A. E. KEITH.
AUTOMATIC TELEPHONE SWITCH.
APPLICATION FILED NOV. 15, 1911. RENEWED OCT. 29, 1914.

1,189,364.

Patented July 4, 1916.
5 SHEETS—SHEET 1.

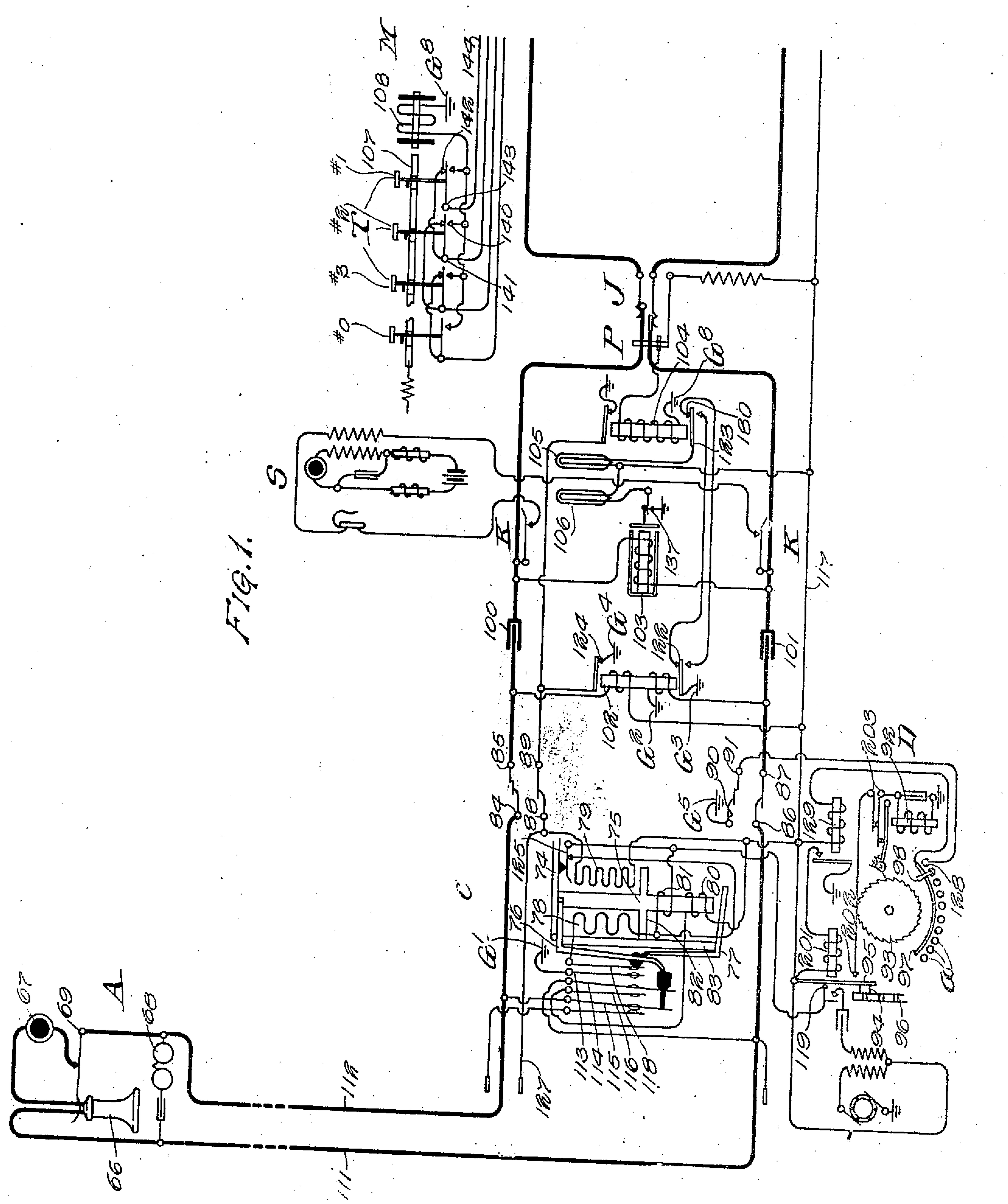

FIG. 1.

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5 SHEETS—SHEET 2.

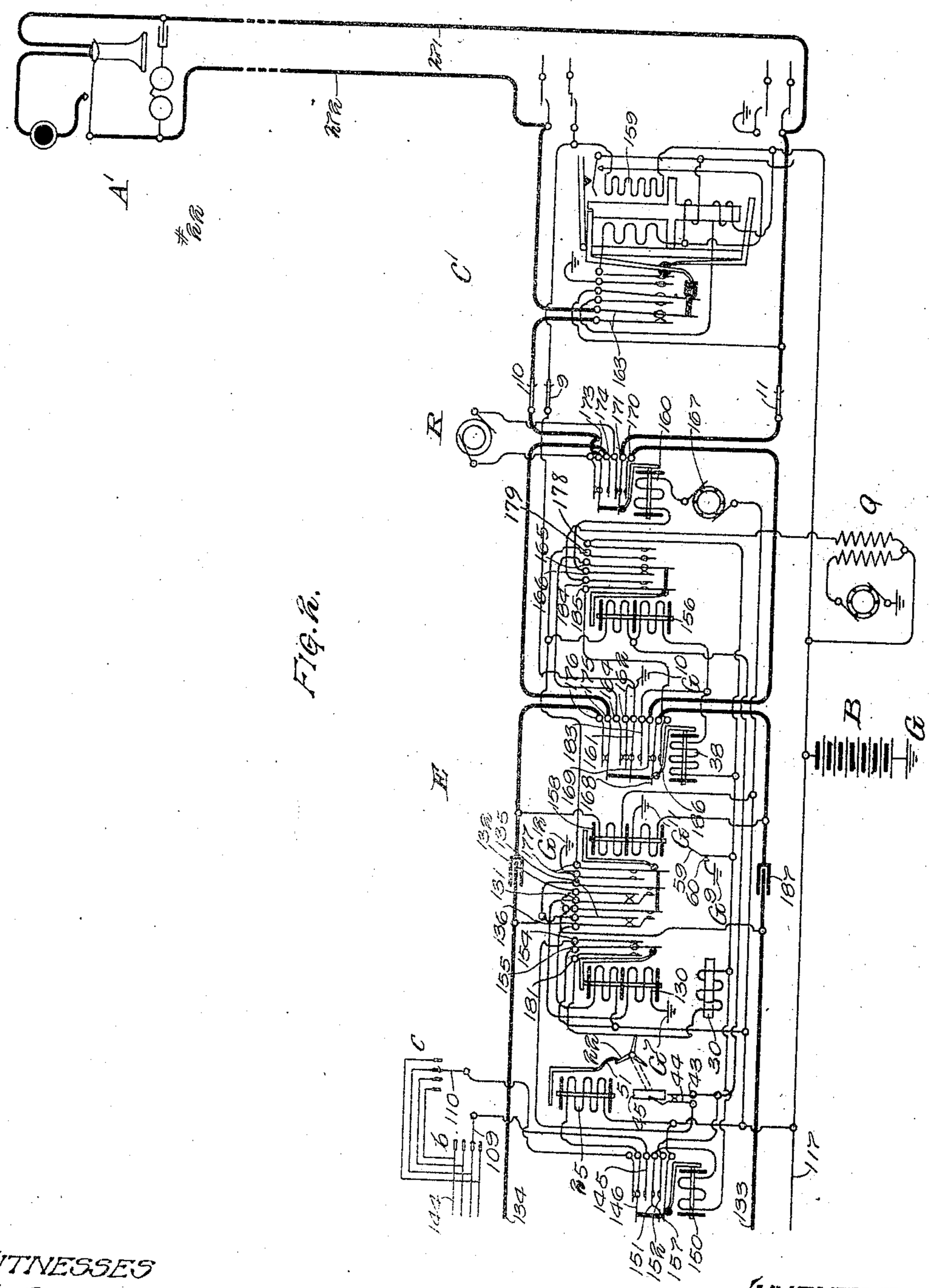

FIG. 2.

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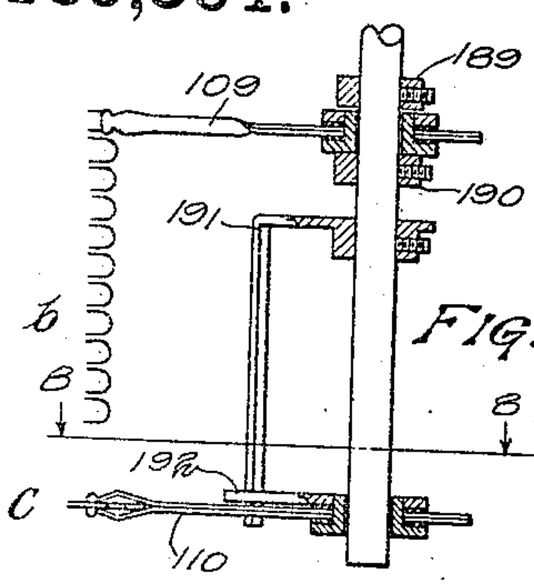

FIG. 7.

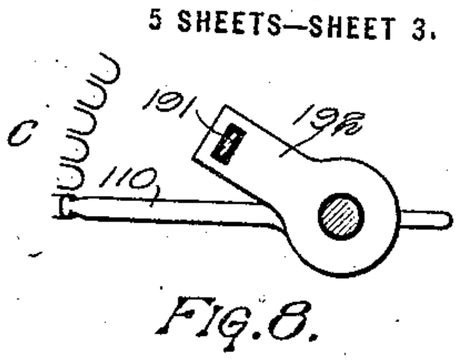

FIG. 8.

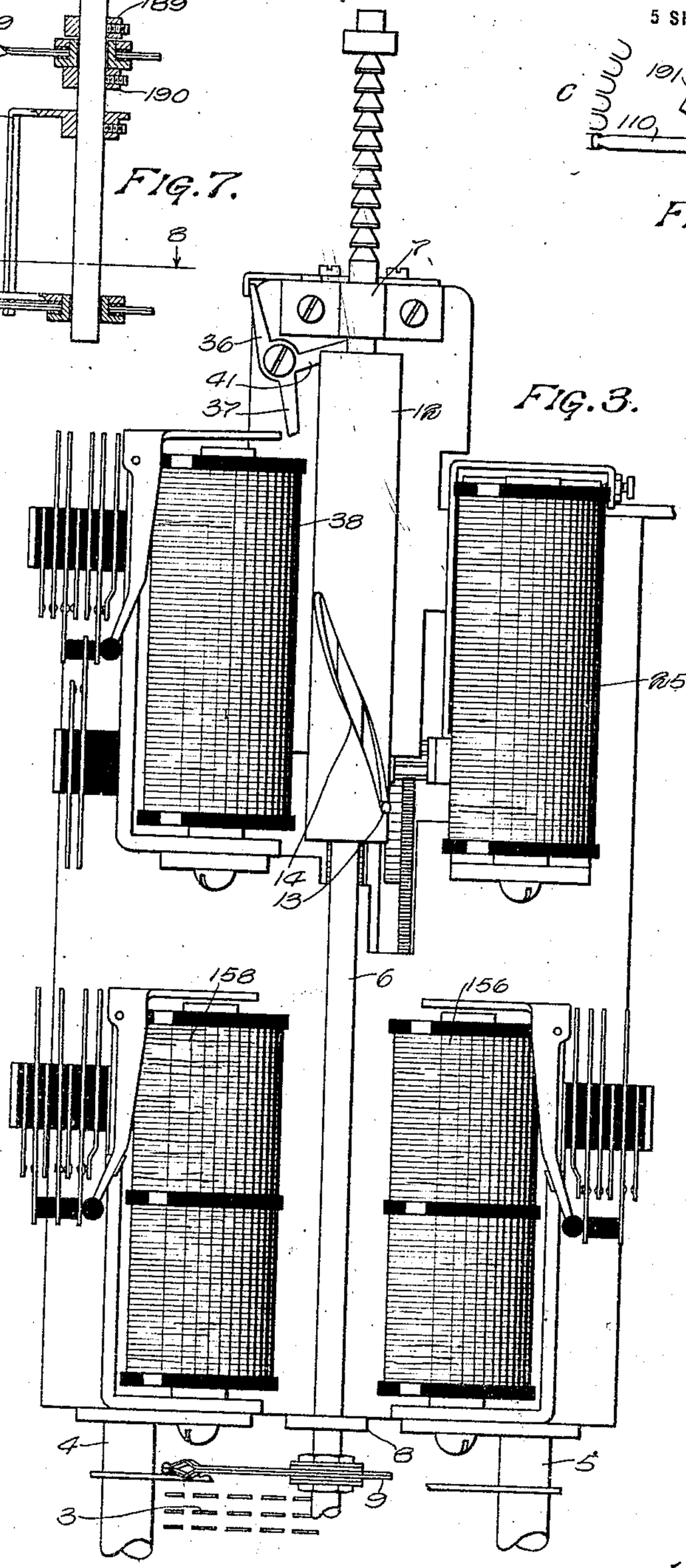

FIG. 3.

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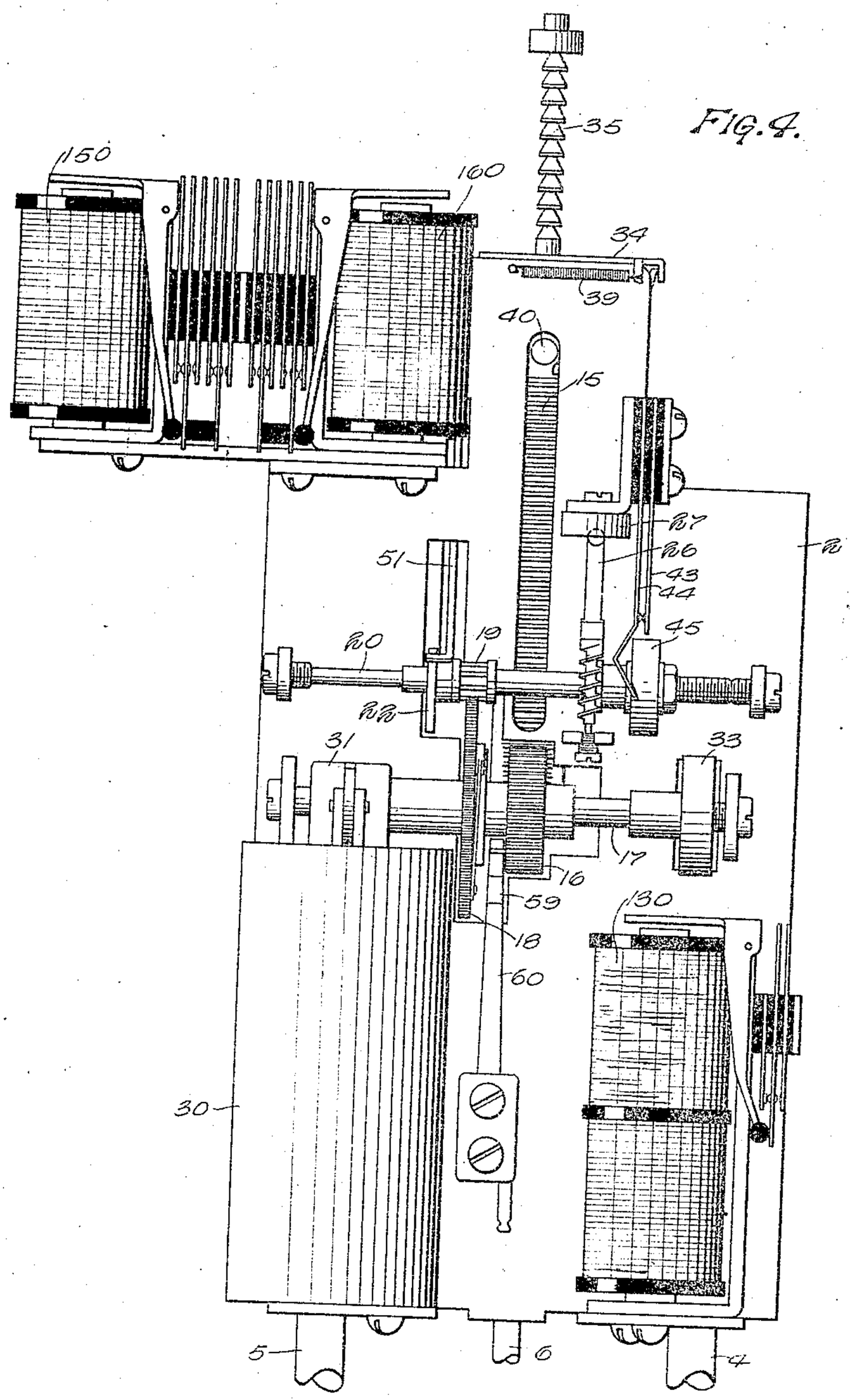
5 SHEETS—SHEET 4.

FIG. 4.



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5 SHEETS—SHEET 5.

FIG. 5.

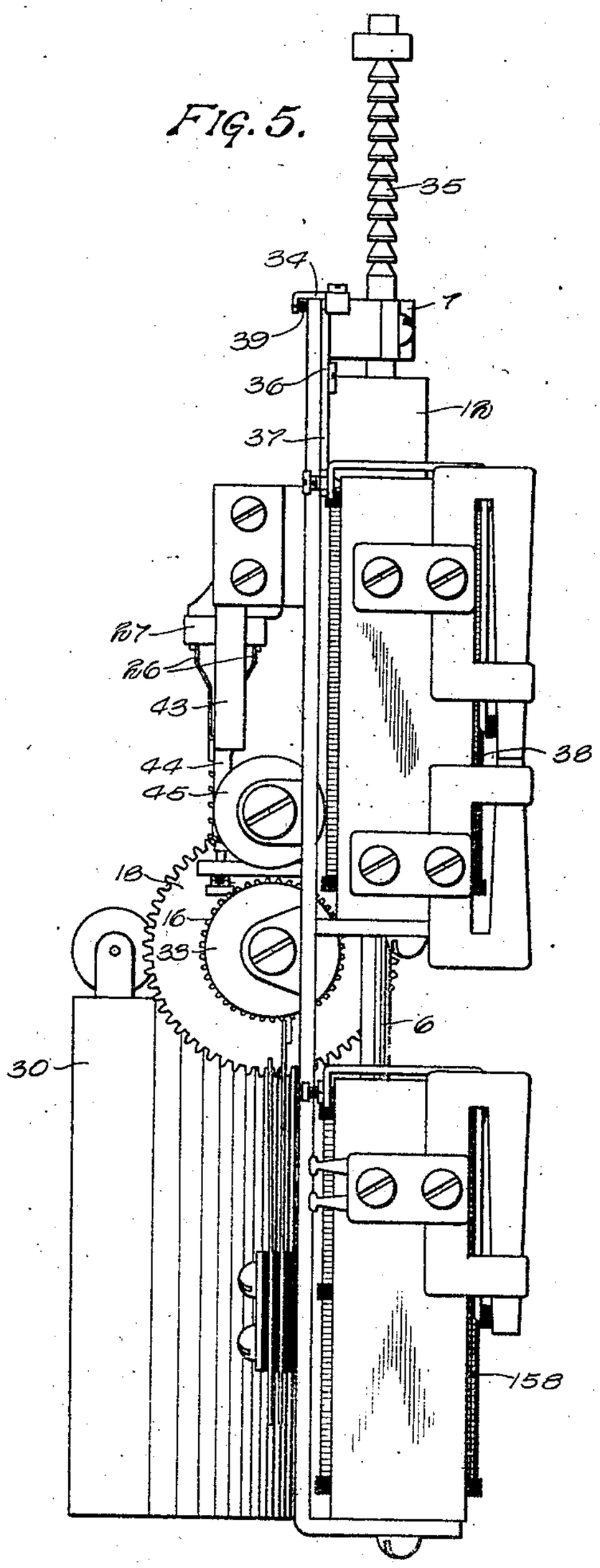
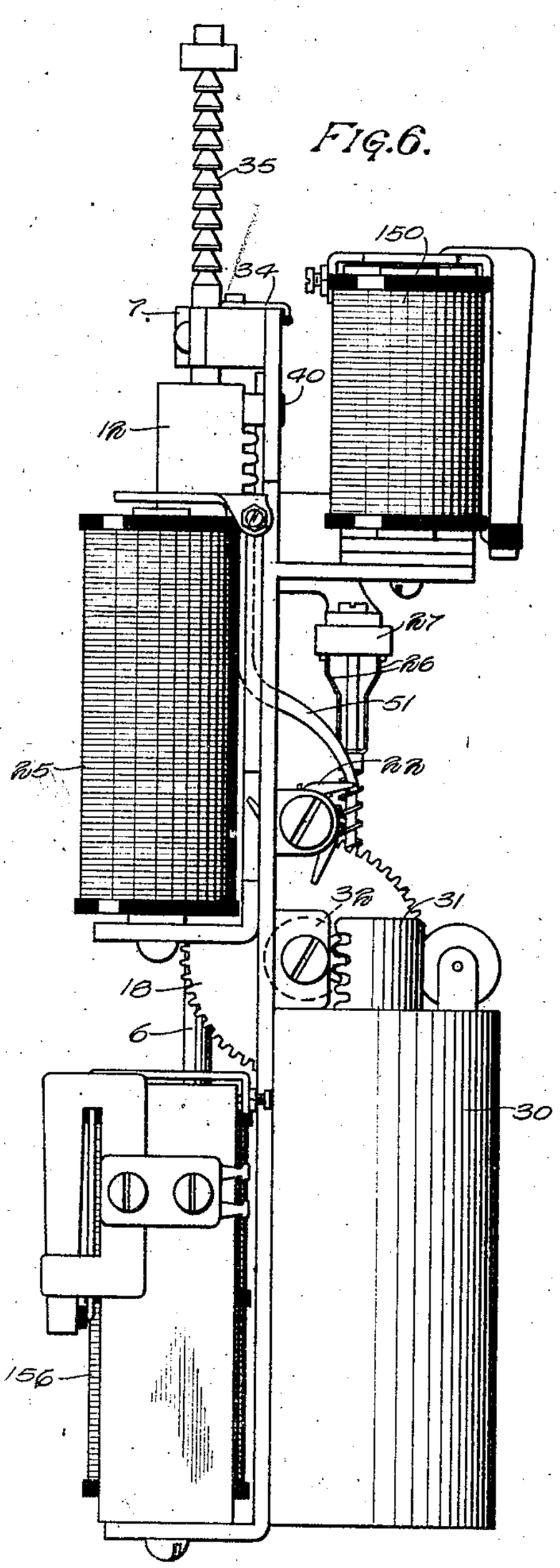


FIG. 6.



WITNESSES

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UNITED STATES PATENT OFFICE.

ALEXANDER E. KEITH, OF HINSDALE, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE-SWITCH.

1,189,364. Specification of Letters Patent. Patented July 4, 1916.

Application filed November 15, 1911, Serial No. 660,367. Renewed October 29, 1914. Serial No. 869,347.

To all whom it may concern:

Be it known that I, ALEXANDER E. KEITH, a citizen of the United States of America, and resident of Hinsdale, Dupage county, Illinois, have invented a certain new and useful Improvement in Automatic Telephone-Switches, of which the following is a specification.

My invention relates to telephone systems, and more particularly to an improved form of automatic telephone switches for use in automatic or semi-automatic telephone systems, and to an improved method of operating said switches.

Heretofore it has been customary to operate automatic switches by a step-by-step motion, the extent of which motion was controlled by a series of impulses corresponding to a digit of the called number, or else these switches have been operated by continuous motion, and the extent of this continuous motion has been controlled by mechanism which operates in synchronism with the automatic switch.

An object of my invention is to provide a switch which, when a call is made, moves its wipers directly to the contact of the desired line, or to the level in which this contact is located, with a uniform motion. This uniform motion is, however, controlled by means of push buttons, and it is unnecessary to employ any means which is operated in synchronism with the automatic switch. Such means are very objectionable, as it is difficult to maintain such mechanism in exact synchronism, and it is thus impossible to obtain exact and accurate operation of the switch.

I have chosen to illustrate my invention in connection with an automatic switch of the type illustrated in the application of John G. Blessing and Bernard D. Willis for improvement in automatic telephone switches, Serial No. 684,110, filed March 16, 1912, in which the switch wipers have a continuous downward movement to select a group and then a continuous rotary movement to select a line in a determined group.

In the drawings Figures 1 and 2 taken together represent a complete connection between a calling and a called line in a system embodying the principles of my invention. Fig. 3 is a front view of the connector switch. Fig. 4 is a rear view of the same. Figs. 5 and 6 are left and right hand side views, respectively, of the connector. Figs. 7 and 8 are views showing the lower end of the shaft of the connector and the wipers carried thereby.

The system represented herein is a semi-automatic system of that character in which the subscribers' lines terminate in automatic trunk-selecting switches which operate upon the initiation of a call to connect the lines with idle trunk lines leading to a manual switchboard and to signal an operator thereat. The operator completes the connection to the called line by manually connecting the trunk seized by the calling subscriber with a second trunk line leading to an automatic switch which has access to the line desired, and by then operating said switch to cause it to connect with the line called for.

In Fig. 1 the line of the substation A is shown connected through its individual trunking switch C with a trunk line ending in a plug P on a manual switchboard. The plug P is shown inserted into a jack J of a trunk line leading to an automatic connector switch E which has been operated to connect with the line of substation A'.

The substation A (Fig. 1) may be an ordinary manual common battery substation and, as shown, it comprises the usual receiver 66, transmitter 67, switch hook 69 and ringer 68.

The line switch C, which is individual to the line of the substation A, and the master switch D can be of any desired type, but I have chosen to illustrate the same as modified forms of the general type of line switch and master switch disclosed in British patent to R. W. James, No. 26,301 of 1906, but of the particular type shown in British patent to T. G. Martin, No. 1419 of 1910. As these switches form no part of my present invention, it is not thought necessary to enter into a detailed description of the same, as this can be readily obtained by referring to the above-mentioned British patents.

In the two sides of the trunk line leading to the plug P there are inserted the two condensers 100 and 101. To the left of the condensers there is bridged across the trunk a double-wound relay 102, with a battery B (Fig. 2) connected between its two windings. At the right of the condensers there is bridged across the trunk a polarized supervisory relay 103. The relay 104 is connected in the third conductor of the cord. The lamps 105 and 106 are supervisory lamps.

The answering key K is for the purpose of connecting the operator's talking set S with the trunk.

Associated with each of the trunk lines leading to the connectors E there is a calling device M comprising a plurality of push buttons T. These buttons are shown extending downward through a bar 107 which is adapted to be moved endwise by the electromagnet 108 when the same is energized. On the side of the rod of each of the push buttons there is a small lug so arranged that when any button is depressed and the bar 107 moved to the right by the magnet 108, said depressed button will be locked down and none of the remaining buttons can be depressed until said magnet is deënergized.

As shown in Figs. 3 to 8, inclusive, the connector switch E, with which I have chosen to illustrate my invention, resembles the automatic switches shown in United States Letters Patents Nos. 815,176 and 815,321, granted March 13, 1906, to Keith, Erickson and Erickson, in that it comprises a bank of contacts which are adapted to be engaged by a set of wipers carried upon a shaft or spindle which is capable of both vertical and rotary motion. In the above figures, 2 represents a plate upon which the various parts are mounted. The banks 3 (only a portion of one of which is shown in Fig. 3) are mounted upon rods 4 and 5 attached to the lower end of the plate 2. These banks may be of any suitable construction and usually comprise ten horizontal rows of contacts with ten contacts in each row. The shaft 6 is mounted in the bearings 7 and 8 upon the front of the plate 2. On the lower end of the shaft there is shown one wiper 9. It will be understood that there may be a pluralitv of wipers attached to the shaft and a separate bank of contacts provided for each wiper. Loosely mounted upon the shaft 6 there is a cylinder 12. There is a pin 13 on the shaft 6 which extends through a spiral slot 14 in the cylinder, the purpose of which will be hereinafter pointed out. On the back of the cylinder 12 there is a series of gear teeth 15 which mesh with a gear wheel 16 on a shaft 17. Loosely mounted on the shaft 17 there is a gear wheel 18 which meshes with a pinion 19 on a second shaft 20. On the side of the wheel 18 is a pawl which is adapted to engage a ratchet on the shaft 17, so that the wheel 18 is forced to rotate with the shaft in one direction but not in the other. Secured to the shaft 20 there is a locking member 22 which is provided with three projections or fingers which are adapted to be engaged by the end of the armature lever 51 of the electromagnet 25, as shown most clearly in Fig. 6. Secured to the shaft 20 there is also a gear wheel which engages a worm gear of a governor comprising a pair of weighted springs 26 and a stationary cup 27. As the shaft 20 rotates, the springs 26 revolve and their ends fly out and rub on the inside of the cup 27, thereby producing a braking action to control the speed of operation of the switch. On the back of the plate 2 is a solenoid 30, the plunger 31 of which is provided with gear teeth which mesh with the pinion 32 on the shaft 17. On the opposite end of the shaft 17 there is a coil spring 33 which exerts a force tending to rotate the shaft. On top of the plate 2 there is a sliding catch 34 which is adapted to engage the teeth 35 on the upper end of the shaft 6. This catch is normally held out of engagement with these teeth, against the tension of the spring 39, by a pin 40 on the back of the cylinder 12, which pin engages the arm 41 of the lever 36. When the cylinder 12 is lowered, the arm 37 of the lever 36 engages the armature of the relay 38 and still holds the catch 34 out of engagement with the teeth on the shaft until the relay 38 is energized. On the back of the switch there is a pair of springs 43 and 44 which are controlled by a disk 45 upon the shaft 20, said disk being composed of insulating material. This disk has notches in its sides which, when they are opposite the spring 44, permit it to come into contact with the spring 43. Whenever the shaft 20 is at rest with one of the fingers of the member 22 engaging the armature lever 51 of the magnet 25, a notch in the disk 45 is opposite the end of the spring 44, permitting it to drop into contact with the spring 43. When the shaft 20 is rotating, the notches in the disk 45 pass the end of the spring 44 so rapidly as not to permit it to come into contact with the spring 43. Located on the back of the switch is a pair of springs 59 and 60 controlled by a pin in the wheel 16 in such a manner that the contact between said springs is closed whenever said wheel is out of its normal position.

In general, the operation of the switch is as follows: The cylinder 12 is normally held in its upper position, as shown in the drawings, against gravity and the tension of the spring 33 on the shaft 17 by the engagement of one of the fingers of the locking member 22 with the arm 51. If the magnet 25 be energized, the arm 51 releases the member 22, thereby unlocking the mechanism. This permits the shafts 20 and 17 to rotate to allow the cylinder 12 and shaft 6 to be lowered. The shaft continues to move downward with a uniform motion until the magnet 25 is deënergized to again lock the mechanism. During this downward movement of the shaft the spring 44 is maintained out of engagement with the spring 43 in a manner previously explained. When the mechanism comes to rest, the spring 44 engages the spring 43, which energizes the relay 38. The relay 38, upon energizing, releases the arm 37 of the lever 36, which permits the catch 34 to be

pulled over into engagement with one of the teeth 35. If, now, the magnet 25 be energized again, the cylinder 12 will move downward again in the same manner as previously explained. The shaft 6, however, cannot move downward with the cylinder 12 at this time owing to the engagement of the catch 34 with the teeth 35. During this downward movement of the cylinder it is, therefore, evident that the slot 14 will have a downward movement with respect to the pin 13, and since the slot 14 extends around the shaft in the form of a portion of a helix, this relative movement of the pin and slot will cause the shaft 6 to be rotated, carrying its wipers over the contacts in their respective rows, corresponding to the particular tooth 35 with which the catch 34 is in engagement. This rotary motion of the shaft will cease when the magnet 25 is deënergized. It will be seen that the downward movement of the cylinder 12 causes the core 31 of the solenoid 30 to be raised, owing to the engagement of the pinion 32 with the rack on the solenoid core. In order to return the parts to normal position it is merely necessary to energize the magnet 30, so as to exert a downward pull upon the solenoid, which thus causes the shaft 17 to revolve in the opposite direction to raise the cylinder and rewind the spring 33. The shaft 20 is not rotated at this time on account of the ratchet and pawl connection between the gear wheel 18 and the shaft 17.

As indicated in Fig. 2, there are carried by the shaft of the connector two wipers 10 and 11 in addition to the wiper 9 shown in Fig. 3, these three wipers being the usual line and private or testing wipers ordinarily found on switches of this general character. In addition to the wipers 9, 10 and 11, the switch is provided with two auxiliary wipers 109 and 110 upon the lower end of the shaft. Each of these wipers is adapted to engage a single row of contacts, which may be conveniently secured to the posts 4 and 5. The wiper 109 is loosely mounted upon the shaft 6 between two collars 189 and 190, which collars are firmly secured to the shaft by means of set screws. Thus, while the wiper 109 is forced to move with the shaft during its vertical motions, said wiper remains stationary during the rotary motions of the shaft. The wiper 110 is loosely mounted upon the shaft. Above the wiper 110 there is an arm 191 rigidly mounted on the shaft 6, said arm having a downwardly extending portion which extends through an opening in an arm 192 which is secured to the wiper 110. The wiper 110 is thus adapted to remain stationary during the vertical movements of the shaft, but is forced to rotate with it. The number of contacts in the bank *b* which are engaged by the wiper 109 is one greater than the number of levels in the line banks, and the number of contacts in the group *c* which are engaged by the wiper 110, is one greater than the number of contacts in each level of the line banks. The contacts in the banks *b* and *c*, with the exception of the last one in each bank, are connected in regular order to the springs of the respective push buttons of the operator's calling device, as shown in Figs. 1 and 2. The wipers 109 and 110 normally rest upon the first contacts of their respective banks.

A number of circuit-controlling relays are provided upon the connector, the function of which will be fully described later.

The complete operations by means of which the substation A is connected with the substation A′ is as follows: When the subscriber at substation A removes his receiver preparatory to making a call, a bridge is closed across the line conductors 111 and 112 through the transmitter 67 and receiver 66, thereby closing a circuit through the line winding 80 of the line switch C. This circuit extends from ground G′ through the springs 113 and 114, line 111, telephone A, line 112, springs 115 and 116 and the winding 80 to the battery lead 117. The winding 80, upon energizing, attracts the armature 77, thereby closing a circuit from ground G′ through the springs 113 and 118, windings 78 and 81, contact 119 and the armature 95 to the battery lead 117. The winding 78, upon energizing, attracts the plunger arm 74 and cut-off armature 76. The plunger arm, upon being attracted, causes the plunger to close the springs 84—91 into contact in pairs, as indicated. The closure of contact between the springs 84 and 85 and 86 and 87 extends the line connection to the trunk plug P, whereupon the relay 102 becomes energized over a circuit extending from ground G^2 through the lower winding of the relay 102, line switch bank springs 87 and 86, thence to and through the telephone A and back over the other side of the line, through the springs 84 and 85 and the upper winding of the relay 102 to the battery lead. The relay 102, upon energizing, closes a circuit through the line signal lamp 105 and a holding circuit through the winding 79 of the switch C. The circuit through the lamp 105 extends from ground G^3 through the armature 122 and its front contact, armature 123 of the relay 104 and the lamp 105 to the battery lead. The circuit through the winding 79 extends from ground G^4 through the contact 124, line switch bank springs 89 and 88 and the winding 79 to battery. The winding 79, upon energizing, operates to hold the armatures 74 and 76 in their operated positions after the winding 78 is deënergized. The

winding 78 is deënergized by the falling back of the armature 77, which occurs shortly after the line winding 80 is disconnected from the line by the operation of the cut-off armature 76. In order to delay the falling back of the armature 77 a short time, so as to give the winding 79 a chance to become energized, the winding 81 is provided on the lower end of the magnet 75. This winding 81 is energized in series with the operating winding 78, and is short-circuited by the closure of the contact 125 when the plunger arm reaches its fully attracted position. This momentary energization of the winding 81, and the short-circuiting thereof, keeps the armature 77 attracted for an instant after the winding 80 is disconnected from the line. The energization of the relay 102 of the trunk also extends a guarding potential from ground G^4 through the springs 124, 89 and 88 and over the conductor 127 to the connector private bank contacts of all the connectors which have access to the line of substation A. The closure of the bank springs 90 and 91 of the line switch C completes a circuit from ground G^5 through the springs 90 and 91, contact 128 (which, it is assumed, corresponds to the seized trunk line), wiper 98, segment 97 and the relay 129 to battery. The relay 129, upon energizing, closes a circuit through the relay 201. The relay 201 thereupon attracts its armature 95, withdrawing the pin 94 from the locking plate 96 and closing the circuit of the motor magnet 92 at the contact 202. Since the circuit of the motor magnet includes the interrupter springs 203, said magnet will operate in a manner similar to that of a buzzer as long as the contact 202 is closed, thereby rotating the ratchet wheel 93 step by step to advance the plungers of the idle line switches away from the trunk seized by the switch C. After the plungers have advanced a short distance, the wiper 98 is disengaged from the contact 128 and the relays 129 and 201 deënergize. The contact 202, however, remains closed until the next opening in the plate 96 passes under the pin 94, whereupon the armature 95 resumes its normal position, breaking the circuit of the motor magnet 92 and locking the plunger shaft. If the next trunk after the one seized by the line switch had been busy, the wiper 98 would have found a guarding potential upon the corresponding contact in the master switch bank, and the relays 129 and 201 would have remained energized while the next opening in the plate 96 was passing under the pin 94, and therefore the plungers of the idle line switches would have been carried past the busy trunk line to an idle one.

Upon seeing the signal displayed by the lamp 105, the operator operates the key K to connect her talking set with the trunk to inquire the number desired. The plug P is thereupon inserted into a jack J of a trunk line leading to a connector E which has access to the group of lines in which the desired line is located. Upon the insertion of the plug P into the jack J, a circuit is closed from ground G^7 (Fig. 2) through the lower winding of the relay 130, springs 131 and 132, conductor 133, jack J and plug P, relay 103, plug P and jack J, conductor 134, springs 135 and 136 and the upper winding of the relay 130 to the battery lead 117. The direction of this current through the relay 103 is such as to attract the armature of the relay in the proper direction to close the contact 137, thereby closing the circuit of the lamp 106. The circuit of the relay 104 of the operator's cord circuit is also closed by the insertion of the plug into the jack. This circuit extends from ground G^8 through the relay 104 and the third conductors of the plug and jack to battery. The relay 104, upon energizing, breaks the circuit of the lamp 105 and furnishes a new holding ground for the line switch C. The energization of the relay 130 at the connector upon the insertion of the plug into the jack shifts the battery connection from the release solenoid 30 to the spring 44. The operator now operates the calling device M in accordance with the number of the substation desired, which, in this case, will be assumed to be 22. In order to call the number 22 the operator first presses the second button T of the device M. This grounds the first two contacts of the auxiliary banks *b* and *c* of the connector through the magnet 108. The grounding of the contacts in the bank *c* at this time is functionless. Since the wiper 109 is resting upon the uppermost contact of the bank *b*, the pressing of the button completes a circuit from ground G^8 through the magnet 108, springs 140 and 141, 142 and 143, conductor 144, upper contact of the bank *b*, wiper 109, springs 145 and 146 and the magnet 25 to the battery lead 117. The magnet 108, upon energizing, locks the depressed button down and locks the others up. The magnet 25, upon energizing, unlocks the mechanism in the manner already explained and allows the switch shaft to move downward. This downward movement of the shaft continues until the wiper 109 passes off the second contact, which was the last one grounded by the push button, whereupon the magnets 108 and 25 deënergize. The magnet 108, upon deënergizing, releases the depressed button of the calling device. The magnet 25, upon deënergizing, locks the mechanism of the connector, bringing the wipers 9, 10 and 11 to rest in front of the second row or level of bank contacts. As has been explained, the springs 43 and 44 are held out of contact

while the switch is operating, and the springs 59 and 60 come into engagement as soon as the switch begins to operate. Therefore, as soon as the switch comes to rest after the operation just described, energizing circuits are closed through the relays 150 and 38. The circuit for the relay 150 extends from ground G^9 through the springs 60 and 59, relay 150, springs 151 and 152, 43 and 44, and 154 and 155 to the battery lead. The circuit for the relay 38 extends from ground G^9 through the springs 60 and 59, relay 38, lower winding of the relay 156 and the springs 43, 44, 154 and 155 to the battery lead. The relay 150, upon energizing, shifts the connection of the magnet 25 from the wiper 109 to the wiper 110 and forms a locking circuit for itself through the springs 151 and 157 independently of the springs 43 and 44. The relay 38, upon energizing, releases the catch 34 in the manner which has been already explained. The catch 34, upon engaging the teeth 35, prevents any further downward movement of the switch shaft. Although the lower winding of the relay 156 is included in the energizing circuit of the relay 38, the relay 156 is not operatively energized. The operator now presses the No. 2 button of the calling device once more for the second digit 2. This again grounds the first two contacts in the groups *b* and *c*. Since the magnet 25 is now connected to the wiper 110, the circuit of the magnets 108 and 25 is closed through this wiper and the contacts *c*. The magnet 25, upon energizing, again unlocks the switch mechanism, but since the shaft is now locked against further downward movement, it is forced to rotate. The rotation of the shaft continues until the wiper 110 passes off the second contact in the bank *c*, whereupon the magnets 108 and 25 again deënergize and the wipers 9, 10 and 11 come to rest upon the contacts of the line No. 22.

During the rotary operation of the switch shaft the circuit of the relay 38 is opened at the springs 43 and 44 so as to permit said relay to deënergize to disconnect the battery from the wipers while they are passing over the contacts. The relay 38 again energizes after the mechanism comes to rest and completes the connection with the called line, as indicated by the heavy conductors in the drawings. The relay 38, upon energizing, also completes an energizing circuit through the cut-off winding 159 of the line switch C′ and the ringing relay 160 of the connector. The circuit of the winding 159 extends from ground G^{10} through the springs 162 and 161, private wiper 9, connector private bank contact of the called line and winding 159 to battery. The winding 159, upon energizing, cuts the switch C′ from the line and closes the contact 163 in the talking circuit. The circuit of the ringing relay 160 extends from ground G^{10} through the springs 162 and 164, 165 and 166, relay 160 and the interrupter 167 to battery. The ringing relay 160, upon energizing, disconnects the calling line from the called line, and connects the ringing current generator R with the called line. Since the circuit of the relay 160 includes the interrupter 167, the relay 160 is energized only intermittently so as not to ring the called line continuously. Of course, the above circuit through the ringing relay is closed upon the termination of the downward movement of the switch shaft; but since the wipers at this time are not in engagement with any bank contacts, and since the circuit is opened upon the beginning of the rotary motion, its first closure is without function.

When the called subscriber removes his receiver, or as soon thereafter as the ringing relay 160 deënergizes, the called substation is provided with talking current over a circuit extending from ground G^{11} through the lower winding of the relay 158 in the connector, springs 168 and 169, ringing relay springs 170 and 171, wiper 11, line 271, receiver and transmitter at substation A′, line 272, contacts 163, wiper 10, springs 173 and 174, 175 and 176 and the upper winding of the relay 158 to battery. The relay 158 is energized by this current and operates to close a circuit extending from ground G^{12} through the springs 177 and the upper winding of the relay 156 to the battery lead. The relay 156, upon energizing, breaks the circuit of the ringing relay 160 at the springs 165 and 166 and forms a locking circuit for itself so as not to fall back and close the ringing circuit again when the called subscriber hangs up his receiver. This locking circuit extends from ground G^9 through the springs 60 and 59, 178 and 179 and the upper winding of the relay 156 to the battery lead. When the relay 158 of the connector energizes upon the response of the called subscriber, it also transposes the connections between the windings of the relay 130 and the conductors 133 and 134, thereby reversing the direction of the current through the relay 103 of the operator's cord. The relay 103 thereupon attracts its armature to the other side and breaks the circuit of the lamp 106 to signify to the operator that the called subscriber has answered. Upon the termination of the conversation, the operator is given the usual disconnect signal by the hanging up of the receiver at the calling and called substations as follows: The hanging up of the receiver at the calling substation breaks the circuit of the relay 102, which thereupon allows its armature to fall back to close a circuit from ground G^3 through the armature 122 and its back contact, contact 180, armature 123 and the lamp 105 to the battery lead 117. The hang-

ing up of the receiver at the called substation permits the relay 158 of the connector to deënergize, which restores the current in the relay 103 to its original direction, whereupon the lamp 106 is again lighted. The simultaneous glowing of the two lamps signifies to the operator that the two connected subscribers have hung up their receivers and that the connection may be taken down. The switches C and E are both released upon the removal of the plug P from the jack J. The switch C is released by the deënergization of the relay 104 which, since the relay 102 is already deënergized, destroys the holding circuit of the winding 79 of said switch, thereby allowing its plunger to be restored to normal position. The connector E is released upon the deënergization of the relay 130, which completes a circuit from ground G^9 through the springs 60 and 59, solenoid 30 and the springs 181 and 155 to the battery lead. The solenoid 30, upon energizing, restores the mechanism of the connector to normal position. When the wheel 16 of the connector reaches its normal position it separates the springs 59 and 60, thereby breaking the restoring circuit of the solenoid 30 and the locking circuit of the relays 150 and 156, thereby leaving all the apparatus in readiness for another call.

In the above description it is assumed that the called line is idle when called. Whenever a line is busy there is a guarding ground potential upon the connector private bank contacts of that line. Whenever the private wiper 9 of the connector engages a contact which is thus grounded, a circuit is closed from said contact through the wiper 9, springs 161 and 183 and the lower winding of the relay 156 to the battery lead. Thus it will be seen that if the line of the substation A′ had been busy when the wipers of the connector came to rest thereon, the relay 156 would have been energized and the relay 38 short-circuited. The relay 38 being short-circuited it could not have energized to complete the connection, while the relay 156 being energized would have completed a connection from the busy signaling machine Q through the springs 184 and 185, 186 and 168 and the condenser 187 to the calling substation over the heavy conductors shown in the drawing. Busy signaling current flowing over this connection through the substation and back over the other side of the line, and through the upper winding of the relay 130 of the connector to the battery lead 117 and busy signaling machine Q, would have signified to the calling subscriber that the line called for was in use. The calling subscriber would then hang up his receiver and give the operator the disconnect signal.

While I have illustrated my invention in connection with a semi-automatic telephone system, it is to be understood that I do not wish to limit myself to such use, as it is obvious that my improved switch can be employed in connection with a semi-automatic system or a complete automatic system. Likewise, while I have illustrated my invention in connection with a particular type of automatic switch, it will be readily apparent that the features of my invention are equally as well adapted for use with other types of automatic switches, and that I do not, therefore, wish to limit myself to the exact construction shown and described.

What I claim as my invention is:—

1. In a telephone system, a group of telephone lines, an automatic switch, a trunk extending to said switch, to which trunk said switch is individual, means for operating said switch with a continuous motion to connect with any one of said lines, means for closing a circuit to initiate the operation of said switch, and means controlled by said circuit closure for controlling the extent of operation of said switch.

2. In a telephone system, a group of lines extending toward a called line, an automatic switch, means for operating said switch to connect with any one of said lines, a plurality of circuits, means for closing any one of said circuits, and means controlled by the closure of any one of said circuits for initiating and for controlling the extent of the operation of said switch.

3. In a telephone system, an automatic switch, a plurality of contacts, means for grounding one or more of said contacts, and means controlled by the grounding of said contacts for initiating and for controlling the extent of the operation of said switch.

4. In a telephone system, an automatic switch having vertical and rotary motion, a wiper associated with said switch, means whereby said wiper moves vertically with said switch but is prevented from rotating therewith, and means controlled by said wiper for controlling said vertical motion.

5. In a telephone system, an automatic switch having vertical and rotary motion, a trunk extending to said switch, to which trunk said switch is individual, a wiper associated with said switch, means whereby said wiper is prevented from moving vertically therewith, means for rotating said wiper with said switch, and means controlled by said wiper for controlling the rotary motion of said switch.

6. In a telephone system, an automatic switch having motion in two intersecting planes, a trunk extending to said switch, to which trunk said switch is individual, a wiper associated with said switch and adapted to move therewith in one of said planes but prevented from moving there-

with in the other of said planes, a set of contacts in the path of said wiper, and means for grounding a plurality of said contacts to control the operation of said switch.

7. In a telephone system, an automatic switch having vertical and rotary motion, a pair of wipers associated with said switch, one of said wipers adapted to move vertically with said switch but prevented from rotating therewith, the other of said wipers adapted to rotate with said switch but prevented from moving vertically therewith, and means controlled by said wipers for controlling the operation of said switch.

8. In a telephone system, an automatic switch having vertical and rotary motion, a pair of wipers associated with said switch, one of said wipers adapted to move vertically therewith but prevented from rotating therewith, the other of said wipers adapted to rotate therewith but prevented from moving vertically, a set of contacts in the path of each of said wipers, and means for grounding one or more of said contacts for controlling the operation of said switch.

9. In a telephone system, a group of lines, an automatic switch, means for moving said switch with a continuous motion to select any one of said lines, a plurality of push buttons, a circuit associated with each of said push buttons, said push buttons operated to close said circuit, and means controlled thereby for controlling the extent of operation of said switch.

10. In a telephone system, lines divided into groups, an automatic switch having motion in one plane to select groups and motion in a plane at right-angles thereto for finding a line in a selected group, means for operating said switch with a continuous motion to connect with any one of said lines, means for closing a circuit to initiate the operation of said switch, and means controlled by said circuit closing for controlling the extent of operation of said switch.

11. In a telephone system, a plurality of lines divided into groups, an automatic switch having motion in one plane to select groups and motion in a plane at right-angles thereto for finding a line in a selected group, means for operating said switch to connect with any one of said lines, a plurality of circuits, means for closing any one of said circuits, and means controlled by the closure of any one of said circuits for initiating and for controlling the extent of the operation of said switch.

12. In a telephone system, a plurality of lines divided into groups, an automatic switch having motion in one plane to select groups and motion in a plane at right-angles thereto for finding a line in a selected group, a plurality of contacts, means for grounding one or more of said contacts, and means controlled by the grounding of said contacts for initiating and for controlling the extent of the operation of said switch.

13. In a telephone system, a plurality of lines divided into groups, an automatic switch having motion in one plane to select groups and motion in a plane at right-angles thereto for finding a line in a selected group, means for moving said switch with a continuous motion to select any one of said lines, a plurality of push buttons, a circuit associated with each of said push buttons, said push buttons operated to close said circuit, and means controlled thereby for controlling the extent of operation of said switch.

14. In a telephone system, a plurality of lines divided into groups, an automatic switch having motion in one plane to select groups and motion in a plane at right-angles thereto for finding a line in a selected group, a single operating means for controlling the operation of said switch in both of said intersecting planes for operating said switch with a continuous motion to connect with any one of said lines, means for closing the circuit to initiate the operation of said switch, and means controlled by said circuit closure for controlling the extent of operation of said switch.

15. In a telephone system, a plurality of lines divided into groups, an automatic switch having motion in one plane to select groups and motion in a plane at right-angles thereto for finding a line in a selected group, a single operating means for operating said switch in both of said intersecting planes to connect with any one of said lines, a plurality of circuits, means for closing any one of said circuits, and means controlled by the closure of any one of said circuits for initiating and for controlling the extent of the operation of said switch.

16. In a telephone system, a plurality of lines divided into groups, an automatic switch having motion in one plane to select groups and motion in a plane at right-angles thereto for finding a line in a selected group, a single operating means for operating said switch in both of said intersecting planes to connect with any one of said lines, a plurality of contacts, means for grounding one or more of said contacts, and means controlled by the grounding of said contacts for initiating and for controlling the extent of the operation of said switch.

17. In a telephone system, an automatic switch having vertical and rotary motion, a single operating means for controlling both of said motions, a wiper associated with said switch, means whereby said wiper moves vertically with said switch but is prevented from rotating therewith, and

means controlled by said wiper for controlling said vertical motion.

18. In a telephone system, an automatic switch having vertical and rotary motion, a single operating means for controlling both of said motions, a wiper associated with said switch, means whereby said wiper is prevented from moving vertically therewith, means for rotating said wiper with said switch, and means controlled by said wiper for controlling the rotary motion of said switch.

19. In a telephone system, an automatic switch having motion in two intersecting planes, a single operating means for operating said switch in said intersecting planes, a wiper associated with said switch and adapted to move therewith in one of said planes but prevented from moving therewith in the other of said planes, a set of contacts in the path of said wiper, and means for grounding a plurality of said contacts to control the operation of said switch.

20. In a telephone system, an automatic switch having vertical and rotary motion, a single operating means for moving said switch vertically and for rotating the same, a pair of wipers associated with said switch, one of said wipers adapted to move vertically with said switch but prevented from rotating therewith, the other of said wipers adapted to rotate with said switch but prevented from moving vertically therewith, and means controlled by said wipers for controlling the operation of said switch.

21. In a telephone system, an automatic switch having vertical and rotary motion, a single operating means for moving said switch vertically and for rotating the same, a pair of wipers associated with said switch, one of said wipers adapted to move vertically therewith but prevented from rotating therewith, the other of said wipers adapted to rotate therewith but prevented from moving vertically, a set of contacts in the path of each of said wipers, and means for grounding one or more of said contacts for controlling the operation of said switch.

22. In a telephone system, a plurality of lines divided into groups, an automatic switch having motion in one plane to select groups and motion in a plane at right-angles thereto to find a line in the selected group, a single operating means for moving said switch with a continuous motion to select a group and to find a line in the selected group, a plurality of push buttons, a circuit associated with each of said push buttons, said push buttons operated to close said circuit, and means controlled thereby for controlling the extent of operation of said switch.

23. In a telephone system, a group of lines extending away from the calling line, an automatic switch, means for operating said switch with a continuous motion to connect with any one of said lines, a plurality of circuits, means for closing any one of said circuits, and means controlled by the closure of any one of said circuits for initiating and for controlling the extent of the operation of said switch.

24. In a telephone system, a group of telephone lines, an automatic switch, a trunk extending to said switch, to which trunk said switch is individual, means for operating said switch in one direction to connect with any one of said lines, a plurality of circuits, means for closing any one of said circuits to initiate the operation of said switch, and means controlled by said circuit closure for controlling the extent of operation of said switch.

25. In a telephone system, a group of telephone lines, an automatic switch provided with a shaft member having motion in one direction, a trunk extending to said switch, to which trunk said switch is individual, means for operating said switch to connect with any one of said lines, a plurality of circuits, means for closing any one of said circuits to initiate the operation of said switch, and means controlled by said circuit closure for controlling the extent of operation of said switch.

26. In a telephone system, a group of lines, an automatic switch, means for moving said switch with a continuous motion in one direction to select any one of said lines, a plurality of push buttons, a circuit associated with each of said push buttons, said push buttons operated to close said circuit, and means controlled thereby for controlling the extent of operation of said switch.

27. In a telephone system, a group of lines, an automatic switch provided with a shaft member having a continuous motion in one direction, means for moving said switch to select any one of said lines, a plurality of push buttons, a circuit associated with each of said push buttons, said push buttons operated to close said circuit, and means controlled thereby for controlling the extent of operation of said switch.

28. In a telephone system, a group of lines extending away from the calling line, an automatic switch, a trunk extending to said switch to which trunk said switch is individual, means for operating said switch to connect with any one of said lines, a plurality of circuits, means for closing any one of said circuits, and means controlled by the closure of any one of said circuits for initiating and for controlling the extent of the operation of said switch.

29. In a telephone system, a group of lines, an automatic switch, a trunk extend-

ing to said switch to which said switch is individual, means for moving said switch in one direction to select any one of said lines, a plurality of push buttons, a circuit associated with each of said push buttons, said push buttons operated to close said circuit, and means controlled thereby for controlling the extent of operation of said switch.

30. In a telephone system, a group of lines, an automatic switch provided with a shaft member having motion in one direction, a trunk extending to said switch to which trunk said switch is individual, means for moving said switch to select any one of said lines, a plurality of push buttons, a circuit associated with each of said push buttons, said push buttons operated to close said circuit, and means controlled thereby for controlling the extent of operation of said switch.

Signed by me at Chicago, Cook county, Illinois, this 7th day of November, 1911.

ALEXANDER E. KEITH.

Witnesses:
ARTHUR J. RAY,
ALBERT ANDERSEN.