

1,199,748.

I. G. MARTIN.
AUTOMATIC AND MANUAL TELEPHONE SYSTEM.
APPLICATION FILED FEB. 27, 1908. RENEWED JAN. 9, 1915.

Patented Sept. 26, 1916.
4 SHEETS—SHEET 1.

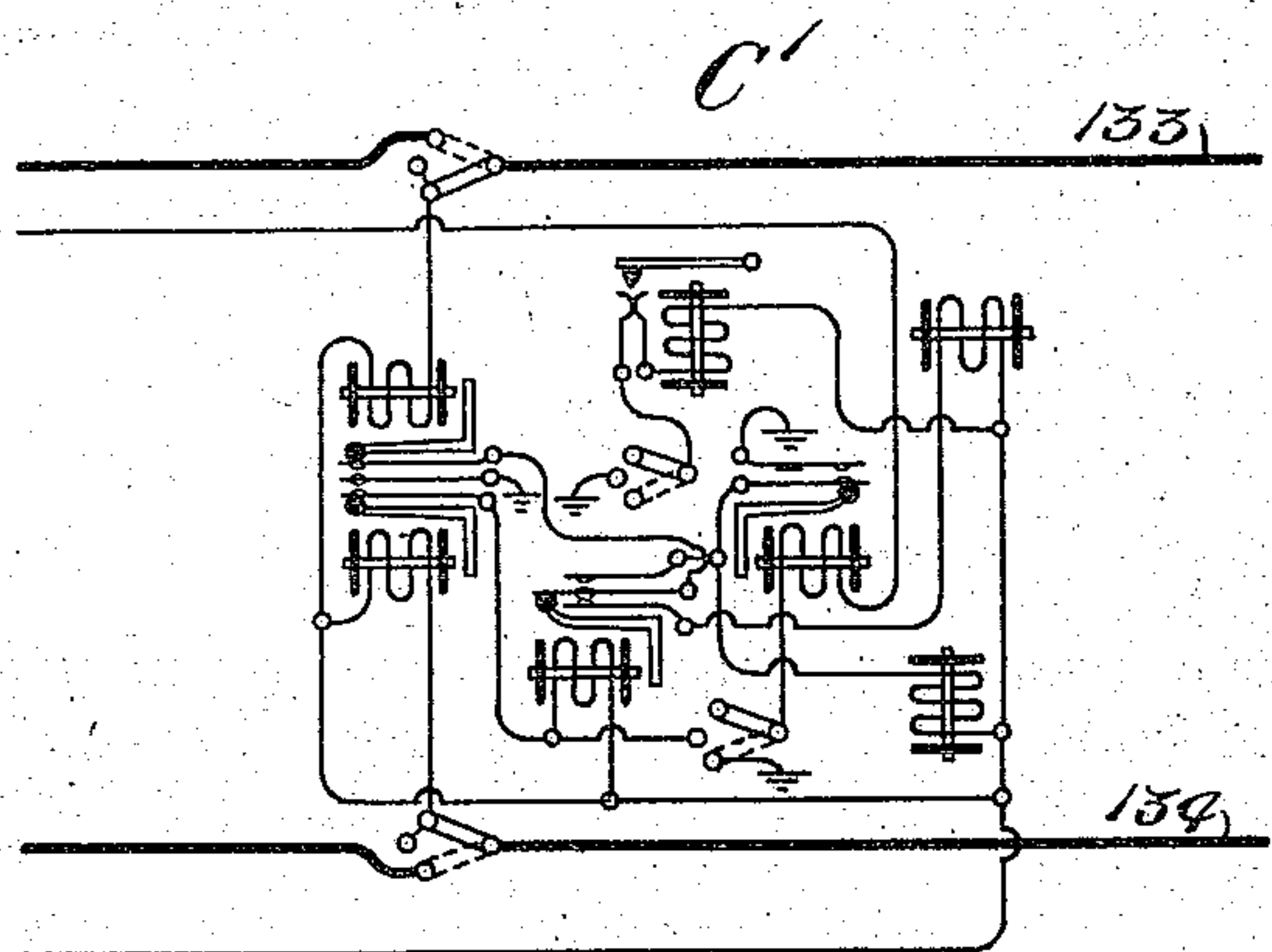
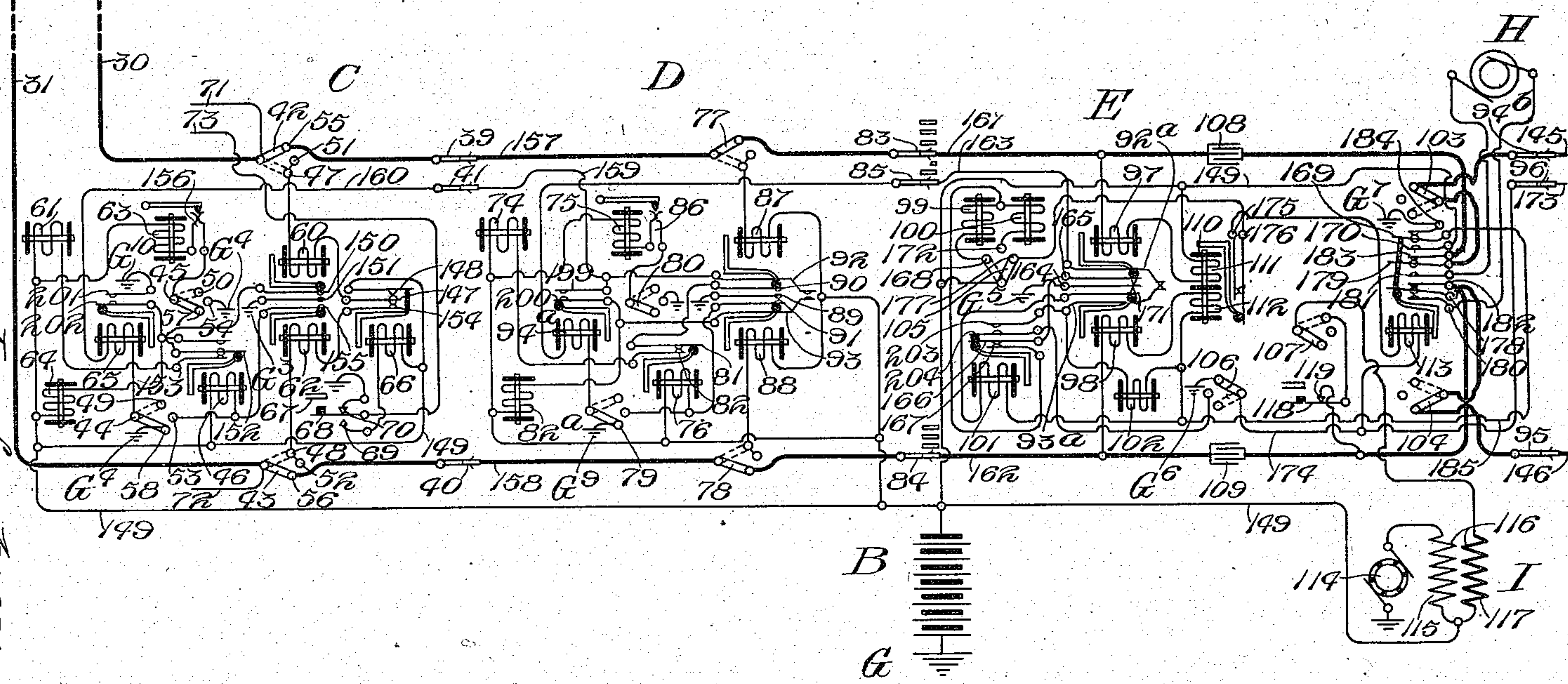
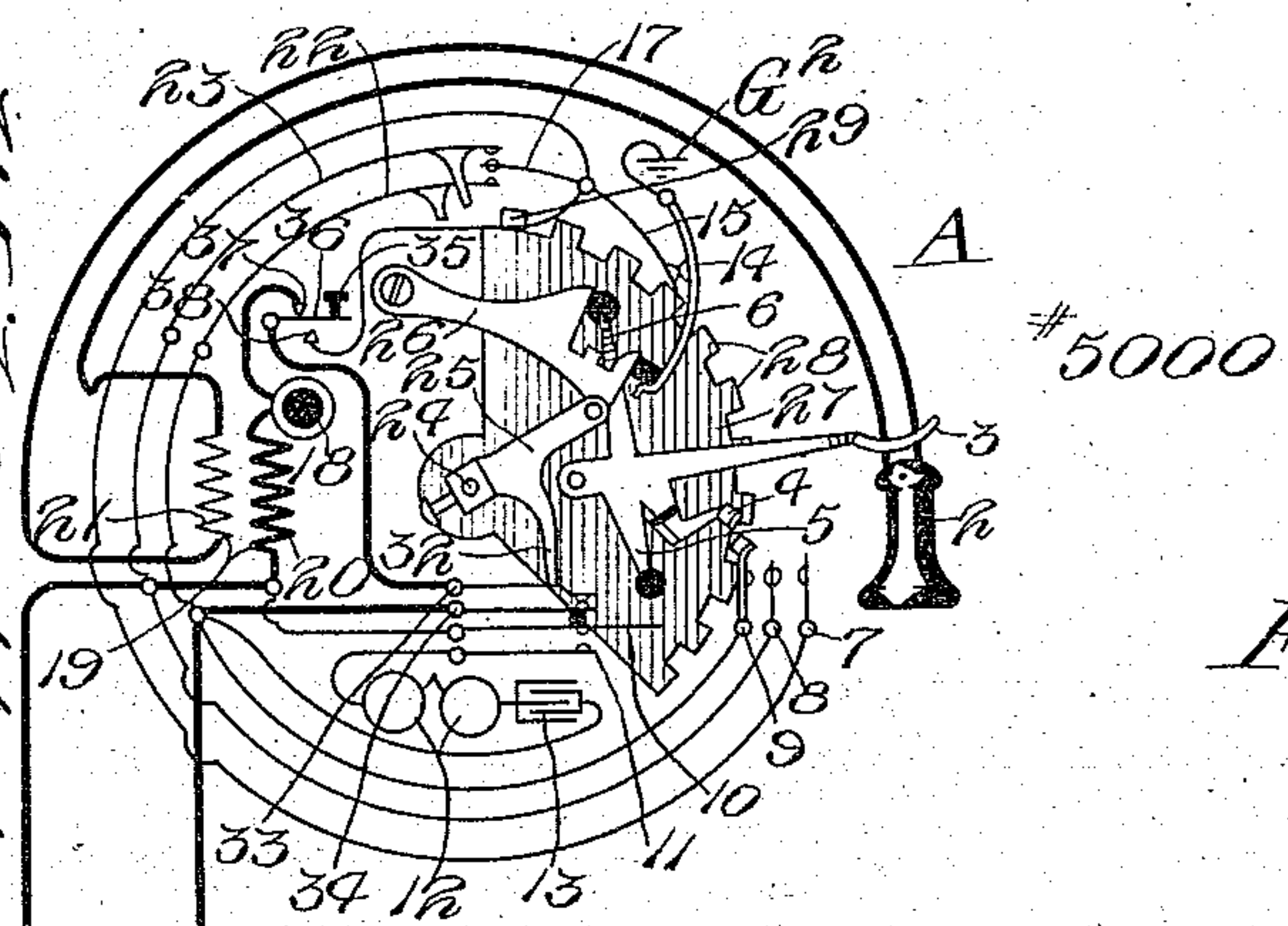


Fig. 1.



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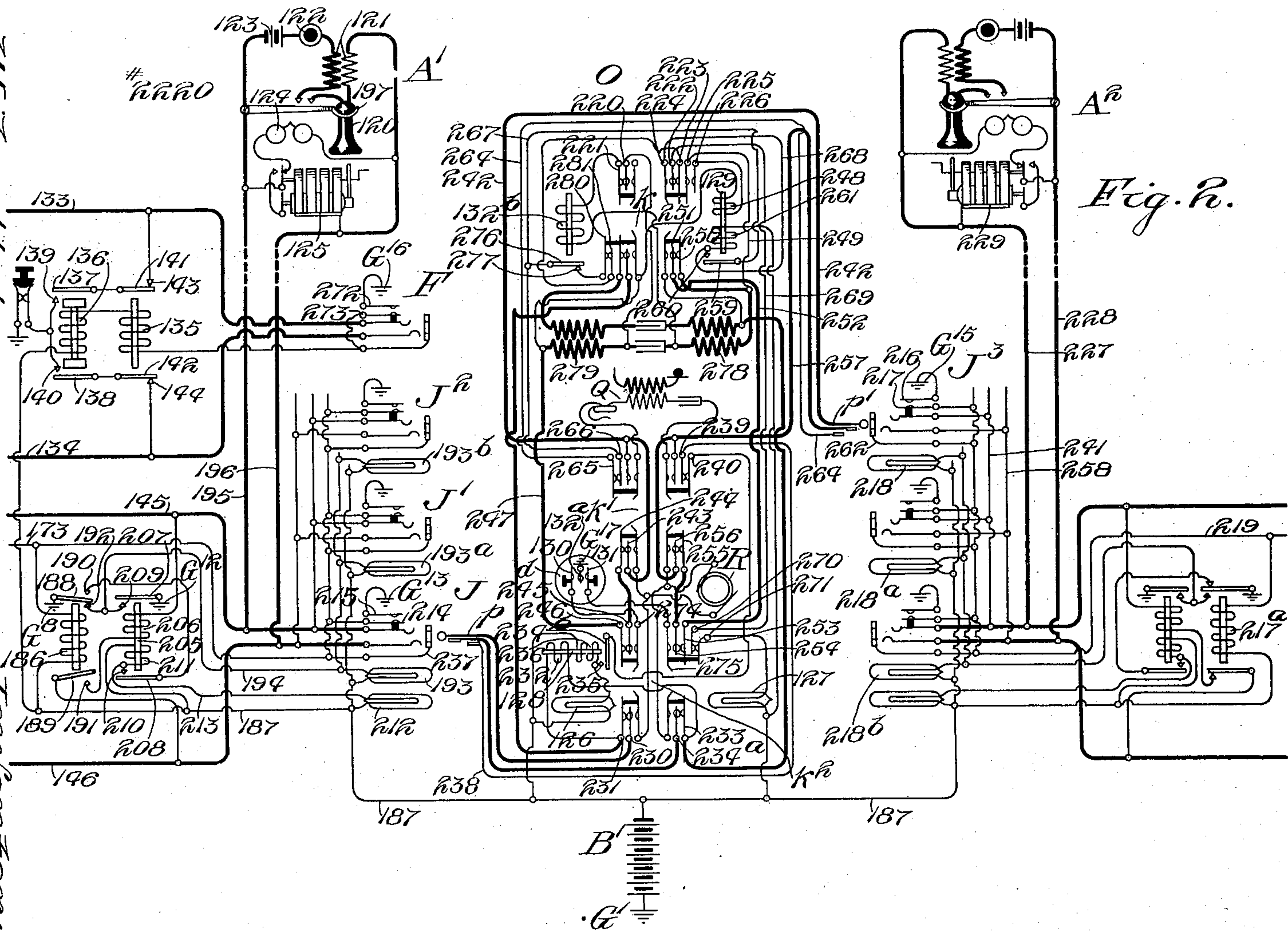
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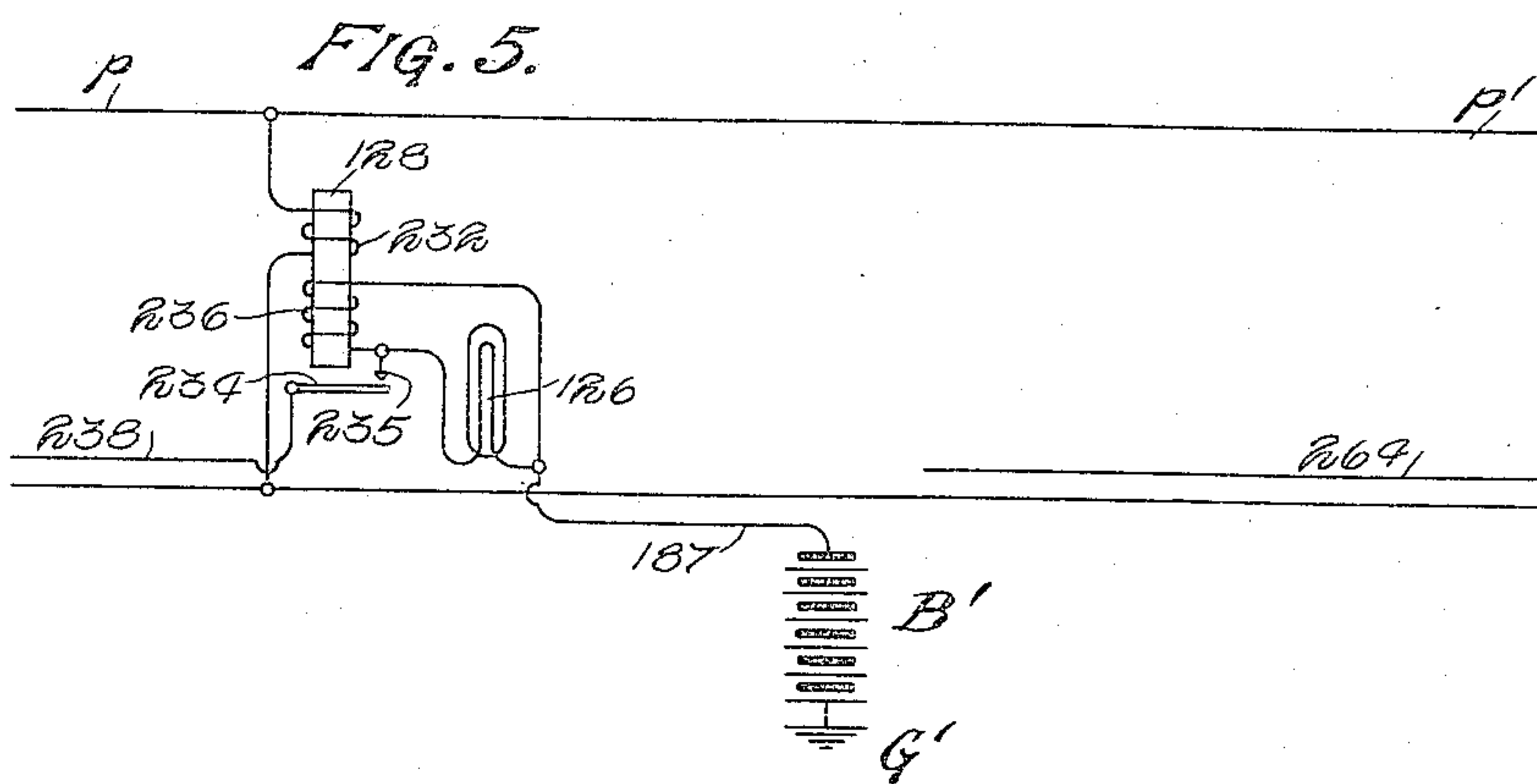
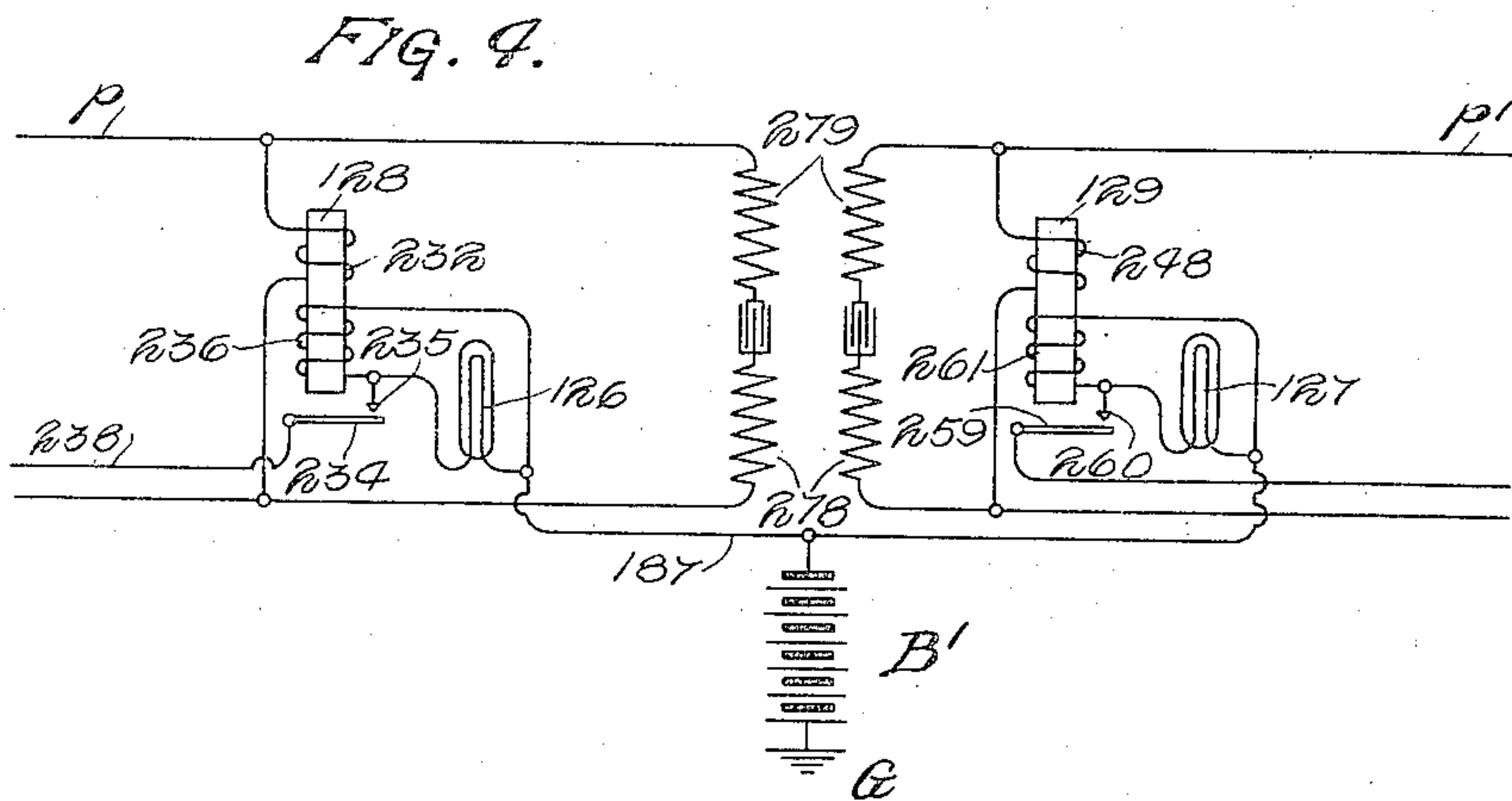
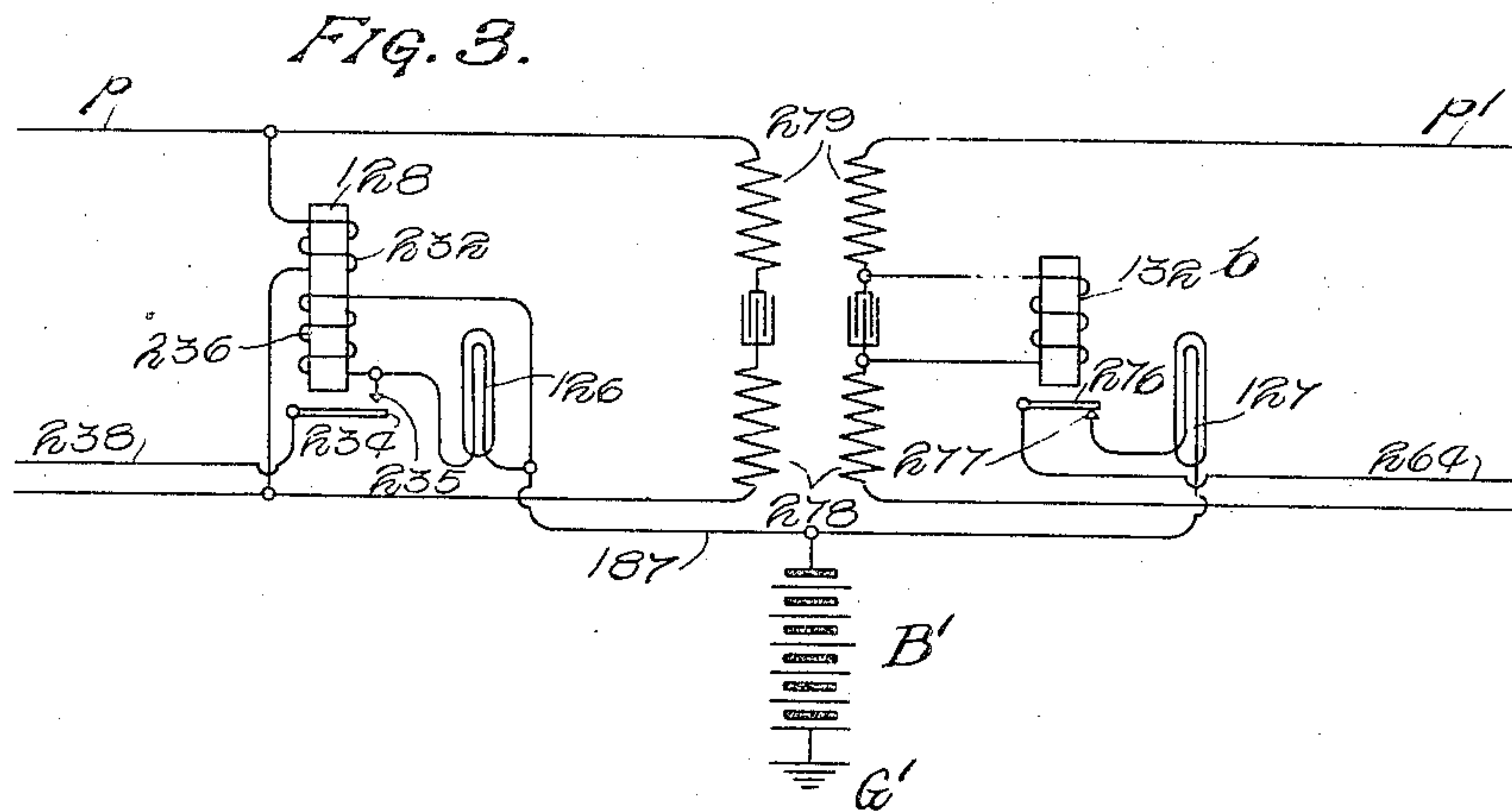
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4 SHEETS—SHEET 2.

Fig. 2.



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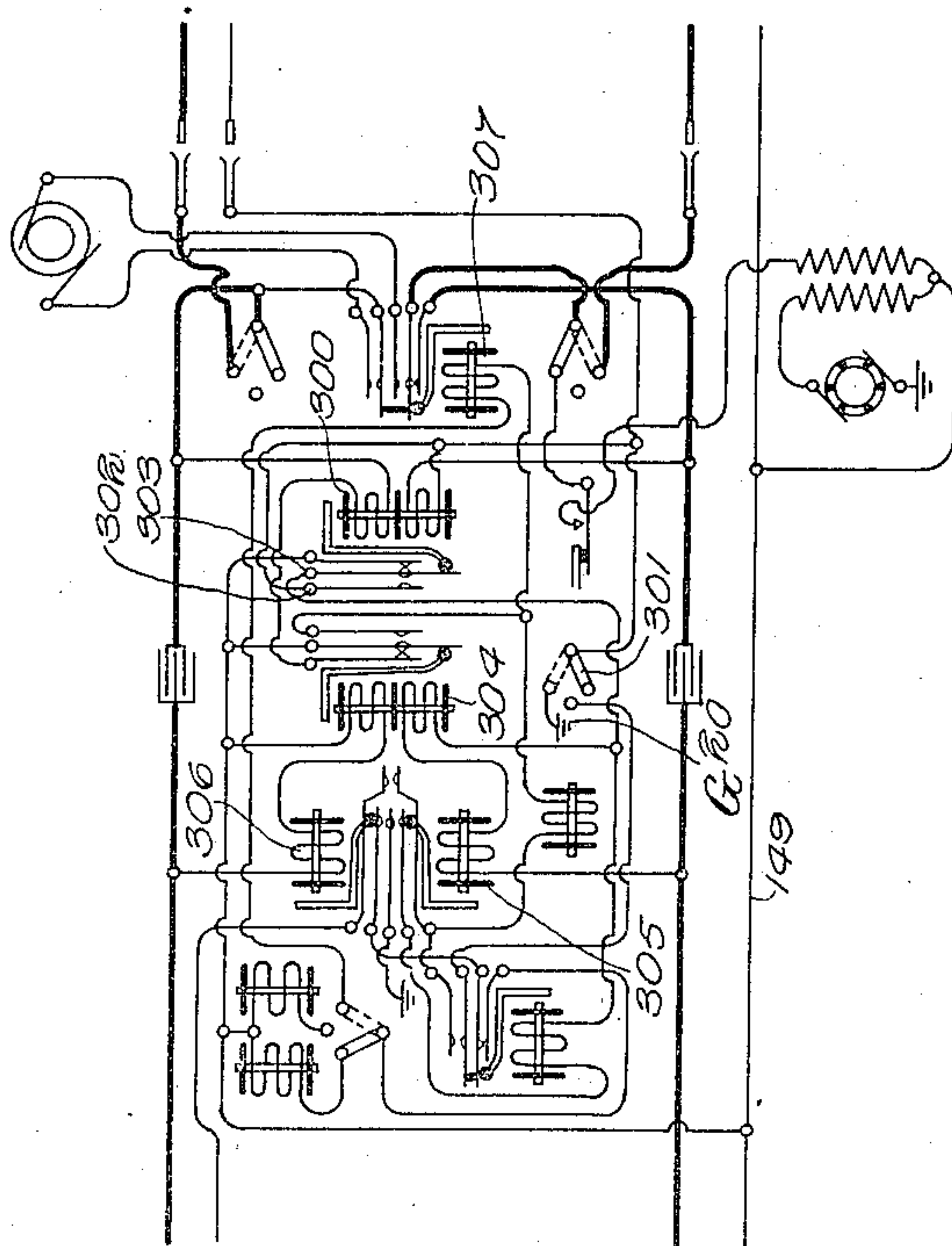
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FIG. 6.



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AUTOMATIC AND MANUAL TELEPHONE SYSTEM.

1,199,748.

Specification of Letters Patent. Patented Sept. 26, 1916.

Application filed February 27, 1908, Serial No. 418,165. Renewed January 9, 1915. Serial No. 1,451.

To all whom it may concern:

Be it known that I, TALBOT G. MARTIN, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Automatic and Manual Telephone Systems, of which the following is a specification.

My invention relates to telephone systems in general, but more particularly to automatic and semi-automatic systems, and especially to systems in which provision is made for giving service between common battery automatic subscribers and local battery manual subscribers—that is to say, between the subscribers of a common battery automatic exchange and the subscribers of a local battery manual exchange.

Generally stated, therefore, the object of my invention is the provision of an improved construction and arrangement whereby good telephone service is afforded between common battery automatic subscribers and local battery manual subscribers, either of the same or different central stations, and whereby a common battery automatic subscriber may call a local battery manual subscriber, or vice versa, without in any way interfering with the regular service between the automatic subscribers, and without interfering with the usual or desired method of giving service between the manual subscribers.

A special object is the provision of an improved cord circuit provided with means for calling automatic subscribers, and with means for supervising connection between two manual subscribers' lines, adapted also for supervising connection between an automatic subscriber's line and a manual subscriber's line, the one cord circuit being thus adapted for extending and supervising connection between lines of either the same or different character.

It is also an object, of course, to provide certain details and features of improvement and combinations tending to increase the general efficiency and serviceability of a telephone exchange system of this particular character.

To the foregoing and other useful ends, my invention consists in matters hereinafter set forth and described.

In the accompanying drawings Figure 1 shows diagrammatically a calling substa-

tion A and its allotted first-selector switch C. A second-selector switch is shown at D and a connector switch at E. A ringer generator is represented at H, while at I there is shown a busy-signaling device. A central battery B having its positive terminal preferably grounded at G is provided for operating the central office switches.

In Fig. 2 there is represented diagrammatically a manual exchange central office, two substations of which are shown at A' and A². The substation A' terminates in the jacks J, J', J², etc. Furthermore, the line conductors of the substations A' and A² multiple with the connector bank contacts of the automatic exchange (Fig. 1), over which multiples the automatic subscribers A, etc., may establish connection with the manual substations A', A², etc. An operator's cord circuit is shown at O, and the usual exchange battery at B', having its positive side preferably grounded at G'.

Fig. 3 is a diagrammatic simplified illustration of the circuits in the cord circuit O when the keys are all in normal position, as in connecting a manual line with an automatic line. Fig. 4 is a similar view showing the circuits when the key K is up, as when a connection is made between manual and manual subscribers. Fig. 5 is a similar view showing the condition of the cord when the key K is down, as when switching from one operator's position to another. When the key is in this position the repeating coil and all relays except the relay 128 are cut out of circuit and are, therefore, not shown in this figure. Fig. 6 is a diagram of the circuits of a common battery connector switch.

The substations may be of any suitable or approved type. The substation A, in connection with which I have elected to illustrate my invention, comprises a receiver 2 and a switch-hook 3 for controlling the substation circuits, which controlling operations are accomplished through the medium of any suitable means, such as the cam-arms 4, 5 and 6. As the switch-hook is lowered the cam-arm 4 momentarily presses the release springs 7, 8 and 9 into engagement, whereby the substation line conductors may be grounded simultaneously. When the switch-hook is down the cam-arm 5 maintains a contact between the springs 10 and 11, thereby bridging the ringer 12 in series with the condenser 13 across the line. The

substation ground circuit is normally broken between the ground springs 14 and 15 by the cam-arm 6; but when said springs come together ground is provided to the ground post 17, and to the release spring 7, as is usually the case in telephone apparatus of this type. The said substation comprises the usual transmitter 18 and induction coil 19, which latter has the primary winding 20 and secondary winding 21. Being an automatic substation, it is provided with the usual vertical and rotary impulse springs 22 and 23. Said substation is provided with a dial (not shown) which is secured to the shaft 24, together with the locking dog 25. Furthermore, there is a locking cam 26 that locks the dog while the receiver is on the switch-hook to prevent rotation of the dial. For operating the impulse springs 22 and 23 the substation is provided with an impulse wheel 27 that is secured to the shaft 24 which carries on its periphery the so-called vertical impulse teeth 28 and one rotary impulse tooth 29. The said impulse teeth are so arranged that when the dial is drawn down the impulse springs 22 and 23 are not carried into contact with the ground post 17; but as the dial returns, first the vertical teeth engage the vertical impulse spring 22, and after they have completed their work the rotary impulse tooth 29 operates the rotary impulse spring 23. In this operation the subscriber's vertical line conductor 30 is first given a number of ground impulses, and then the rotary line conductor 31 is given one ground impulse. It will be noticed that as long as the dial is out of normal position the dog 32 permits the primary circuit springs 33 and 34 to separate, thus preventing the impulses that are delivered to one line conductor from passing to the other. The means whereby a subscriber may signal a called subscriber comprises the push-button 35 which, when pressed, carries the spring 36 from engagement with the contact point 37 into engagement with the contact point 38, whereby the vertical line conductor 30 is grounded.

The first-selector switch shown at C may be of any suitable or approved type, for example of the type described in United States Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson. It embodies among other details the following well-known devices and circuits: The switch shaft (not shown) carries the vertical and rotary wipers 39 and 40, respectively, and the private wiper 41. The side switch is well-known and comprises the side switch wipers 42, 43, 44 and 45, which may be designated as the vertical, rotary and private side switch wipers, and the rotary magnet wiper, respectively. The side switch is under the control of the pri-

vate magnet 46, and when the side switch is in normal or first position the wipers 42, 43, 44 and 45 occupy the contact points 47, 48, 49 and 50, respectively. In the second position they rest on the contact points 51, 52, 53 and 54, respectively, and in the third position the contact points 55, 56, 58 and 57 are engaged by their respective wipers. Through the medium of the vertical line relay 60, and while the side switch is in first position, the subscriber controls the vertical magnet 61, which latter operates to raise the switch shaft and wipers 39, 40 and 41 vertically. By means of the rotary line relay 62, and while the side switch is in first position, the subscriber controls the private magnet 46, and, therefore, the side switch. While the side switch is in second position the rotary magnet 63, which operates to carry the switch shaft and wipers 39, 40 and 41 in a rotary direction, is energized. The vertical and rotary line relays 60 and 62, acting conjointly, provide the means whereby the subscriber controls the release magnet 64 while the side switch is in first or second position. If the side switch passes to the third position, then, since the selector C is of the trunk-release type, the selector is controlled through the next switch (with which latter a connection is then established) by means of the back-release relay 65 and through the private wiper 41. The bridge-cut-off relay 66 is provided to open the connection between the line relays 60 and 62 and between said relays and battery. This is desirable, because if the relays are not disconnected from each other and battery, the ringing current for signaling the subscriber may operate either or both of the relays 60 and 62 and cause some interference with the switch. It is also desirable to remove the bridge formed through the said relays from across the line to give the voice-currents as clear a path as possible. The selector switch shaft which carries the wipers 39, 40 and 41 is also provided with a normal arm 67 which, when the shaft is given a vertical step, permits the spring 68 to pass from engagement with the contact point 69 into engagement with the spring 70. The normal conductors 71, 72 and 73 lead to the connector banks and provide the means by which calling subscribers may establish connection with the line of substation A.

The second-selector D is similar to the first-selector switch C, both in point of mechanical construction and operation. In the second-selector D there are no normal conductors such as the normal conductors 71 and 72 of the selector switch C. There is also no necessity in the second-selector for a bridge-cut-off relay such as the relay 66 of the selector C, and it is also omitted; and the line relays are connected directly to the

battery lead. The private normal conductor, such as the private normal conductor 73 of the selector C, is of no utility in connection with the second-selector and is also omitted. Since like parts are likewise represented throughout the drawings, the vertical magnet 74 and the rotary magnet 75, the release magnet 82^a and the private magnet 76 will be recognized and understood.

The said private magnet 76, of course, controls the side switch wipers 77, 78, 79 and 80, the said private magnet also controlling the circuit of the vertical magnet 74 in the usual manner by means of the springs 81 and 82, but not the circuit of the release magnet 82^a, for the release magnet spring is omitted. The vertical movement of the switch shaft, and therefore of the wipers 83, 84 and 85, is controlled by the vertical magnet 74, and the rotary movement by the rotary magnet 75, the said rotary magnet circuit being provided with the usual interrupter springs 86. The operative magnets of the switch are, of course, controlled by the subscriber through the use of the vertical and rotary line relays 87 and 88, as is well known. Said relays have under their control the usual springs 89, 90 and 91, and in addition the trunk-release springs 92 and 93, whereby the said switch may be released when the side switch wipers are in first or second position. After the side switch passes to third position and establishes connection with the connector switch, the release of the selector is controlled from the connector by means of the back-release relay 94^a and through the private wiper 85.

The connector switch E is of the general type disclosed in United States Letters Patent No. 815,176, granted March 13, 1906, to Keith, Erickson and Erickson, but is modified to adapt it to provide talking battery current for the calling substation only, since the called substations with which this connector is adapted to connect are of the local battery type. The connector E, therefore, is adapted to provide the means for establishing final connection between a common battery substation and a local battery substation. The mechanical details of the selector and connector, as is well known, are very much the same. For instance, the connector switch shaft (not shown), like the selector switch shaft, carries the line wipers 94^b and 95 and the private wiper 96. The connector switch is also controlled by the calling subscriber through the medium of the vertical and rotary line relays 97 and 98. The vertical line relay 97 directly controls the vertical magnet 99, and also the rotary magnet 100. The purpose of the vertical magnet 99 is to give the shaft and shaft wipers a vertical motion, and the rotary magnet 100 imparts to the shaft and shaft wipers a rotary or circular motion.

The rotary line relay 98 controls the private magnet 101, which latter, under certain conditions, controls in turn the vertical and rotary magnets 99 and 100, the release magnet 102, and also the side switch wipers 103, 104, 105, 106 and 107. The side switch of the connector, like the side switch of the selector, has a normal or first position, a second position and a third position. The release magnet 102 is also controlled by the vertical and rotary line relays 97 and 98 conjointly. By the use of the condensers 108 and 109, the circuit through the connector is divided into two sections. The connector is provided with a differentially-wound relay 110 which is composed of the windings 111 and 112. The function of this relay is to provide the calling subscriber with talking battery current. Furthermore, the connector is provided with a ringer relay 113 which is so arranged that when the connector side switch passes to third position an energizing circuit is then closed through the said relay. By means of the differential relay 110 the energizing circuit through the ringer relay is controlled, and when the said relay 113 deenergizes (while the side switch is in third position) the ringer generator H is bridged across the terminals of the called line to signal the called subscriber. From the foregoing it is evident that the operation of the ringer relay (as arranged in the connector switch E) is the opposite of the operation of the ringer relay disclosed in Patent No. 815,176—that is, to bridge the ringer generator across the called line the ringer relay must be deenergized, instead of energized as is usually the custom. The central station is equipped with the busy-signaling apparatus I of any suitable design, as, for example, the one comprising an interrupter 114 in series with the primary winding 115 of the induction coil 116, whereby a busy-signaling current is induced in the secondary winding 117 of the said induction coil 116. The secondary winding 117 is connected with the side switch wiper 107, and when the normal springs 118 and 119 are in contact, and the side switch is in first position, the busy-signaling current may be transmitted to the calling subscriber.

The common battery connector shown in Fig. 6 is very similar to the connector E, with the addition of the so-called back-bridge relay 300 through the windings of which the called substation is provided with talking current from the central office battery. The ringer relay 307 of this connector remains deenergized during conversation, but is energized to ring the called line when the relays 306 and 304 are energized as a result of the pressing of the ringing button at the calling substation after the side switch of the connector has passed to third position.

The manual substation, as shown in Fig. 2, comprises the usual receiver 120, induction coil 121, transmitter 122 and local battery 123. At 124 a ringer is shown, which is normally bridged across the subscriber's line conductors. By means of the magneto generator 125 the subscriber signals the central office attendant. The local substations A^1 and A^2 of the manual exchange may be connected by the operator's cord circuit O; also, when it is desired to connect the manual substation A^1 with the automatic substation, this same cord circuit is used, the plug p' being inserted in the jack F, which latter is the terminal of the trunk-line conductors 133 and 134 leading to the automatic exchange and terminating in the first-selector switch C' . Furthermore, the trunk conductors 133 and 134 are provided with an automatic or releasing device comprising the relays 135 and 136. The relay 136 is a slow-acting relay, while the relay 135 is quick-acting; and this arrangement is provided in order that when the said relays deenergize, the relay 136 maintains its armatures 137 and 138 in engagement with the contact points 139 and 140 for a moment after the armatures 141 and 142 engage the contact points 143 and 144, thereby transmitting to the line conductors 133 and 134 a ground impulse. The operator's cord circuit shown at O comprises the usual supervisory lamps 126 and 127, which in turn are controlled by the supervisory relays 128 and 129, respectively. At d there is shown a calling device by means of which the operator may operate the switches of the automatic exchange. The calling device, as shown, comprises the push-button springs 130 and 131 which are adapted to be pressed onto the ground post 132^a, whereby impulses may be sent to the trunk-line conductors. At Q the usual operator's set is shown, and the relay 132^b is provided for controlling the lamp 127 when the operator establishes connection with a subscriber of the automatic exchange. Furthermore, the operator's cord circuit is provided with the usual ringing and listening keys common to cord circuits of this character.

It will now be shown how a subscriber of the automatic central station may operate the central office switches and establish connection with a subscriber of the manual exchange. To call the substation A' , the number of which it is assumed is 2220, the subscriber at substation A removes his receiver from the switch-hook and operates the calling device once, in the well-known manner, for each digit. When the dial returns to normal position for the first digit, the first-selector switch C is operated to establish connection with the trunk conductors of the second-selector switch D. On returning to normal position for the second digit the dial

grounds the line conductors, and the second-selector D is in turn operated to establish connection with the connector switch E. The impulses for the last two digits are directed to the connector switch E, which operates to place the shaft wipers in connection with the conductors 145 and 146, which are multiple terminals of the line conductors of substation A' . The first digit being 2, the spring 22 is pressed onto the ground post 17 twice. As a result the vertical line relay 60 of the first-selector C is energized each time by a flow of current from the substation ground G^2 through the springs 14 and 15 to the ground post 17, thence through spring 22 to the vertical line conductor 30, side switch wiper 42, contact point 47, vertical line relay 60, thence to the cut-off relay springs 147 and 148 to the battery lead 149, and through battery B to ground G. Each time that the vertical line relay energizes, the spring 150 is pressed onto the ground spring 151. The vertical magnet 61 is thereby energized, and the wipers 39, 40 and 41 of the selector C are raised to the second bank level and thus brought opposite the first contact of said level. The energizing circuit for the vertical magnet 61 extends from ground G^3 to the springs 151 and 150, private magnet springs 152 and 153 to the vertical magnet 61, to the battery lead 149, thence through battery B to ground G.

Following the vertical impulses, the rotary impulse spring 23 is pressed onto the ground post 17, grounding the rotary line conductor 31 and therefore energizing the rotary line relay 62. The energizing current passes from ground G^2 to the springs 14 and 15, ground post 17 and rotary impulse spring 23 to the rotary line conductor 31, through the side switch wiper 43 and contact point 48, rotary line relay 62, cut-off relay springs 154, 147 and 148 to the battery lead 149, thence through battery B to ground G. The rotary line relay, upon energizing, presses the springs 155 and 151 into contact, whereby the circuit is closed through the private magnet 46, said circuit extending from ground G^3 to the springs 151 and 155 to the winding of the private magnet 46, to the battery lead 149, thence through battery B to ground G. The private magnet, upon energizing and deenergizing, permits the selector side switch to pass from first to second position, whereby the side switch wipers 44 and 45 engage the contact points 53 and 54, respectively. The closure of contact between the side switch wiper 45 and the contact point 54 establishes an energizing circuit for the rotary magnet 63 from ground G^4 to the contact point 54 and side switch wiper 45, interrupter springs 156 to the rotary magnet 63, to the battery lead 149, thence through battery B to ground G. The said rotary magnet then operates to rotate the wipers 39,

40 and 41 of the selector C into engagement with the first contact of the second level, from which contact it is assumed the trunk-line conductors 157, 158 and 159 lead to the selector D. If the first trunk is busy, however, and the wipers have to pass over busy trunk-lines, then as soon as the private wiper 41 engages the first grounded contact point of the private bank, the private magnet 46 energizes again, locking the side switch in second position. The energizing circuit for the said private magnet extends from the grounded terminal G of battery B through an occupying switch (not shown) to the private wiper 41, thence over the conductor 160 and through the back-release relay 65 to the side switch wiper 44, contact point 53, private magnet 46, thence through the said magnet to the battery lead 149, and through battery B to ground G. The private magnet 46, upon thus becoming energized, locks the side switch in second position, thus maintaining the wiper 45 in engagement with the grounded contact point 54, whereby the rotary magnet 63 will be energized step by step until the wipers are carried beyond the last busy trunk-line. At the instant that the private wiper 41 leaves the last busy contact point, the energizing circuit through the private magnet 46 is destroyed, and as a result the selector side switch passes to third position. If, however, there are no busy trunk-lines, the rotary magnet 63 releases the side switch to third position as soon as the wipers are carried into engagement with the first trunk-line. As soon as the side switch passes to third position, as stated, the subscriber's line conductors 30 and 31 are extended to the trunk conductors 157 and 158, which in this case it is assumed lead to the selector switch D. The extension of the line occurs, of course, as soon as the side switch wipers 42 and 43 engage the contact points 55 and 56, respectively. Not only is the subscriber's line thus extended, but a guarding potential is established at the private wiper 41 for protecting the seized trunk-line against interference by other calling subscribers, when the side switch wiper 44 engages the grounded contact point 58. This guarding potential is established from ground G⁴ to the contact point 58, to the side switch wiper 44 and through the back-release relay 65, conductor 160 to the private wiper 41. It will be seen, of course, that the energizing circuit for the rotary magnet 63, to which reference has already been made, is destroyed when the idle trunk-line is seized—that is, when the side switch wiper 45 disengages from the contact point 54. The grounding of the line conductors 30 and 31 for the second digit 2 operates the second-selector D in a similar manner to establish connection with an idle trunk-line leading to the connector switch E—that is, when the

line conductor 30 is grounded twice, the vertical line relay 87 is energized and operates to close an energizing circuit through the vertical magnet 74, which operates in the usual manner to carry the shaft wipers 83, 84 and 85 upwardly two vertical steps.

After the vertical impulses the rotary line conductor 31 is given one ground impulse, whereby the rotary line relay 88 is energized, and an energizing circuit is in turn closed through the private magnet 76 which now operates to permit the side switch wipers to pass from first to second position. The rotary magnet 75 now energizes and operates to rotate the shaft wipers 83, 84 and 85 to the first idle trunk-line. When this trunk line is seized, as explained in connection with the selector switch C, the side switch wiper passes to third position, thus extending the subscriber's line conductors 30 and 31 to the trunk conductors 161 and 162, which latter lead to the connector switch E. Also, when the side switch passes to third position, a guarding potential is established at the private conductor 163, extending from the side switch wiper 79. The grounding of the line conductors 30 and 31 for the last two digits affects the connector by operating the vertical and rotary line relays 97 and 98. When the said vertical line conductor 30 is grounded, the vertical line relay 97 is energized by a flow of current from the substation ground G² over the conductor 30, trunk conductor 157, side switch wiper 77, shaft wiper 83, trunk conductor 161 to the vertical line relay 97, winding 111 of the relay 110 to the battery lead 149, thence through battery B to ground G. The winding 111 of the relay 110 being included in this circuit, the said relay energizes, but its operation at this particular time is without effect. Each time that the vertical line relay operates for the third digit the vertical magnet 99 operatively energizes to carry the shaft wipers 94^b, 95 and 96 in a vertical direction, one step at a time, until the said wipers are carried two steps and thus brought opposite a level in which are located the terminals of the line No. 2220. The circuit through the vertical magnet extends from ground G⁵ to the springs 164 and 165, private magnet springs 166 and 167 to the winding of the vertical magnet 99, contact point 168, side switch wiper 105 to the battery lead 149, thence through battery B to ground G. When the rotary line conductor 31 is grounded, following the grounding of the vertical line conductor, the connector rotary line relay 98 becomes energized over a circuit extending from the substation ground G² to the rotary line conductor 31, side switch wiper 43, contact point 56, shaft wiper 40, trunk conductor 158, side switch wiper 78, shaft wiper 84, trunk conductor 162, rotary line relay 98 to the winding 112,

springs 169 and 170 to the battery lead 149, thence through battery B to ground G. The winding 112 of the differential relay 110 being included in this circuit, as is the winding 111 in the vertical line relay circuit, the said relay energizes, but with no effect. The rotary line relay 98, upon energizing, operates to close an energizing circuit through the private magnet 101, which latter in turn operates to release the side switch from first to second position. The energizing circuit to the private magnet extends from ground G⁵ to the springs 164 and 171, to the winding of the private magnet 101, to the springs 160 and 170, to the battery lead 149, thence through battery B to ground G. For the last digit the subscriber operates the dial as previously described, grounding the vertical line conductor 30 ten times and the rotary line conductor 31 once. The connector vertical and rotary line relays 97 and 98 are operated over previously traced circuits. However, when the vertical line relay now operates, a circuit is closed through the rotary magnet 100 instead of through the vertical magnet 99, since the side switch wiper 105 is now in second position and in engagement with the contact point 172. Each time that the rotary magnet is energized, the shaft wipers 94^b, 95 and 96 are rotated one step at a time until the said wipers are carried into engagement with the normal conductors 145, 146 and 173, the first two of which conductors lead to the line terminals of the desired substation. The rotary line relay 98, upon energizing, completes an energizing circuit through the private magnet 101 as before, which latter now operates with one of two results, namely the release of the side switch from second to third position, or the so-called busy-release of the connector. It will be assumed that the former result occurs, and that the side switch passes from second to third position, whereby the side switch wipers 103 and 104 are placed in connection with the shaft wipers 94^b and 95, respectively. Furthermore, when the side switch passes to third position a guarding potential is established for protecting the called line. This potential extends from ground G⁶ to the side switch wiper 106, conductor 174 and to the shaft wiper 96, which latter engages the private contact corresponding to the called line.

When the side switch wiper 106 engages the third-position contact point, an energizing circuit is established through the ringer relay 113, whereby the connector shaft wipers 94^b and 95 are disconnected from the ringer generator terminals and connected with the calling subscriber's extended conductors, and the calling substation is provided with battery current for talking purposes. The circuit through the ringer relay 113 extends from ground G⁶, side switch

wiper 106 to the winding of the ringer relay 113, springs 175 and 176 of the differential relay, contact point 177, side switch wiper 105 to the battery lead 149, thence through battery B to ground G. The ringer relay, upon energizing, operates to shift the springs 178, 179 and 169 from engagement with the springs 180, 181 and 170 into engagement with the springs 182, 183 and 184, respectively. When the spring 169 is shifted from the spring 170 into engagement with the spring 184, the conductor 185 is changed from the negative pole of battery B to the grounded positive pole, whereby a circuit is established which provides the calling substation with talking battery current. This circuit extends from ground G⁷ to the springs 184 and 169, conductor 185 to the winding 112 of the differential relay 110, rotary line relay 98, through the trunk conductors 162 and 158 to the rotary line conductor 31, through the primary winding 20 and transmitter 18 to the vertical line conductor 30, trunk-line conductors 157 and 161, vertical line relay 97, through the winding 111 of the differential relay 110 to the battery lead 149, thence through battery B to ground G. Furthermore, when connection is established with the normal conductors 145 and 146, and the side switch passes to third position, an energizing circuit is established through the private normal relay 186 allotted to the line of substation A' at the manual exchange (Fig. 2). This circuit extends from ground G⁶ to the side switch wiper 106, shaft wiper 96, private normal conductor 173 to the private relay 186 (Fig. 2), to the battery lead 187, thence through battery B' to ground G'. This relay, upon energizing, attracts its armatures 188 and 189 from engagement with the contact points 190 and 191, and the armature 188 engages the contact point 192, whereby a circuit is completed and the busy lamp 193 placed in multiple with the busy lamps 193^a and 193^b. This circuit extends from ground G⁸ to the armature 188 and contact point 192, conductor 194, through the lamps 193, 193^a and 193^b in multiple to the battery lead 187, thence through battery B' to ground G'. The glowing of these lamps indicates to the operator that the allotted line thereto is busy.

To signal the called subscriber the subscriber at substation A presses the signaling button 35, whereby the vertical line conductor 30 is grounded, and the connector vertical line relay 97 and the differential relay 110 becomes energized as before. At this particular time, when the relay 110 operates to separate the springs 175 and 176, the energizing circuit through the ringer relay 113 is broken. The said relay deenergizes and permits the springs 169, 179 and 176 to

assume their normal positions, whereby the ringer generator terminals are bridged across the line terminals of the called substation A'. The signaling current is, therefore, sent from the generator H to the ringer relay springs 181 and 179, side switch wiper 103, shaft wiper 94^b, vertical normal conductor 145, thence to the tip line conductor 195 (Fig. 2), through the substation ringer 124 to the sleeve conductor 196, thence to the battery normal conductor 146, shaft wiper 95, side switch wiper 104, ringer relay springs 178 and 180 back to the ringer generator H. As soon as the calling subscriber ceases to press the signaling button 35, the energizing circuit for the vertical line relay 97 and the differential relay 110 is broken. When this circuit is broken, the differential relay springs 175 and 176 again engage and reestablish the energizing circuit through the ringer relay, which latter operates as before. In response to the signal the subscriber at substation A' removes the receiver 120 from the switch-hook 197 whereby the primary circuit including the local battery and the transmitter is closed, and the receiver 120 in series with the secondary winding of the induction coil 121 is bridged across the line conductors 195 and 196. The substation A' is provided with talking battery current from the local battery 123, while the transmitter at the calling substation is energized by a current from the central battery B of the automatic exchange through the differential relay 110 of the connector E. The two substations A and A' being thus provided with battery current for talking purposes, conversation may be carried on over the conductors shown by the heavy lines in Figs. 1 and 2. The release of the switching apparatus is brought about when the calling subscriber restores the receiver 2 to the switch-hook 3, thereby pressing the release springs 7, 8 and 9 into engagement for a moment. The contact of said release springs grounds the vertical and rotary line conductors 30 and 31 simultaneously from ground G² to the release spring 7, thence through the springs 8 and 9 to the rotary and vertical line conductors. The grounding of the rotary line conductor 31 produces a short-circuiting of the rotary line relay 98 in series with the winding 112 of the differential relay 110, said short-circuit extending from ground G² through the springs 184 and 169, winding 112 of the differential relay 110, rotary line relay 98 to the shaft wiper 84, side switch wiper 78, trunk conductor 158, shaft wiper 40, side switch wiper 43 to the rotary line conductor 31, release springs 8 and 7 to the substation ground G². Therefore, since the winding 111 of the differential relay 110 alone carries current, the said relay becomes energized and attracts its armature, which shifts the

spring 175 out of contact with the spring 176. The disengagement of the springs 175 and 176 destroys the energizing circuit through the relay 113, and the spring 169 passes out of engagement with the spring 184 and into engagement with the spring 170, which removes the said short-circuit from around the rotary line relay 98 and winding 112, and establishes an energizing circuit instead extending from the substation ground G² through the release springs 7 and 8 to the rotary line conductor 31, thence to the rotary line relay 98, as previously traced, winding 112 of the differential relay 110, through the springs 169 and 170 to the battery lead 149, thence through battery B to ground G. The rotary line relay 98 now operates, and the trunk-release springs 92^a and 93^a come into contact, whereby an energizing circuit is established through the release magnet 102 of the connector E and the release relay 94^a of the selector D. However, the current now in passing, as above stated, through the winding 112 aids the winding 111 in maintaining the springs 175 and 176 disengaged. The energizing circuit through the release relay 94^a and release magnet 102 extends from ground G² at the selector D, side switch wiper 79, release relay 94^a, shaft wiper 85, conductor 163, trunk-release springs 92^a and 93^a, release magnet 102, springs 169 and 170 to the battery lead 149, and through battery B to ground G. When the conductor release magnet 102 is thus supplied with current it energizes, and as a result the switch shaft and side switch are restored to normal position, thus breaking the connection between the connector switch shaft wipers 94^b, 95 and 96 and the normal conductors 145, 146 and 173.

The back-release relay 94^a being in the same circuit with the release magnet energizes simultaneously with the latter, and operates to close a series circuit through the selector release magnet 82^a and back-release relay 65 of the selector C by pressing together the back-release springs 199 and 200. This latter circuit extends from ground G⁴ through the side switch wiper 44, back-release relay 65, conductor 160, shaft wiper 41, conductor 159, release relay springs 199 and 200, release magnet 82^a to the battery lead 149, thence through battery B to ground G. The release relay 65 being included in this circuit operatively energizes and places the springs 201 and 202 in contact, whereby an energizing circuit is in turn established through the release magnet 64 of the selector C. The circuit through the said release magnet 64 extends from ground G¹⁰ through the release springs 201 and 202, through the release magnet 64, thence to the battery lead 149, and through battery B to ground G. When the ground to the line

conductors 30 and 31 is interrupted all the magnets involved in the release are deenergized, and all the switches are fully restored. If the called line #2220 is busy at the time that the calling subscriber #5000 attempts to establish connection, the connector E is released by the last impulse to the rotary line conductor 31 as follows: The said impulse energizes the rotary line relay 98 of the connector E, which relay in turn energizes the private magnet 101, pressing the private springs 203 and 204 into contact after the private wiper 96 has been carried onto the grounded private bank contact. Of course, it is understood that whenever the line #2220 is busy, the connector private bank contacts connected with the private normal 173 are all connected to ground. The manner in which this conductor is grounded from the manual exchange—that is, when the operator plugs in onto this line—will be explained hereafter. Therefore, since the connector side switch is in second position when the private magnet springs 203 and 204 are brought into contact, an energizing circuit is established through the release magnet 102 from the said grounded private bank contact to the private wiper 96, thence to the side switch wiper 106 (which is in second position) to the private magnet springs 204 and 203, to the release magnet 102, through the springs 169 and 170 to the battery lead 149, thence through battery B to ground G. The connector switch shaft and side switch are thus released, and connection is not established with the called subscriber. Now, when the calling subscriber presses the signaling button, the vertical line relay 97 becomes energized and operates to close a circuit through the vertical magnet 99. The vertical magnet operates to carry the switch shaft vertically, whereby the off-normal springs 118 and 119 engage to permit the busy-signaling current to pass to the calling subscriber in the usual way. Of course, when the subscriber hangs up his receiver after receiving the busy-signal, he grounds the line relays 97 and 98 of the connector E, as already explained, producing the release of the switching apparatus as formerly. As previously explained, the subscribers' lines of the automatic exchange are divided into groups of one thousand, and the thousand-groups are in turn subdivided into groups of one hundred subscribers; then the lines of the manual subscribers which are to be called by the automatic subscribers are placed in one of the hundred groups—the two-hundred group of the two thousand, for example; or if there are more manual subscribers' lines than can be accommodated by one group, a second or a third hundred may be reserved. The idea is to reserve certain hundreds for the manual

lines exclusively, so that the connector switches allotted for establishing connection with the manual groups may be arranged to provide the calling substation with talking battery current, while the called substation is provided with talking battery current from a local battery. The automatic subscribers are allotted to other hundred groups, and the connector switches adapted to make connection with these lines are arranged to provide both the calling and called substations with talking battery current, and may be of the type shown in Fig. 6.

As explained in the foregoing, the automatic substation A called the manual substation A'. It will now be shown how one automatic subscriber may operate the central office switches to establish connection with the second automatic subscriber. Suppose, for example, that the subscriber at substation A desires to signal the automatic subscriber at substation #3550. In that event the receiver is removed from the switch-hook and the dial operated in the usual manner for the digits of the desired number. The first-selector switch (for the first digit) extends the calling subscriber's lines to a second-selector switch of the three thousand group. In response to the vertical and rotary impulses for the second digit, the second-selector switch D operates and establishes connection with the connector switch of the five hundred group. The connector switch thus selected operates for the last two digits to select the normal conductors of the desired line. The operation of the selector and connector switches is the same as that previously explained. The connector switches allotted to this group, as previously stated, are adapted to provide both the calling and called substations with battery current for talking purposes. The release of the central office switching apparatus in this case is initiated in the same manner as that explained, and from the foregoing it will be readily seen how one automatic subscriber may call and establish connection with the second automatic subscriber.

It will now be explained how the manual subscriber A' (Fig. 2) may obtain connection with the manual subscriber A². The subscriber at substation A' operates the magneto generator 125, whereby an energizing circuit is established to the relay 205 extending from one terminal of the generator to the tip conductor 195, thence to the multiple conductor 145, through the winding 206 of the relay 205, contact point 191, armature 189 to the conductor 146, thence to the sleeve conductor 196 back to the generator 125. The relay 205 thereupon energizes and attracts its armatures 207 and 208 to engage the contact points 209 and 210. When the armature 208 engages the contact point 210

a locking circuit for the relay 206 is formed through the winding 211. This circuit extends from ground G^8 to the armature 188 and contact point 190, to the armature 208 and contact point 210, winding 211 of the relay 205 to the battery lead 187, thence through battery B' to ground G' . Also, when the armature 208 engages the contact point 210 a circuit is closed through the line lamp 212, this circuit extending from ground G^8 through armature 188, contact point 190, armature 208 and contact point 210, conductor 213 to the lamp 212, to the battery lead 187, and thence through battery B' to ground G' . The glowing of this lamp indicates to the operator that the subscriber of the line allotted thereto desires a connection. Also, when the armature 207 engages the contact point 209, a circuit is closed through the busy lamps 193, 193^a and 193^b. This circuit extends from ground G^{12} through the armature 207, contact point 209 to the conductor 194, thence through the said busy lamps to the battery lead 187, and through battery B' to ground G' . The glowing of these lamps indicates to the operators of the various positions that the line at substation A' is busy. In response to the signal of the lamp 212, the operator inserts the plug p into the jack J . When the plug enters the said jack a number of circuit changes occur as follows: The spring 214 is pressed into engagement with the spring 215, whereby a guarding potential to the private normal conductor 173, which leads to the connector banks of the automatic exchange, is provided. This potential extends from ground G^{13} to the springs 215 and 214, to the conductor 173 which leads to the connector banks of the automatic exchange shown in Fig. 1; thus the line conductors at substation A' are protected against seizure by an automatic subscriber. Also, when the spring 214 engages the spring 215 a circuit is closed through the private normal relay 186, said circuit extending from ground G^{13} to the springs 215 and 214, the conductor 173, thence through the relay 186 to the battery lead 187, and through battery B' to ground G' . This relay, upon energizing, attracts its armatures 188 and 189, as before explained, and when the armature 188 disengages from the contact point 190 the locking circuit then established through the winding 211 of the relay 205 becomes broken, and the said relay 205 returns to normal position; and the circuits through the line lamp 212 and the busy lamps which were established upon energization of the relay are now broken, but a new circuit is established instead through the busy lamps, which circuit extends from ground G^8 through the armature 188, contact point 192, conductor 194, through the said busy lamps in multiple to the battery lead 187, thence through bat-

tery B' to ground G' . Upon learning that connection with substation A^2 is desired, the operator inserts the calling plug p' into the jack J^3 .

When plug p' enters the jack J^3 the springs 216 and 217 are pressed into contact, and an energizing circuit is established through the private normal relay 217^a allotted to the line at substation A^2 . When this relay operates, a circuit is closed through the busy lamps 218, 218^a and 218^b in the same manner explained in connection with substation A' . Also, a guarding potential is established at the private normal conductor 219 for protecting the line conductors of substation A^2 against seizure by calling subscribers of the automatic exchange. When the operator inserts the plug p' into the jack J^3 the key k is also operated, whereby the springs 220 and 221 are disengaged; also, the spring 222 is shifted from engagement with the spring 223 into engagement with the spring 224, and the spring 225 is carried into contact with the spring 226. The operation of the key k in this manner and at this time is to establish certain circuits which will give the operator supervision when the subscriber at substation A^2 rings off, so to speak. The ringing and listening key k' is operated in the usual manner to bridge the ringer generator R across the tip and sleeve conductors 227 and 228. The subscriber at substation A^2 , in response to the signal, removes the receiver from the switch-hook, and thereby closes the local primary circuit. The subscribers at the two substations may now carry on conversation over a circuit shown by the heavy lines in Fig. 2. At the completion of the conversation the subscribers at the two substations ring off—that is, the magneto generators 125 and 229 are given a turn, whereby energizing circuits are established through the supervisory relays 128 and 129 for indicating to the operator that the connection is no longer desired. The circuit through the relay 128 extends from the magneto 125 to the tip conductor 195, to the jack J and tip of the plug p , through the springs 230 and 231, winding 232 of the relay 128, thence through the springs 233 and 234^a, through the sleeve of the plug p and sleeve spring of the jack J to the sleeve conductor 196 and back to the magneto generator 125. The said relay 128 thereupon energizes and attracts its armature 234^b to engage the contact point 235, thereby a locking circuit is established through the winding 236 of the relay 128, and also a circuit through the supervisory lamp 126. This circuit extends from ground G^{13} at the jack J to the springs 215 and 214, to the ring 237, thence to the conductor 238 to the springs 239 and 240, armature 234^b, contact point 235, then through the lamp 126 by one path and the winding 236 by the

other path to the battery lead 187, thence through battery B' to ground G'. Upon removing the plug *p* from the jack J the operator destroys this energizing circuit, and the supervisory relay 128 returns to normal position. When the subscriber at substation A² restored his receiver and operated the magneto generator 229, an energizing circuit was established through the supervisory relay 129, said circuit extending from the magneto generator 229 to the tip conductor 227, thence through the multiple conductor 241 to the tip spring of the jack J³, and tip of the plug *p'*, conductor 242 to the springs 243 and 244, springs 245 and 246, conductor 247, thence through the winding 248 of the relay 129 to the springs 226 and 225, conductor 249, then through the springs 250 and 251, conductor 252 to the springs 253 and 254, springs 255 and 256, thence to the conductor 257 to the sleeve of the plug *p'*, and sleeve spring of the jack J³, multiple conductor 258 to the sleeve line conductor 228 and back to the generator 229. The relay 129 thereupon energizes and attracts its armature 259 to engage the contact point 260, whereupon a locking circuit is established through the winding 261, and a circuit is also established through the supervisory lamp 127. This circuit extends from ground G¹⁵ to the springs 216 and 217, thence to the sleeve 262 of the jack J³, conductor 264 to the springs 265 and 266, conductor 267, armature 259 and contact point 260, through the winding 261 by one path and to the battery lead 187, and over the contact point 260 to the conductor 268 and the springs 224 and 222, conductor 269 to the springs 270 and 271, to the lamp 127, to the battery lead 187 by the second path, thence through battery B' to ground G'. The operator thereupon removes the plug *p'* from the jack J³, whereby this circuit is broken when the plug disengages from the jack, thus restoring the relays energized thereby to normal position. Suppose, now, that a subscriber at substation A' desires connection with a subscriber of the automatic exchange. In that event the operator is signaled in the usual manner, and upon learning that a subscriber of the automatic exchange is desired inserts the plug *p'* into the jack F of the trunk-line conductors 133 and 134 which lead to the first-selector C' of the automatic exchange shown in Fig. 1.

When the plug *p'* enters the jack F an energizing circuit is established through the releasing relays 135 and 136, said circuit extending from ground G¹⁶ to the springs 272 and 273, thence through the relay 135 and relay 136 to the battery lead 187, thence through battery B' to ground G'. These relays then energize and attract their respective armatures, as previously stated. The key *k*² is operated to place the springs

245 and 274, and 254 and 275 in contact, whereby the calling device *d* is connected with the trunk conductors 133 and 134. The operator may then operate the calling device *d* in the usual manner, whereby the first-selector C' and the second-selector and the connector are each in turn operated in the usual manner to establish the desired connection. The impulses to the line conductor 133 pass from ground G¹⁷ to the ground post 132^a, spring 130 to the springs 274 and 245, springs 244 and 243 to the tip conductor 242, thence through the tip of the plug *p'* to the vertical line conductor 133. The impulses to the rotary line conductor 134 extend from ground G¹⁷ to the ground post 132^a and spring 131, through the springs 275 and 254, springs 255 and 256, sleeve conductor 257, thence through the sleeve of the plug *p'* to the rotary line conductor 134. After having established connection with the desired line the operator restores the key *k*² to normal position, whereby the calling subscriber at substation A' is connected with the automatic subscriber called by the operator. As has been previously stated, connection with automatic substations are obtained through the medium of common battery connectors such as shown in Fig. 6. The operations of the connector shown in said Fig. 6, in so far as the setting up of the connection is concerned, are practically the same as those of the connector E. When the called subscriber answers, the called substation is supplied with talking current from the central office battery through the windings of the back-bridge relay 300 of the connector shown in Fig. 6. The relay 300 is energized by this current, and as a result thereof battery current from the connector passes back to the manual exchange through the supervisory relay 132^b of the cord circuit O, thence back to the rotary line conductor 134, and again to the connector. This circuit extends from ground G²⁰ at the connector through the side switch wiper 301, springs 302 and 303, relays 304 and 305 and through the selectors to the rotary line trunk conductor 134, thence through the jack F to the sleeve of the plug *p'*, conductor 257, through the springs 256 and 255, through the springs 254 and 253, conductor 252, springs 251 and 250, through the winding 278 of the repeating coil, thence through the winding of the relay 132^b, springs 221 and 220, then through the winding 279 of the repeating coil, conductor 247, springs 246 and 245, springs 244 and 243 to the tip conductor 242, thence through the tip of the plug *p'* to the vertical line conductor 133, thence to the connector and through the relays 306 and 304 and battery B to ground G. The relay 132^b thereupon energizes and draws its armature 276 from engagement with the contact point 277. After the con-

5 versation has ceased, the manual subscriber
 at substation A' rings off in the usual man-
 ner, thus signaling the operator. The auto-
 matic subscriber in turn restores his receiver
 10 to the switch-hook, and the energizing cir-
 cuit previously traced through the super-
 visory relay 132^b is in turn broken, and the
 armature 276 engages the contact point 277,
 whereby a circuit is established to the super-
 15 visory lamp 127. This circuit extends from
 ground G¹⁶ to the springs 272 and 273,
 through the ring of the jack F to the ring
 conductor 264, thence through the springs
 265 and 266, armature 276 and contact point
 277, springs 280 and 281, springs 223 and
 222, conductor 269 to the springs 270 and
 271, lamp 127 to the battery lead 187, thence
 20 through battery B' to ground G'. The oper-
 ator is thus given the disconnect signal, and
 upon removing the plug p' from the jack F
 the energizing circuit through the releasing
 relays 135 and 136 becomes broken, when
 the springs 272 and 273 disengage. The
 relay 136 being a slow-acting relay (while
 25 the relay 135 is quick-acting) the armatures
 141 and 142 engage the contact points 143
 and 144 before the armatures 137 and 138
 disengage from the contact points 139 and
 140. By this arrangement the trunk-line
 30 conductors 133 and 134 are simultaneously
 grounded, thus bringing about the release
 of the central office switches.

From the foregoing it will be seen how
 a manual subscriber at substation A' may
 35 obtain connection with an automatic sub-
 scriber through the medium of the cord cir-
 cuit O; the substation of the automatic ex-
 change being provided with talking battery
 current through the medium of the common
 40 battery connector, while the manual sub-
 station A' is provided with a local battery
 for talking purposes. The cord circuit O
 provided in this instance is the link between
 the local battery manual substation and the
 45 common battery automatic substation, while
 in the other instance—that is, when the au-
 tomatic substation A called the manual sub-
 station A'—the connector E was the con-
 necting link between the manual local bat-
 50 tery substation and the common battery au-
 tomatic substation.

From the foregoing it will be seen that I
 provide for efficient service between com-
 mon battery automatic subscribers and local
 55 battery manual subscribers, as well as be-
 tween the different lines terminating at the
 manual switchboard, all through the me-
 dium of one and the same cord circuit, such,
 for example, as the one O herein described
 60 and illustrated. As previously explained,
 the operator, by reason of this improved
 cord circuit arrangement, has efficient and
 complete supervision of all connections,
 whether between automatic and manual
 65 lines, or between manual lines. The com-

mon battery automatic subscribers can call
 the local battery manual subscribers without
 the assistance of an operator, and in such
 case the said cord circuit is not necessary;
 but when a local battery manual subscriber 70
 calls a common battery automatic sub-
 scriber, then the said cord circuit is brought
 into use, the operator using the calling de-
 vice for extending connection automatically
 to the called line. 75-

With further respect to the cord circuit O,
 it will be seen that this can be used for con-
 necting one manual line with another when
 the called manual subscriber's line, or a
 multiple thereof, is not found on the same 80
 board, or at the same operator's position
 where the calling subscriber's line termi-
 nates. In this way the said cord circuit can
 be used for automatically trunking between
 manual subscribers' lines terminating at dif- 85
 ferent boards, or terminating at different
 operators' positions, as well as for trunking
 a manual subscriber into connection with the
 line of an automatic subscriber. The man-
 ual lines have multiple connector terminals, 90
 as well as multiple jacks, and hence it is
 possible for the operator to use her calling
 device for automatically extending connec-
 tion to either a manual line or an automatic
 line, as may be desired. As between manual 95
 subscribers whose lines terminate at the same
 board, or which have multiple jacks at the
 same operator's position, the connection will
 be purely manual—that is to say, only the
 cord circuit will be necessary for connecting 100
 together the two lines. Between automatic
 subscribers' lines the trunking may be
 purely automatic, and from an automatic
 line to a manual line the trunking may be
 purely automatic. Thus the trunking may 105
 all be under the control of the operator at
 the cord circuit O, or it may be accom-
 plished partly by the calling subscriber and
 partly by the operator, or it may all be un-
 der the control of the calling subscriber. 110
 As between manual lines having jacks at the
 same operator's position, there is no need
 for trunking, as the said cord circuit is suffi-
 cient for such a connection.

It will be seen that the cord circuit O 115
 is also adapted for use in an exchange where
 some lines terminate at one operator's posi-
 tion which has no multiples at a second
 operator's position. In that case, if a sub-
 scriber whose line terminates in the second 120
 operator's position wants a connection with
 a subscriber whose line terminates in the
 first operator's position, connection can be
 made between the two subscribers by throw-
 ing the key K down and plugging in to 125
 an operator's trunk which terminates in
 the No. 1 operator's position, and having at
 said position on ordinary signal. The oper-
 ator at the first position then comes in on
 the same trunk, cuts off the signal, and 130

plugs out on the desired line, throwing the key K up. With the circuits in this condition the No. 1 operator would get front and back supervision, while the No. 2 operator would receive only a back signal.

It will be seen that the cord circuit O may also be used for completing connections between automatic subscribers and manual subscribers. In this case certain trunk lines will extend from the banks of the connector switches E to equipment upon an operator's board similar to that shown in connection with jack equipment J except, of course, the subscriber's line equipment shown associated with the jack J will be done away with. As shown (in connection with jack J) there will be an ordinary signal associated with each trunk line that terminates upon the operator's board, so that, when a connection is extended through any one of the connector switches E to this equipment, a signal will be operated to notify the operator that an automatic subscriber is calling and desires a connection with a manual subscriber, whose line multiples terminate either directly in her board or at a second operator's board which may be in a second exchange. In the first instance, that is, where the subscriber desires a connection with a subscriber whose line terminates upon the first operator's board, the operator after having inserted the plug p' into the jack to which a call is extended and having operated her listening key and inquired the number the subscriber desired, then plugs into the multiple jack of the called subscriber and operates a key K (associated with the cord circuit) to give her supervision over the called subscriber. She may receive supervision over the calling line in one of two different ways. The first manner is as follows: The calling subscriber upon replacing his receiver upon the switch hook and releasing the automatic switches, will cause the signal upon the operator's board to be operated, thus giving the operator supervision notifying her that the calling subscriber has replaced his receiver. The second method referred to above is as follows: The calling subscriber may operate his ringing key 35 and cause the connector switch to transmit ringing current to the supervisory relay 128 (associated with the cord circuit) and thus give the operator supervision in this manner. If the call is for a subscriber whose line terminates in a second exchange, the first operator will extend the call (after having received it in the manner above mentioned,) to the second operator as hereinbefore explained. It will also be seen that it is possible for the operator after she has received a call in the above mentioned manner to plug into the jack F and extend a call through the me-

dium of the automatic switches to an automatic or a manual subscriber's line.

This application is subordinate to my co-pending applications 278,816 filed September 16, 1905 and 339,833 filed October 20, 1906, and likewise the application of Martin and Campbell, 292,005 filed December 16, 1905, in which applications the feature of establishing connections between automatic and manual subscribers' lines is broadly claimed. The invention in my present application in its broader aspect, is limited to connections between automatic subscribers' lines and local battery subscribers' lines. Certain specific features of my present invention, however, are not so limited, as will be readily understood by having reference to the accompanying claims.

What I claim as my invention is:—

1. In a telephone system, a calling subscriber's line, a local battery manual line for the called subscriber, a manual operator's cord circuit for extending a connection from said called line, and means by which the calling subscriber automatically extends the calling line into connection with said called line.

2. In a telephone system, and in combination with common battery automatic subscribers' lines and local battery manual subscribers' lines, means including automatic switches and an operator's cord circuit for establishing a connection between any two of said lines, said operator's cord circuit provided with repeating coils intermediate the answering and calling plugs thereof, and with front and back supervisory signals, whereby said cord circuit may be used for connecting together two manual lines, or an automatic line and a manual line, as may be desired.

3. In a telephone system, automatic subscribers' lines, local battery manual subscribers' lines, means including automatic switches and an operator's cord circuit for establishing a connection between any two of said lines, said operator's cord circuit adapted for connecting together two manual lines, or an automatic line and a manual line, and front and back supervisory signals for the cord circuit, whereby the operator has complete supervision of the connection between two lines of the same or different character.

4. In a telephone system, a local battery manual subscriber's line, an automatic subscriber's line, a cord circuit for answering a call from the manual line, trunk lines, automatic switches for selecting an idle trunk, and means controlled by the operator at the cord circuit for controlling said switches to find an idle trunk to extend connection to the automatic subscriber's line.

5. In a telephone system, a local battery

manual subscriber's line, a common battery automatic subscriber's line, a cord circuit for answering a call from the manual line, trunk lines, automatic switches for selecting an idle trunk, and means controlled by the operator at the cord circuit for controlling said switches to find an idle trunk to extend connection to the automatic subscriber's line.

6. In a telephone system, common battery automatic subscribers' lines divided into groups, local battery manual subscribers' lines divided into groups, and automatic means by which the common battery automatic line is extended into connection with the local battery manual line, said automatic means having one motion to select a group and a second motion to find the called line in the predetermined group.

7. In a telephone system, calling subscribers' lines divided into groups, local battery manual lines for the called subscribers also divided into groups, a manual operator's cord circuit for extending a connection from said called line, and means by which a calling subscriber automatically extends the calling line into connection with a called line, said means having one motion to select a group and a second motion to find the called line in the predetermined group.

8. In a telephone system, common battery automatic subscribers' lines divided into groups, local battery manual subscribers' lines divided into groups, and means including automatic switches and an operator's cord circuit for connecting together two manual lines or a manual line and an automatic line, as may be desired, said automatic switches controllable from said operator's cord circuit, and having motion first in one plane to select a group and then motion in a plane at right-angles to said other plane to find the called line in the predetermined group.

9. In a telephone system, common battery automatic subscribers' lines divided into groups, local battery manual subscribers' lines divided into groups, and means including automatic switches and an operator's cord circuit provided with supervisory devices for giving the operator complete supervision of a connection between two manual lines, or between a manual line and an automatic line, as may be desired, said automatic switches controllable from said operator's cord circuit, and having motion first in one plane to select a group and then motion in a plane at right-angles to said other plane to find the called line in the predetermined group.

10. In a telephone system, automatic subscribers' lines divided into groups, local battery manual subscribers' lines divided into

groups, and means including automatic switches and an operator's cord circuit provided with supervisory devices for giving the operator complete supervision of a connection between two manual lines, or between a manual line and an automatic line, as may be desired, said automatic switches controllable from said operator's cord circuit, and having motion first in one plane to select a group and then motion in a plane at right-angles to said other plane to find the called line in the predetermined group.

11. In a telephone system, and in combination with common battery automatic subscribers' lines divided into groups and local battery manual subscribers' lines divided into groups, means including automatic switches and an operator's cord circuit provided with repeating coils intermediate the answering and calling plugs thereof, and with front and back supervisory signals, whereby two manual lines, or a manual line and an automatic line may be connected together, as may be desired, said automatic switches controllable from said operator's cord circuit, and having motion first in one plane to select a group and then motion in a plane at right-angles to said other plane to find the called line in the predetermined group.

12. In a telephone system, automatic subscribers' lines divided into groups, local battery manual subscribers' lines divided into groups, and means including automatic switches and an operator's cord circuit for connecting together two manual lines, or a manual line and an automatic line, and front and back supervisory signals for the cord circuit, whereby the operator has complete supervision of the connection between two lines of the same or different character, said automatic switches controllable from said operator's cord circuit, and having motion first in one plane to select a group and then motion in a plane at right-angles to said other plane to find the called line in the predetermined group.

13. In a telephone system provided with calling mechanism for the automatic subscribers' lines thereof, a common battery automatic subscriber's line, a local battery manual subscriber's line, and automatic means by which the common battery automatic line is extended into connection with the local battery manual line, said mechanism operative to transmit calling current for one digit of any called number and then come to rest before manual operation thereof for the next digit.

14. In a telephone system provided with calling mechanism for the automatic subscribers' lines thereof, a calling subscriber's line, a local battery manual line for the called subscriber, a manual operator's cord

circuit for extending a connection from said called line, and means by which the calling subscriber automatically extends the calling line into connection with said called line, said mechanism operative to transmit calling current for one digit of any called number and then come to rest before manual operation thereof for the next digit.

15. In a telephone system provided with calling mechanism for the automatic subscribers' lines thereof, common battery automatic subscribers' lines, local battery manual subscribers' lines, means including an automatic switch responsive to said calling mechanism, and an operator's cord circuit for connecting together two automatic lines or an automatic line and a manual line, as may be desired, said calling mechanism operative to transmit calling current for one digit of any called number and then come to rest before manual operation thereof for the next digit.

16. In a telephone system having relays bridged across the conductors of the talking circuit for controlling automatic trunking switches, a common battery automatic subscriber's line, a local battery manual subscriber's line, and automatic means by which the common battery automatic line is extended into connection with the local battery manual line, said system provided with automatic means for reducing the number of bridges across any automatically established talking circuit.

17. In a telephone system having relays bridged across the conductors of the talking circuit for controlling automatic trunking switches, a calling subscriber's line, a local battery manual line for the called subscriber, a manual operator's cord circuit for extending a connection from said called line, and means by which the calling subscriber automatically extends the calling line into connection with said called line, said system provided with automatic means for reducing the number of bridges across any automatically established talking circuit.

18. In a telephone system, automatic trunking switches, relays bridged across the conductors of the talking circuit for controlling said automatic trunking switches, common battery automatic subscribers' lines, local battery manual subscribers' lines, means including said automatic switches, and an operator's cord circuit for connecting together two manual lines or an automatic line and a manual line, as may be desired, said switches provided with automatic means for reducing the number of bridges across any automatically or semi-automatically established talking circuit.

19. In a telephone system, automatic trunking switches, relays bridged across the

conductors of the talking circuit for controlling said automatic trunking switches, automatic subscribers' lines, local battery manual subscribers' lines, means including said automatic switches, and an operator's cord circuit for connecting together two automatic lines, or an automatic and a manual line, as may be desired, said switches provided with automatic means for reducing the number of bridges across any automatically or semi-automatically established talking circuit.

20. In a telephone system, automatic trunking switches having relays bridged across the conductors of the talking circuit for controlling said switches, a local battery manual subscriber's line, an automatic subscriber's line, a cord circuit for answering a call from the manual line, and means controlled by the operator at the cord circuit for automatically extending connection to the automatic subscriber's line through said switches, said switches provided with automatic means for reducing the number of bridges across any automatically or semi-automatically established talking circuit.

21. In a telephone system, automatic trunking switches having relays bridged across the conductors of the talking circuit for controlling said switches, a local battery manual subscribers' line, a common battery automatic subscriber's line, a cord circuit for answering a call from the manual line, and means controlled by the operator at the cord circuit for automatically extending connection to the automatic subscriber's line through said switches, said switches provided with automatic means for reducing the number of bridges across any automatically or semi-automatically established talking circuit.

22. In an automatic telephone system, the combination of common battery lines; stations thereon; a central source of current; each of said common battery stations having a receiver and transmitter; said transmitters being in series with said central source of current; and local battery lines; local battery stations thereon; each local battery station having a receiver and transmitter, each of said transmitters being in series with a local source of current; automatic means for uniting said common battery lines and said local battery lines for conversational purposes; line signals for said local battery lines; and means for making manual connections to and from said local battery lines.

23. In an automatic telephone system, the combination of common battery lines; stations thereon; a central source of current; each of said common battery stations having a receiver and transmitter; said transmitters being in series with said central

source of current; and local battery lines; local battery stations thereon; each local battery station having a receiver and transmitter, each of said transmitters being in series with a local source of current; automatic means for uniting said common battery lines and said local battery lines for conversational purposes; calling mechanism by which the common battery subscribers control said automatic means to extend connection to the local battery lines; and means by which an operator controls the connection from a local battery line to a common battery line.

24. In an automatic telephone system, the combination of common battery lines; stations thereon; a central source of current; each of said common battery stations having a receiver and transmitter; said transmitters being in series with said central source of current; and local battery manual lines; local battery stations thereon; each local battery station having a receiver and transmitter, each of said transmitters being in series with a local source of current; and manual and automatic means for uniting said common battery lines and said local battery lines for conversational purposes.

25. In a telephone system, a plurality of local battery manual subscribers' lines, a cord circuit for connecting any two of said lines for talking purposes, other subscribers' lines divided into groups, automatic switching apparatus provided with means for electing one of said groups by one operation and for finding the line of a called subscriber by another operation, a calling device for said cord for operating said switches to connect the called line and one of the manual lines via said automatic switches and said cord circuit, and a centralized source of current for supplying current to said other lines for talking purposes.

26. In a telephone system, a plurality of local battery manual subscribers' lines, a cord circuit for connecting any two of said lines for talking purposes, other subscribers' lines divided into groups, automatic switching apparatus provided with means for electing one of said groups by one operation and for finding the line of a called subscriber by another operation, a calling device for said cord for operating said switches to connect the called line and one of the manual lines via said automatic switches and said cord circuit, said cord provided with supervisory devices for giving the operator supervision of connection between the manual subscribers and between the manual and said other subscribers.

27. In a telephone system, a plurality of local battery manual subscribers' lines, a cord circuit for connecting any two of said manual lines, automatic subscribers' lines

having calling devices, automatic switching apparatus associated with said automatic subscribers' lines and operable therefrom through the medium of said calling devices, groups of automatic lines associated with said automatic switches, said automatic switches provided with means for electing one of said groups by one motion and for picking out an automatic line in the group by another motion, means comprising said cord and automatic switches to connect an automatic subscriber's line and a manual line, and a centralized source of current for supplying current to the automatic subscriber's line for talking purposes.

28. In a telephone system, a plurality of local battery manual subscribers' lines, a cord circuit for connecting any two of said lines for talking purposes, other subscribers' lines divided into groups, automatic switching apparatus provided with means for electing one of said groups by one operation and for finding the line of a called subscriber by another operation, a calling device for said cord for operating said switches to connect the called line and one of the manual lines via said automatic switch and said cord circuit, a centralized source of current for supplying current to the automatic lines for talking purposes, said cord provided with supervisory devices for giving the operator supervision of connection between the manual and between the manual and said other subscribers.

29. In a telephone system, a plurality of local battery manual subscribers' lines, a cord circuit for connecting any two of said lines for talking purposes, other subscribers' lines divided into groups, automatic switching apparatus provided with means for electing one of said groups by one operation and for finding the line of a called subscriber by another operation, a calling device for said cord for operating said switches to connect the called line and one of the manual lines via said automatic switch and said cord circuit, said cord provided with a repeating coil between the answering and calling plugs and with front and back supervisory signals.

30. In a telephone system, a plurality of local battery manual subscribers' lines, a cord circuit for connecting any two of said lines for talking purposes, other subscribers' lines divided into groups, automatic switching apparatus provided with means for electing one of said groups by one operation and for finding the line of a called subscriber by another operation, a calling device for said cord for operating said switches to connect the called line and one of the manual lines via said automatic switches and said cord circuit, a centralized source of current for supplying current to the automatic

lines for talking purposes, said cord provided with a repeating coil between the answering and calling plugs and with front and back supervisory signals.

5 31. In a telephone system, common battery subscribers' lines and local battery subscribers' lines, automatic switching apparatus for use in establishing a connection between one of said common battery lines and
10 one of said local battery lines, said automatic switching apparatus including an automatic connector switch provided with means for supplying talking current to the calling subscriber as soon as the said connector switch extends connection to the said
15 local battery line.

32. In a telephone system, common battery subscribers' lines and local battery subscribers' lines, automatic switching apparatus for automatically extending a connection
20 from a calling common battery subscriber's line to a called local battery subscriber's line, said automatic switching apparatus including a connector switch for directly establishing connection to the line terminals of
25 said called local battery subscriber, and means individual to said connector switch for supplying talking current to the said calling line before the said called subscriber answers.
30

33. In a telephone system, common battery automatic lines and local battery manual lines, automatic switching apparatus for connecting one of said common battery lines
35 to one of said local battery lines, said switching apparatus including an automatic connector switch for establishing connection with the multiple contacts of the called subscriber's line, and means in said connector
40 switch for supplying the calling subscriber

with talking current prior to the taking down of the receiver at the called subscriber's substation.

34. In a telephone system, common battery subscribers' lines and local battery subscribers' lines, automatic switching apparatus for automatically extending a connection from a calling common battery subscriber's line to a called local battery subscriber's line, said automatic switching apparatus including a progressively movable
45 connector switch for directly establishing connection to the line terminals of said called local battery subscriber, a coil individual to said connector switch, and means
50 for supplying talking current through said coil to the said calling line before the said called subscriber answers.
55

35. In a telephone system, common battery subscribers' lines and local battery subscribers' lines, automatic switching apparatus for automatically extending a connection from a calling common battery subscriber's line to a called local battery subscriber's line, said automatic switching apparatus including a progressively movable
60 connector switch for directly establishing connection to the line terminals of said called local battery subscriber, a coil individual to said connector switch for controlling the operation thereof, and means for
65 supplying talking current through said coil to the said calling line before the said called subscriber answers.
70

Signed by me at Chicago, Cook county, Illinois, this 19th day of February, 1908.

TALBOT G. MARTIN.

Witnesses:

ARTHUR B. SPERRY,
EDWARD D. FALES.