carrying the wipers 15, 16, 17, and 18. The shaft is normally held at the extremity of its upward movement by the spring 19, the tension of which may be regulated by the thumb screw 20. The lower end of the shaft carries a projection which controls the springs 21, the same being normally held in engagement. In addition the frame 9 supports the two sets of teeth 22 and 23, between which the pallet 14 operates. The bank 10 consists of an insulating material in which are embedded the conducting rings 24, 25, 26 and 27 together with the four groups of contacts V, W, X, and Y. A solenoid 28 is so placed that it will act upon the shaft 13 in a downward direction. Referring to Fig. 4 (in which the switch is at normal), it will be seen that the wipers 15, 16, 17, and 18 are removed from the bank, the pallet 14 is resting between two teeth in the set 22, and the springs 21 are in engagement. Upon the energization of the solenoid 28 the shaft 13 is drawn downward, the pallet 14 leaves the teeth 22 and engages the teeth 23 (as shown in Fig. 6). It will be seen that this change of position has caused the pallet 14 to move through a small angular displacement, and as the pallet is rigidly connected to the shaft 13 it follows that said shaft together with the wipers 15, 16, 17 and 18 has been given a slight rotary movement to the left. With the shaft 13 in an operated position, the wipers 15, 16, 17 and 18 are lowered upon their respective rings

and contacts. As shown in Fig. 8, the shaft 13 when operated causes the spring 29 to be removed from behind spring 30, thus allowing the springs 21 to separate. Upon the deenergization of the solenoid, the shaft 13 returns to normal and in so doing the pallet 14 leaves the teeth 23 and engages the teeth 22 (as shown in Fig. 7). This movement of the pallet 14 has caused it, together with the shaft 13 and the wipers 15, 16, 17 and 18, to be rotated through a small angle to the left when the shaft returns to normal, the projection upon its lower end causes the springs 21 to close and the spring 30 to be moved to such a position that the spring 29 falls in behind it. By means of this peculiar construction, it will be seen that the springs 21 remain in contact until the shaft 13 has very nearly reached the limit of its downward movement and in turn the springs 21 remain open until the shaft 13 has very nearly reached the limit of its upward movement. Referring to Fig. 3, (in which the wipers are shown at normal), should the solenoid 28 be energized, the wipers 15, 16, 17 and 18 would be lowered upon the bank and then given a slight angular motion in a clockwise direction and as a result wiper 15 would short contact 87 and conductor 24, wiper 16 would short contact 32 and conductor 27, wiper 17 would short contact 86 and conductor 25, wiper 18 would short contact 31 and conductor 26. Upon the deenergization of the solenoid 28 the wipers 15, 16, 17 and 18 would be given a slight angular motion in a clockwise direction and in addition be raised from contact with the bank. Thus it will be seen that in one complete revolution of the shaft 13, the wipers 15, 16, 17 and 18 will have made connection with all of the contacts in the circular groups V, Y, W and X, respectively. It will be assumed that the contacts in groups V and W are respectively the negative and positive line terminals of the various trunks, the contacts in the group X are the terminals of the release conductor of the various trunks, while the contacts in group Y are the terminals of the stopping conductor of the various trunks. It is thus seen that as the wipers 15, 16, 17 and 18 engage their respective contacts they are given a slight rotary movement, thus insuring a good clean contact. It will be understood, of course, that the various contacts engaged by the wipers at any one time are all associated with the same trunk. For instance contact 87 would be the negative line, contact 86 would be the positive line, contact 31 would be the release conductor and contact 32 would be the stopping conductor of a certain trunk line. Referring to Fig. 1 it will be seen that in addition to the above described apparatus, the line switch C comprises a line relay 37

and a bridge-cut-off relay 38, with suitable spring assemblies attached thereto.

The selector switch E (Fig. 1) 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 the central office apparatus is controlled by impulses delivered over the two sides on 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 39, 40 and 41 carried upon a shaft (not shown) which has a vertical movement controlled by the vertical magnet 42 and a rotary movement controlled by the rotary magnet 43. The operations of various parts of the switch are controlled through the medium of the double wound line relay 44. The usual side switch comprising the wipers 50, 51, 52 and 53 is controlled by the private magnet 54 in the usual well known manner. Means for permitting the switch to be restored to normal position is provided in the release magnet 45, which, upon energizing attracts an armature which in turn withdraws the retaining double-dog, from the shaft. The springs 46 close only when the switch shaft has been raised one or more steps from its lowest position. The relays 47, 48 and 49 are slow acting, that is, slow to release their armatures upon de-energizing.

The connector switch H (Fig. 2) is of the same general type of connector switch as 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 the two sides of the line in series. Among other details, the connector H comprises a bank of contacts arranged in horizontal rows or levels, which contacts are adapted to be engaged by a set of wipers, 55, 56, and 57 carried upon a shaft (not shown) which has a vertical movement controlled by the vertical magnet 58 and a rotary movement controlled by the rotary magnet 59. The usual side switch comprising the wipers, 60, 61, 62 and 63 is controlled by the private magnet 64 in the usual and well known manner. The operations of various parts of the switch are controlled through the medium of the line relay 65 in conjunction with the spring assembly thereto attached. Talking battery is supplied to the so-called back bridge relay 72. The ringer relay 66 affords the means

by which ringing current is applied to the called line. Means for permitting the switch to be restored to normal positions are provided in the release magnet 67, which, upon energizing, attracts an armature which in turn withdraws the retaining double-dog from the shaft. The springs 68 and 69 close only when the switch shaft has been raised one or more steps from its lowest position. The relays 70 and 71 are slow acting—that is, slow to release their armatures upon deenergizing. The called substation A' (Fig. 2) and its individual line switch C' are similar in all respects to the calling substation A and its individual line switch C.

For the purpose of supplying battery current for operating the apparatus, and for talking purposes there is shown the battery B, having one terminal grounded at G. For the purpose of supplying ringing current to ring the called substation there is shown the ringing current generator R. The busy signaling machine Q, as represented herein, comprises an induction coil or transformer, the primary winding of which is included in a local circuit with a battery and a suitable interrupting device. Through the medium of this interrupting device an interrupted current is supplied through 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 be now explained how connection can be established between the line of substation A and the line of a called substation A'. The number of the called substation will be assumed 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 at the calling substation A, (Fig. 1), a circuit is formed which may be traced from ground G' through springs 73 and 74, conductor 75, substation A, conductor 76, springs 77 and 78, relay 37 to battery B. The relay 37, upon energizing, closes a circuit from ground G² through springs 79, 80 and 81, springs 21, solenoid 28 to battery B. The solenoid 28 will now operate in a manner similar to that of a buzzer, to advance the wipers 24, 25, 26 and 27 over their respective bank contacts as explained in the description of line switch C. Upon the wiper 27 engaging the first contact which leads to an idle selector which will be assumed to be selector E, a circuit is formed from ground

G³ through springs 82 and 83, bank contact 36, wiper 27, springs 84 and 85, relay 38, solenoid 28 to battery B. The resistances of the solenoid 28 and the relay 38 are such that in the above circuit the relay 38 will energize while the solenoid 28 will remain in an operated position. The relay 38 upon energizing, removes the line relay 37 from the line and extends the line connection to the line relay 44 of the selector E. In addition, the relay 38 forms a locking circuit for itself until a holding circuit is closed in the selector E. The said circuit extends from ground G² through springs 79 and 80, springs 88 and 85, relay 38, solenoid 28 to battery B. The line relay 37 is made slow acting so that it will remain energized an instant after its circuit is opened by the relay 38 so that time may be allowed for a holding circuit to be formed in the switch ahead. The circuit of the line relay 44 may be traced from ground G¹ through the lower winding of relay 44, side switch wiper 51, (in first position) springs 32 and 25, springs 89 and 74, substation A, springs 77 and 90, springs 24 and 31, side switch 50 (in first position), upper winding of relay 44 to battery B. The line relay 44, upon energizing, closes a circuit through relay 47, which, in turn, upon energizing, affords the previously mentioned holding circuit which may be traced from ground G³, springs 82 and 91, springs 35 and 26, springs 88 and 85, relay 38, solenoid 28 to battery B.

The foregoing is the condition of the central office apparatus immediately after the receiver is removed from the switch-hook at the calling substation. The operation of the substation calling device for the first digit 2 twice momentarily forces the spring 6 out of engagement with the spring 7, each time breaking the circuit of the line relay 44 of the selector E. Each time the line relay 44 of the selector deenergizes in response to the impulses from the substation it permits the spring 94 to disengage the spring 95 and to engage the spring 93. Since the relay 47 is slow acting its armature does not have time to fall back to its normal position during the momentary interruptions of its circuit, consequently a circuit is closed through the vertical magnet 42. This circuit extends from ground G³ through springs 94 and 93, springs 96 and 97, relay 48, vertical magnet 42, side switch wiper 52 (in first position) to battery B. The vertical magnet receives two impulses over this circuit operating to raise the switch shaft and wipers 39, 40 and 41 two steps to a position opposite the second row or level of bank contacts. The private magnet relay 48, which is included in the energizing circuit of the vertical magnet, is energized by the first impulse, and since it is slow acting its arma-

ture is held in an operated position throughout the series of impulses. In its operated position the relay 48 closes a circuit extending from ground G^6 through springs 98, private magnet 54 to battery B. Shortly after the last impulse is delivered to the vertical magnet, the relay 48 deenergizes, breaking the circuit of the private magnet 54, which in turn, deenergizes, permitting the side switch to pass from first to second position. The passage of the side switch wiper 52 from first to second position disconnects the battery from the vertical magnet 42 and closes a circuit through the slow relay 49 and rotary magnet 43. This circuit extends from ground G^4 through interrupter springs 99, rotary magnet 43, relay 49, side switch wiper 52 (in second position) to battery B. The rotary magnet 43, upon energizing, attracts its armature, which operates to rotate the shaft and wipers one step, and by means of a finger attached to the rotary armature holds down the armature of the private magnet 54, and opens the circuit of its own magnet at the interrupter springs 99. The armature of the rotary magnet thereupon falls back and if the trunk line upon the terminals of which the wipers have just been rotated is idle, the armature of the private magnet falls back also, permitting the side switch to pass to third position. If the first trunk of the second level is busy, however, the private wiper 40 finds the first private bank contact grounded in a manner to be explained later. The engagement of the private wiper 40 with a grounded contact completes a circuit extending from contact 101 through private wiper 40, side switch wiper 53 (in second position), private magnet 54, and to battery B. The private magnet is energized by a current flowing over this circuit and prevents the side switch from passing to the third position when the rotary armature falls back. With the side switch thus locked in second position, the rotary magnet will continue to rotate the shaft and thereby advance the wipers step by step until the private wiper 40 engages a non-grounded contact of an idle trunk, whereupon the private magnet 54 deenergizes and permits the side switch to pass into third position. The movement of the side switch wiper 52 from second position breaks the circuit of the rotary magnet 43, and the side-switch wipers 50 and 51 extend the line connection through the shaft wipers 39 and 41 to the connector H.

Upon the completion of the connection to the connector H the line relay 65 and the release relay 70 are energized in the same manner in which the corresponding relays of the selector E were first energized. The relay 70, upon energizing, provides a ground

potential at the first selector private bank contacts of the seized trunk and closes a holding circuit through the relay 47 of the selector E. This circuit extends from ground G^7 through springs 100, to private bank contact 101 (and to the corresponding contact in the bank of each selector which has access to the trunk line leading to the connector H); from the bank contact 101 the circuit then extends through the wiper 40, side switch wiper 53 (in third position) springs 102 and 103, relay 47 to battery B. This circuit is closed before the relay 47 has time to deenergize after its former circuit is broken by the deenergization of the relay 44. During the short interval that elapses between the time the side switch of the selector E passes to third position and the time the relay 70 of the connector H energizes, the seized trunk is protected by a ground potential extending from ground G^8 through the springs 104 and 102 of the guarding relay 49 at the selector E. The relay 49 is slow acting and is energized in series with the rotary magnet 43 and remains energized for an instant after the side switch has passed to third position.

When the substation calling device is operated for the second digit 2, the circuit of the connector line relay 65 is broken twice. Since the relay 70 is slow acting it does not deenergize during the momentary interruptions of its circuit by the line relay 65, so that each time the latter relay is deenergized, a circuit is closed from ground G^9 through springs 105 and 106, springs 107 and 108, relay 71, vertical magnet 58, side switch wiper 62 (in first position) to battery B. The vertical magnet 58 receives two impulses over this circuit and operates to raise the switch shaft and wipers 55, 56 and 57 to a position opposite the second level of bank contacts. The relay 71, which is included in series with the vertical magnet, remains in its energized position during the entire time that impulses are being transmitted through it and operates to close the circuit of the private magnet 64. The circuit for the private magnet extends from ground G^{10} through springs 109 and 110, private magnet 64 to battery B. After the last impulse is delivered, the relay 71 opens the circuit of the private magnet 64, which, upon deenergizing, permits the side switch to advance from first to second position. The movement of the side switch wiper 62 from first to second position transfers the battery connection from the vertical magnet 58 to the rotary magnet 59.

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 59 in series with the relay 71, where-

by the shaft wipers are rotated onto the contacts of the desired line. This circuit extends from ground G^9 through springs 105 and 106, springs 107 and 108, through relay 71, springs 111, rotary magnet 59, side switch wiper 62 (in second position) to battery B. The relay 71 operates in response to the impulses for this digit in the same manner as for the previous digit to cause the private magnet 64 to permit the side switch to advance to the third position. By the engagement of the side switch wipers 60 and 61 with their third position contact points, the line connection is completed with the called line. Upon the engagement of wiper 63 with its third position contact point, a circuit is completed through the cut-off relay 112 of the called line switch. The circuit extends from ground G^{11} through side switch wiper 63 (in third position), private wiper 56, relay 112, solenoid 113 to battery B. The resistances of the solenoid 113 and the relay 112 are such that the solenoid is not operatively energized, but the relay 112 operates to disconnect battery and ground from the called line. The connection of ground G^{11} with the connector private bank contact of the called line prevents the called line from being seized by some other connector switch. By the engagement of side switch wiper 62 with its third position contact point, the circuit of the ringer relay 66 is closed. This circuit extends from ground G^{12} through ringer interrupter 114, ringer relay 66, springs 115, side switch wiper 62 (in third position) to battery B. The ringer relay is energized only intermittently through the medium of the interrupter 114, and operates to disconnect the calling line from the called line and to bridge the ringing current generator R across the called line to signal the called subscriber. Upon the response of the called subscriber his line is provided with talking current through the windings of the back bridge relay 72. The relay 72 upon energizing, closes a circuit through the relay 116, which circuit extends from ground G^{11} through side switch wiper 63 (in third position) springs 117, relay 116 to battery B. The relay 116, upon energizing, opens the circuit of the ringer relay 66 at the springs 115 and closes a locking circuit for itself through its springs 118 independent of the springs 117.

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 connector line relay 65 which immediately de-energizes and opens the circuit of relay 70. The relay 70, upon deenergizing, opens the

holding circuit for the release relay 47 of the selector E and completes a circuit from ground G^9 through springs 105 and 106, springs 107 and 119, off-normal springs 68, release magnet 67 to battery B. The release magnet, upon energizing, attracts its armature which removes the retaining double-dog from the shaft and its own circuit is broken at the springs 68 when the said shaft reaches its lowest position. The release relay 47, upon deenergizing, closes a circuit from ground G^9 through springs 94 and 93, springs 96 and 120, release magnet 45, off-normal springs 46 to battery B. The release magnet, upon energizing, attracts its armature which removes the retaining double-dog from the shaft and its own circuit is opened at the springs 46 when the said shaft reaches its lowest position. In addition, the relay 47, upon deenergizing, removes the ground G^9 from the circuit of relay 38 and solenoid 28, whereupon the relay 38 and solenoid 28 deenergize, thus restoring the line switch C to normal.

It having been described how one subscriber establishes connection and releases the same, it will now be explained how a connection is prevented from being made with a busy line. 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. It is obvious that the side-switch wipers are in the second position during the test for and after finding that the contact desired is busy. The connector private wiper, upon engaging this guarded contact, closes a circuit as follows: ground from the private bank contact through private wiper 56, side switch wiper 63 (in second position), springs 121, and 122, relay 123, springs 124 and 110, private magnet 64 to battery B. The relay 123, upon energizing, closes the contact of springs 125, whereby a busy tone is sent back to the calling subscriber from the busy machine Q by way of the side switch wiper 61 (in second position) thence through the calling substation A and the upper winding of relay 65 to battery B. A further result of the energizing of relay 123 is the opening of the circuit of the rotary magnet 59 at springs 111 and the closing of a locking circuit for itself through the springs 161 and 122. The calling subscriber upon receiving the busy signal replaces his receiver upon the receiver hook and releases the connection as hereinbefore explained.

From the foregoing it will be seen that we have devised a very simple switch, the wipers of which always progress in one direction and at the same time have motion in a different plane, that is, they may have, for example, as herein shown, a clockwise mo-

tion and an up and down motion. We do not therefore, wish to limit ourselves to the particular construction shown.

What we claim is:

1. In a telephone system, two lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for propelling said shaft comprising two engaging surfaces and a driving member, means for driving the shaft in one direction through the medium of said driving member engaging with said surfaces one at a time, and means for automatically continuing said operation.

2. In a telephone system, two lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for propelling said shaft comprising two engaging surfaces and a driving member, means for driving the shaft always in the same direction through the medium of said driving member engaging with said surfaces one at a time, and means for automatically continuing said operation.

3. In a telephone system, two lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for propelling said shaft comprising two engaging surfaces and a driving member, means for driving the shaft in one direction through the medium of said driving member engaging alternately with said surfaces.

4. In a telephone system, two lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for propelling said shaft comprising two engaging surfaces having active sections and a driving member, means for driving the shaft through the medium of said driving member engaging with an active section in one surface, thereby advancing the shaft to a position where the driving member may then effectually engage an active section of the other surface to drive the shaft to a position where the driving member may again effectually engage an active section of the first surface to advance the shaft in the same direction and means for operating the member again to drive the shaft by engaging with an active section of the second surface, and means for automatically continuing said operation.

5. In a telephone system, two lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for propelling said shaft comprising two engaging surfaces having active sections and a driving member, means for driving the shaft through the medium of said driving member engaging with an active section of one surface, thereby advancing the shaft to a position where the driving member may then effectually engage an active section of the other surface to drive the shaft to a posi-

tion where the driving member may again effectually engage an active section of the first surface to advance the shaft and means for operating the member again to drive the shaft by engaging with an active section of the second surface, said means automatically continuing the operation to automatically advance the shaft.

6. In a telephone system, two lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for propelling said shaft comprising two engaging surfaces having active sections and a driving member, means for driving the shaft through the medium of said driving member engaging with an active section of one surface, thereby advancing the shaft to a position where the driving member may then effectually engage an active section of the other surface to drive the shaft to a position where the driving member may again effectually engage an active section of the first surface to advance the shaft and means for operating the member again to drive the shaft by engaging with an active section of the second surface, said means automatically continuing the operation to automatically advance the shaft, said means comprising an electric circuit.

7. In a telephone system, two lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for propelling said shaft comprising two engaging surfaces having active sections and a driving member, means for driving the shaft through the medium of said driving member engaging with an active section of one surface, thereby advancing the shaft to a position where the driving member may then effectually engage an active section of the other surface to drive the shaft to a position where the driving member may again effectually engage an active section of the first surface to advance the shaft and means for operating the member again to drive the shaft by engaging with an active section of the second surface, said means automatically continuing the operation to automatically advance the shaft, said means comprising an electric circuit and a circuit interrupter.

8. In a telephone system, two lines, a switch for connecting said lines, said switch having a shaft, an electromagnetic driving mechanism therefor for propelling said shaft comprising two engaging surfaces and a driving member, means for driving the shaft in one direction through the medium of said driving member engaging with said surfaces one at a time, and means for automatically continuing said operation.

9. In a telephone system, lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for said shaft

comprising two sets of teeth and a driving member, means for driving the shaft through the medium of said driving member engaging with said sets one at a time, and means for automatically continuing said operation.

10. In a telephone system, lines, a switch for connecting said lines, said switch having a shaft, an electromagnetic driving mechanism for said shaft comprising two sets of teeth and a driving member, means for driving the shaft through the medium of said driving member engaging with said sets one at a time, and means for automatically continuing said operation.

11. In a telephone system, lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for said shaft comprising two sets of teeth and a driving member, means for driving the shaft always in the same direction through the medium of said driving member engaging with said sets one at a time, and means for automatically continuing said operation.

12. In a telephone system, lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for said shaft comprising two sets of teeth and a driving member, means for driving the shaft through the medium of said driving member engaging with said sets alternately one at a time, and means for automatically continuing said operation.

13. In a telephone system, lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for said shaft comprising two sets of teeth staggered with respect to each other and a driving member, means for driving the shaft through the medium of said driving member engaging with a tooth in one set thereby advancing the shaft to a position where the driving member may effectually engage a tooth in the other set to drive the shaft to a position where the driving member may then effectually engage a tooth in the first set, and means for operating said member, and means for automatically continuing said operation.

14. In a telephone system, lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for said shaft comprising two sets of teeth staggered with respect to each other and a driving member, means for driving the shaft through the medium of said driving member engaging a tooth in one set thereby advancing the shaft to a position where the driving member may effectually engage a tooth in the other set to drive the shaft to a position where the driving member may then effectually engage a tooth in the first set and means for operating said member, said means automatically continuing the operation.

15. In a telephone system, lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for said shaft comprising two sets of teeth staggered with respect to each other and a driving member, means for operating said member to drive the shaft by engaging a tooth in one set thereby advancing the shaft to a position where the driving member may effectually engage a tooth in the other set to drive the shaft to a position where the driving member may then effectually engage a tooth in the first set and means for operating said member, and means for automatically continuing the operation, said means comprising an electric circuit.

16. In a telephone system, lines, a switch for connecting said lines, said switch having a shaft, a driving mechanism for said shaft comprising two sets of teeth staggered with respect to each other and a driving member, means for operating said member to drive the shaft by engaging a tooth in one set thereby advancing the shaft to a position where the driving member may effectually engage a tooth in the other set to drive the shaft to a position where the driving member may then effectually engage a tooth in the first set and means for operating said member, and means for automatically continuing the operation, said means comprising an electric circuit and a circuit interrupter.

17. In a telephone system, a line, a series of lines associated therewith, a switch for connecting said line with any one of the lines of said series, said switch provided with connecting means for that purpose, a driving mechanism for said connecting means comprising a magnet and a shaft, a set of wipers for said line, a bank of terminals for said series associated with said wipers, and means for operating said driving mechanism to advance the wipers upon the energization as well as upon the deenergization of the magnet, whereby the wipers are at one time carried into engagement with the bank and at another time lifted out of engagement with the bank, said magnet controlled by said wipers to automatically continue said operation.

18. In a telephone system, a line, a switch for said line having a bank, said bank having sets of line terminals, a set of wipers in said switch for connecting the line with a set of terminals, a controlling device individual to said switch for operating said wipers to connect and disconnect the line from the bank contacts and for advancing said wipers always in the same direction with one motion to establish the connection and another motion to break the connection, said device controlled by said wipers to automatically continue said operation.

19. In a telephone system, a calling line,
trunk lines, a non-numerical switch for con-
necting the calling line with any one of said
trunk lines, a plurality of wipers for said
5 switch adapted to engage contacts associated
with said trunk lines, an operating magnet
for said switch for controlling the opera-
tion of the same, means controlled over the
calling line for initiating the operation of
10 said switch, and automatic means for con-
tinuing the operation until one of said

wipers engages a normal grounded contact,
a circuit closed thereby over another one of
said wipers for holding the operating mag-
net energized.

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Signed by us at Chicago, Cook county,
Illinois, this 18th day of September, 1914.

ALEXANDER E. KEITH.
JOHN G. BLESSING.

Witnesses:

HERBERT W. KRACKE,
GEORGE GANOCHOWSKI.