F. LUBBERGER.

TELEPHONE EXCHANGE SYSTEM.

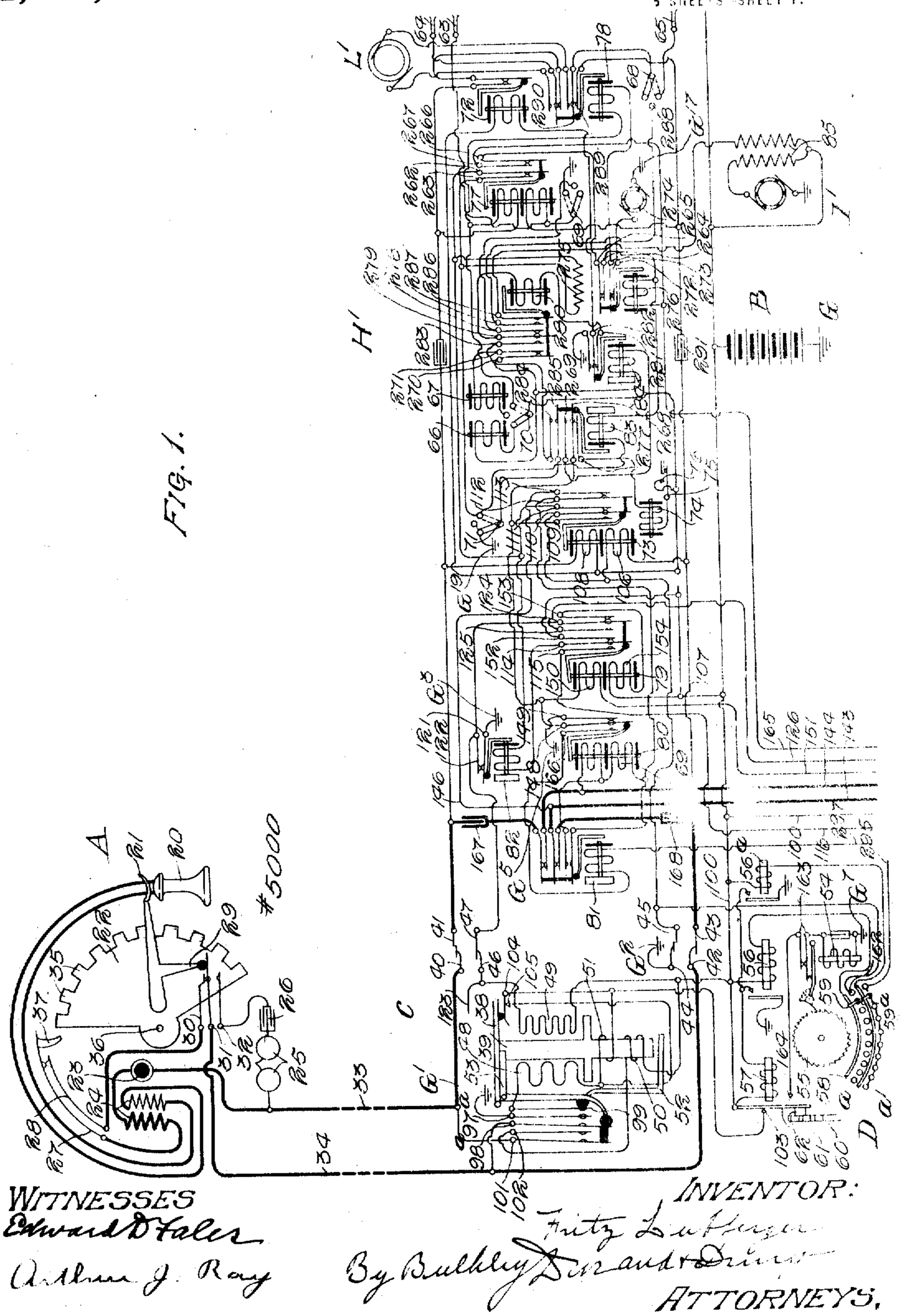
APPLICATION FILED DEC. 10, 1909. RENEWED JULY 18, 1918.

1,295,181.

Patented Feb. 25, 1919.

5 SHEETS-SHEET 1.

FIG. 1.



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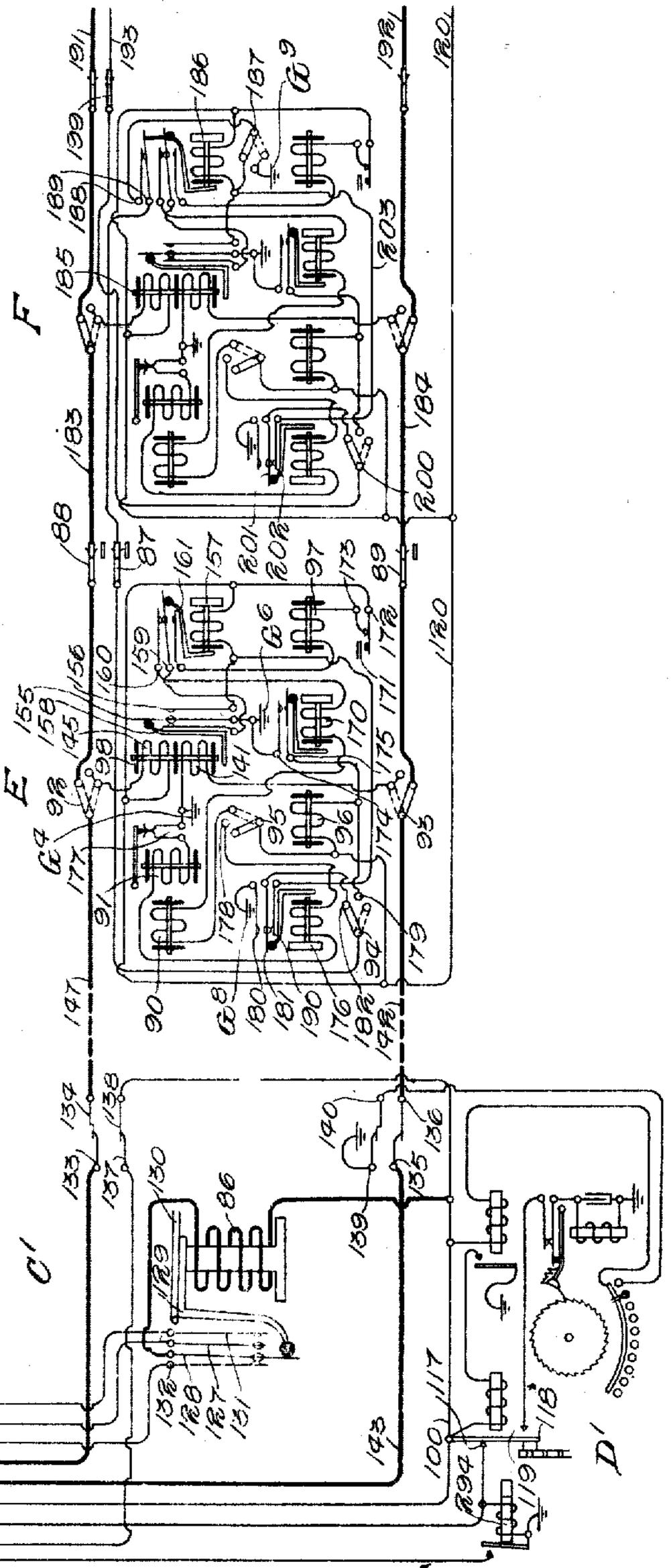

FIG. 2.

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5 SHEETS—SHEET 3.

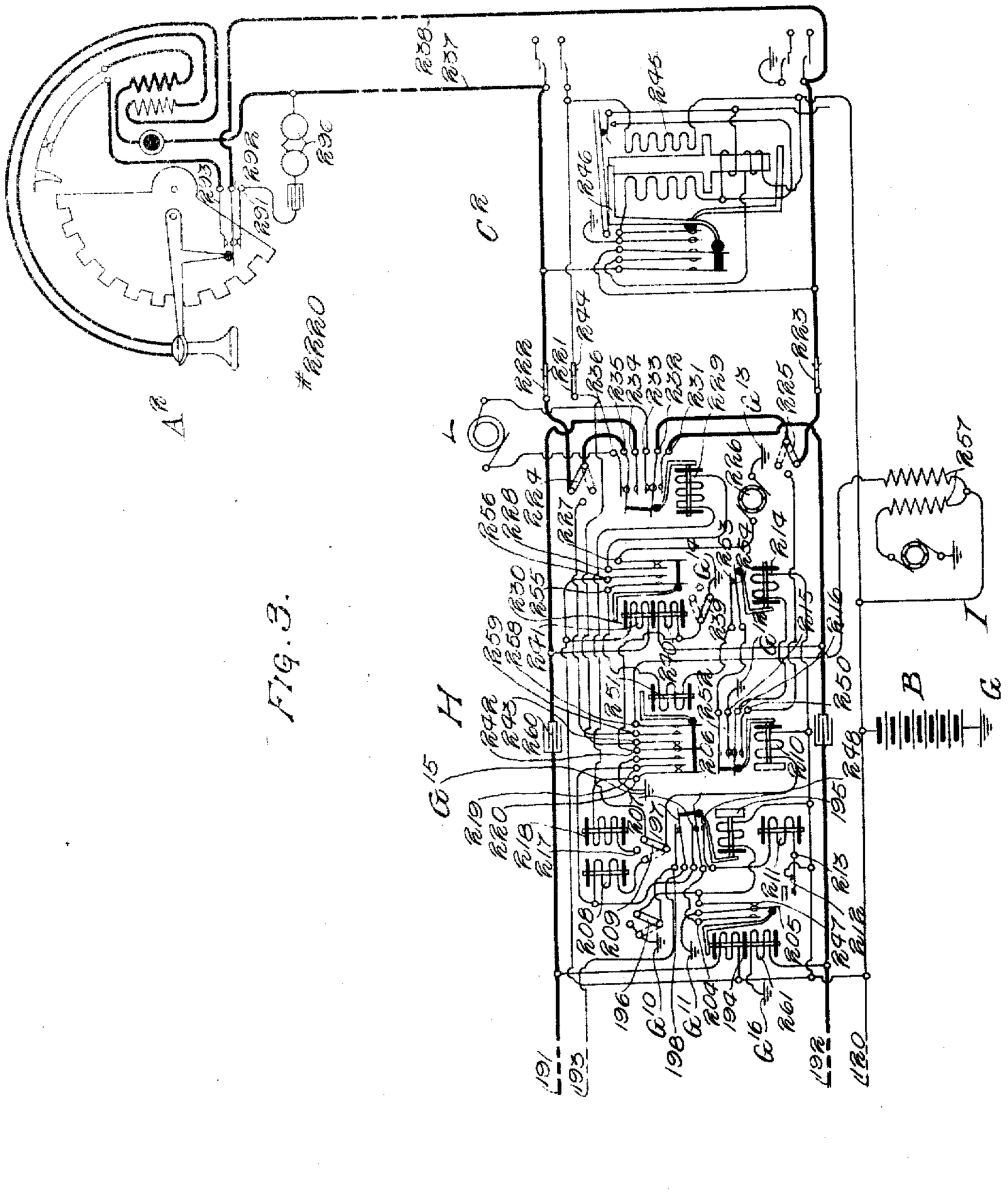

FIG. 3.

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5 SHEETS—SHEET 4.

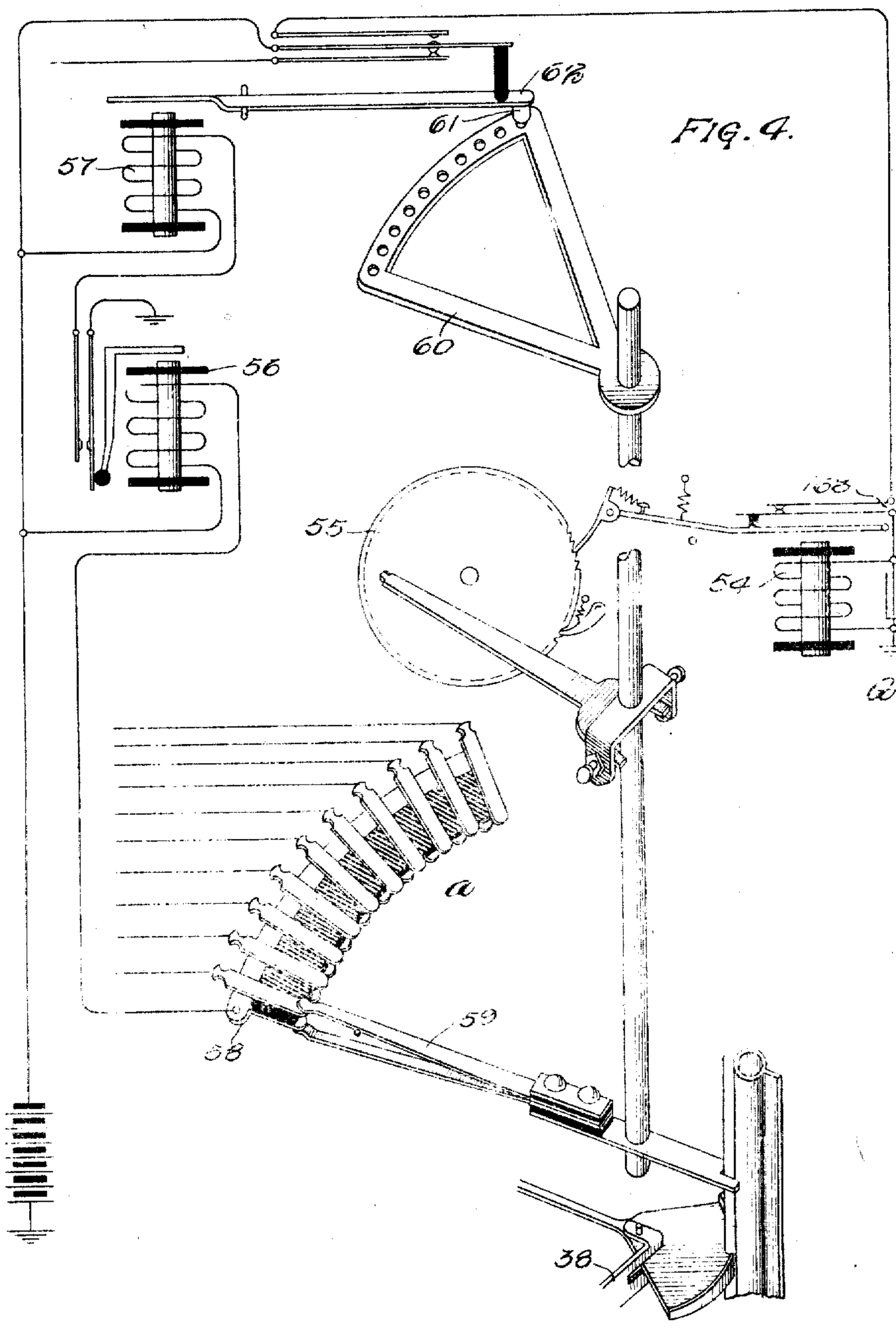

FIG. 4.

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5 SHEETS—SHEET 5.

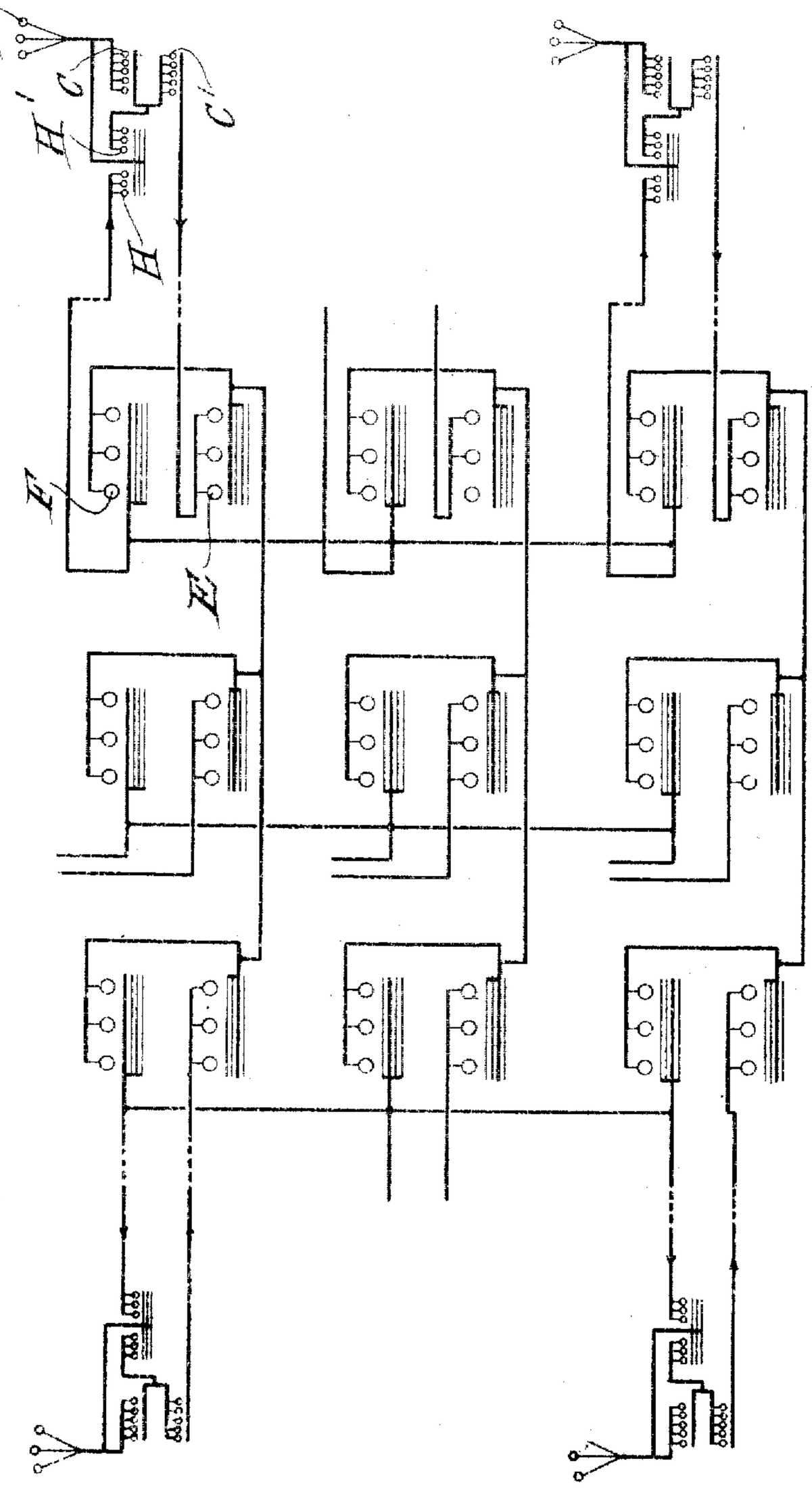

FIG. 5.

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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

1,295,181. Specification of Letters Patent. Patented Feb. 25, 1919.

Application filed December 10, 1909, Serial No. 532,430. Renewed July 18, 1918. Serial No. 245,588.

To all whom it may concern:

Be it known that I, FRITZ LUBBERGER, a subject of the Emperor of Germany, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Telephone-Exchange Systems, of which the following is a specification.

My invention relates to telephone exchange systems in general, so far as the broader purposes of my invention are concerned, but more especially to systems of that kind in which the subscribers' lines terminate at subcentral stations which are connected by trunk lines with the main or central station.

The principal object of my invention is, therefore, the provision of means whereby a subscriber of one subcentral station may call another subscriber of the same station without calling through the main or central station. Thus a subscriber of one subcentral station calls a subscriber of another subcentral station by extending the call through the main or central station; but a subscriber of one subcentral station communicates with another subscriber of the same station without extending the call through the main or central station. Prior to my invention it was usual, in a district system, for all calls to pass through the main or central station, even though the calling and called subscribers were in the same group. Now, however, with my improved arrangement, calling and called subscribers of the same group communicate without the necessity of extending the call through the main or central station. As I say, though, there are certain features of novelty which are not limited to a district system, and which may be used in various systems.

The nature of my invention will hereinafter more fully appear.

In the accompanying drawings Figures 1, 2 and 3 taken together show the complete circuit connections between a calling substation A (Fig. 1) and is called substation A^2 (Fig. 3) in a system embodying the principles of my invention, there being a connector switch H′ by means of which the substation A may obtain connection with the substation of its own exchange.

The apparatus shown in Fig. 1 and the secondary switch C′ and master switch D′ shown in Fig. 2 belong to a branch exchange, while the remaining apparatus shown in Fig. 2 belongs to a distant or main exchange. Fig. 3 shows a portion of the apparatus of a second branch exchange. To the line of substation A there is allotted, at the branch exchange, the individual line switch C. This line switch C, together with a number of other similar switches, is controlled by a common mechanism D, usually called a master switch. Each of the line switches C has access to a number of trunks, each of which leads to a connector switch H′ and also, through condensers, to a so-called secondary line switch C′ (Fig. 2). The secondary switch C′ is similar in its operation to the line switch C and is controlled by a master switch D′. The secondary switch C′ has access to a plurality of trunk lines leading to the main exchange, where each one terminates in a so-called first selector switch E. The first selector E has access to trunk lines leading to second selectors F, from which trunk lines lead to connector switches H (Fig. 3). At I there is shown a busy signaling machine, and at L a ringing current generator is shown. The substation A^2 is provided with a line switch C^2 similar to that of substation A. One or more batteries B are provided, each having one terminal grounded for the purpose of supplying current for operating the switches and for talking purposes. The branch exchange (Fig. 1) is also provided with a ringing current generator L′ and a busy signaling machine I′.

Fig. 4 shows the essential features of the master switch D (Fig. 1).

Fig. 5 is a diagrammatic illustration of the arrangement of the switches in a complete system.

The automatic substations may be of any suitable or approved type. As here shown, the substation A comprises a receiver 20, switch hook 21, impulse wheel 22, transmitter 23, induction coil 24, ringer 25, condenser 26 and impulse springs 27 and 28. The switch hook controls the substation circuits through the medium of the cam arm 29 and springs 30, 31 and 32. When the receiver is on the hook the arm 29 maintains spring 31 in contact with spring 32, thus bridging the ringer 25 and condenser 26 in series across the line conductors 33 and 34. When the receiver is removed the hook is forced upward by a spring (not shown), allowing the spring 31 to disengage spring 32

and come into engagement with spring 30. By this action the circuit of the ringer 25 is opened and a bridge consisting of the transmitter 23, primary winding of induction coil 24 and impulse springs 27 and 28 is closed across the line conductors 33 and 34. The impulse wheel 22 carries upon its periphery the impulse teeth 35 and is secured to a shaft 36, to which there is also secured a dial (not shown) provided with finger holes. When the dial is rotated forward, a certain number of teeth (corresponding to the digit called) are advanced past the cam 37 upon the end of the spring 27, but with no effect upon said spring. When the dial is released it is returned to normal position, together with the impulse wheel, by a spring (not shown). As each tooth passes the cam 37 during this backward motion, the spring 27 is forced out of engagement with the spring 28 to open the bridge across the line.

The line switch C and master switch D are of the general type disclosed in British Patent No. 26,301 of 1906, and in the *Western Electrician* of Chicago, Illinois, of January 25, 1908. As here shown, the line switch C consists essentially of a plunger (not shown) attached to a plunger arm 38, and a magnet 39. When the plunger arm 38 is attracted by the magnet 39 the plunger is forced into a bank of springs, and forces the springs 40, 42, 44 and 46 into contact with the springs 41, 43, 45 and 47, respectively. The magnet 39 is composed of four windings, a pull-in winding 48, a cut-off winding 49, a line winding 50 and an auxiliary winding 51. The magnetic circuit of the windings 48 and 49 is separate from that of the windings 50 and 51. The pull-in winding 48 is for the purpose of attracting the plunger arm 38 to force the plunger into the bank. The circuit of the winding 48 is controlled by the calling subscriber through the medium of the line winding 50 and armature 52. The winding 51 prevents the armature 52 from falling back immediately upon the deënergization of the winding 50. The cut-off winding 49 is provided for the purpose of holding the plunger arm 38 in an operated position and for operating the cut-off armature 53. If the winding 49 is energized while the armature 53 and plunger arm 38 are in an operated position, both the armature and plunger arm will be held in this position after the winding 48 is deënergized, but if the winding 49 is energized while the armature 53 and plunger arm 38 are in normal position, only the armature 53 will be operated, as the winding 49 is not as strong as winding 48. Although only one set of springs 40, 41, 42, 43, 44, 45, 46 and 47 is shown, each line switch C is provided with a bank comprising a number of such sets of springs, each set forming the terminal of a trunk line leading to a secondary switch C'. Each trunk is multipled through the corresponding bank contacts of a group of switches C'. The plungers normally rest in locking engagement with a plunger shaft (not shown), and through the medium thereof are always held opposite an idle trunk terminal by the master switch D.

The master switch D consists essentially of a motor magnet 54 which operates the ratchet wheel 55, circuit controlling relays 56, 56ª and 57, and two banks of contacts a and a' each comprising a number of individual contacts (one for each trunk) and a common segment. The wipers 59 and 59ª are adapted to always keep some one of the individual contacts of each bank in electrical connection with the common segments. By a suitable mechanical connection the rotary motion of the ratchet wheel 55 is transmitted to the plunger shaft to give said shaft a reciprocating motion to move the idle plungers back and forth in front of the bank terminals. To the plunger shaft there is also secured a cam 60 having on its surface a number of circular openings which are adapted to be engaged by the pin 61 upon the end of the armature 62. The openings in the cam 60 are so spaced that the pin 61 can engage an opening only when the plungers that are in engagement with the plunger shaft are in a position directly in front of a bank terminal.

The connector switch H' is of the general type disclosed in the United States Letters Patent No. 815,176, granted March 13, 1916, to Keith, Erickson and Erickson, but, as here shown, is modified to operate in conjunction with a two-wire system—that is, a system in which no ground connection is required at the sub-station for controlling the automatic switches. Among other details the connector comprises a set of wipers 63, 64 and 65 secured to a shaft (not shown) which has a vertical motion controlled by the vertical magnet 66 and a rotary motion controlled by the rotary magnet 67. The usual side switch, comprising the wipers 68, 69, 70 and 71, is controlled by the private magnet 72 in a well known manner. The operation of the switch is controlled by the calling subscriber through the medium of the double-wound line relay 73. Means for releasing the connector are provided in the release magnet 74, which is connected to battery through springs 75 and 76 only when the switch shaft is out of its normal position. A back-bridge relay 77 is provided, through which the called substation is provided with talking current. The ringer relay 78 provides means for connecting the generator L' with the called line. In addition to the usual equipment the connector H' is provided with relays 79, 80, 81 and 82 to enable it to operate in conjunction

with my improved trunking system. The relays 81, 82, 83 and 84 are slow-acting relays *i. e.*, relays that are slow to deënergize after their energizing circuits have been broken.

The busy signaling machine I′ comprises an interrupter which interrupts the current through the primary winding of an induction coil 85, thus producing an alternating current in the secondary winding.

The secondary switch C′ is of the same general type as the line switch C, its magnet 86 having only one winding, however, which serves both as an operating and holding coil.

The selectors E and F are of the general type shown and disclosed in United States Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson, but, like the connector H′, are adapted to operate in a two-wire system. Like the connector, the selector E comprises a set of wipers 87, 88 and 89 having a vertical motion controlled by a vertical magnet 90 and a rotary motion controlled by the rotary magnet 91. The usual side switch, comprising the wipers 92, 93, 94 and 95, is controlled by the private magnet 96. The release magnet 97 and line relay 98 are like those of the connector H′. The selectors E and F are provided with the so-called connector release—that is, the mechanism of the switches is released immediately upon the energization of the release magnet rather than upon its deënergization, as shown in the said selector patents.

The connector H is similar to the connector H′, with the exception of the relays 79, 80, 81 and 82, and with other slight modifications of its circuits, as will appear from the description of its mode of operation.

The operation of the apparatus employed in establishing connection between two substations is as follows: It will be explained, first, how the subscriber at substation A may operate the central office switching apparatus to establish connection with the subscriber at substation A^2, the number of which will be assumed to be 2220. In order to call substation #2220, the subscriber at substation A removes the receiver from the switch hook, then inserts a finger in the #2 finger hole of the dial, rotates it until the finger strikes a stop and then permits the dial to return to normal position. The operation of the dial is then repeated for each of the remaining digits. When the receiver is removed from the hook the spring 31 is allowed to disengage spring 32 and to engage spring 30, thereby closing a bridge, consisting of the transmitter 23, primary winding of the induction coil 24 and impulse springs 27 and 28, across the line conductors 33 and 34. When this bridge is closed across the line it furnishes an energizing circuit for the line winding 50 of the line switch C. This circuit extends from ground G′ through springs 97^a and 98^a, line 34, springs 31 and 30, impulse springs 28 and 27, primary winding of induction coil 24, transmitter 23, line 33, springs 101 and 102 and winding 50 to battery lead 100. The winding 50, upon energizing, attracts the armature 52, which forces spring 99 into engagement with spring 97^a, thereby closing a circuit extending from ground G′ through springs 97^a and 99, windings 48 and 51, contact point 103 and armature 62 to battery lead 100. The winding 48, upon energizing, attracts the cut-off armature 53 and the plunger arm 38. The armature 53 operates to separate springs 101 and 98^a from the springs 97^a and 102, thereby opening the energizing circuit of the winding 50. The armature 52 does not fall back immediately upon the deënergization of the winding 50, but remains up for an instant by the current flowing through the winding 51 in series with the winding 48. When the plunger arm 38 is attracted it thrusts the plunger into the bank and forces the spring 104 into contact with the contact point 105, thus short-circuiting the winding 51 and causing it to deënergize slowly, thereby allowing the armature 52 to fall back. The falling back of the armature 52 opens the energizing circuit of the winding 48, but not, however, before the winding 49 has been energized, as will be explained, to hold the armature 53 and the plunger arm 38 in their operated positions. At the instant the plunger of the line switch presses the bank springs 40, 42, 44 and 46 into engagement with the springs 41, 43, 45 and 47 an energizing circuit is closed through the connector line relay 73. This circuit extends from ground G^2 through the springs 44 and 45, winding 106 of the relay 73, conductor 107, springs 43 and 42, line 34, thence through the substation and over line 33, springs 40 and 41 and winding 108 of the relay 73 to battery lead 100, thence through battery B to ground G. The relay 73, upon energizing, shifts the spring 110 out of engagement with the spring 109 and into engagement with the spring 111, and forces spring 112 into engagement with spring 113. The engagement of springs 110 and 111 closes an energizing circuit through the relay 82. This circuit extends from ground G^2 through bank springs 44 and 45, springs 110 and 111 of the relay 73, relay 82, springs 114 and 115, conductor 116, contact point 117 and armature 118 to battery lead 100. The relay 82, upon energizing, forces spring 121 into engagement with spring 122, thereby providing a guarding ground over the private normal conductor 123 to the connector private bank contacts of the calling line, and closing an energizing circuit through the

winding 49 to maintain the line switch C in an operated position. The engagement of springs 121 and 122 of the relay 82 also closes an energizing circuit through the magnet 86 of the secondary switch C'. This circuit extends from ground G^3 through springs 121 and 122, 124 and 125, conductor 126, springs 127 and 128 and magnet 86 to battery lead 100. The magnet 86, upon energizing, attracts the armature 129 and plunger arm 130. The armature 129 operates to separate springs 128, 127 and 131 and force spring 128 into engagement with spring 132. The plunger arm 130, upon being attracted, forces its plunger into the bank, forcing springs 133, 135, 137 and 139 into contact with springs 134, 136, 138 and 140, respectively. When the springs 133 and 135 engage the springs 134 and 136, respectively, the line connection is extended to the first selector E, thereby closing a circuit extending from ground G^4 at the selector through the winding 141 of relay 98, side switch wiper 93, trunk conductor 142, bank springs 136 and 135, conductors 143 and 146, springs 113 and 112 of relay 73, both windings of relay 80 in series, conductor 144, bank springs 133 and 134, trunk conductor 147, side switch wiper 92 and winding 145 of the relay 98 to the battery lead 120. Both relays 98 and 80 are energized over this circuit. The relay 80, upon energizing, forces the spring 148 into contact with the spring 149, thereby closing a holding circuit through the magnet 86 of the secondary switch C'. This circuit extends from ground G^5 through the springs 149 and 148, winding 150 of the relay 79, conductor 151, springs 132 and 128 and magnet 86 to the battery lead 100. The current flowing over the circuit just traced maintains the line switch C' in its operated position and also energizes the relay 79. The relay 79, upon energizing, operates to shift the spring 114 out of engagement with the spring 115 and into engagement with the spring 152, and to shift the spring 124 out of engagement with the spring 125 and into engagement with the spring 153. The engagement of the springs 114 and 152 provides a new battery connection for the relay 82, to prevent the deënergization of the said relay when the armature 118 disengages contact point 117 upon the operation of the master switch D'. The shifting of the spring 124 disconnects the ground G^3 from the conductor leading to the secondary switch C' and closes a circuit through the winding 154 of the relay 79. When the relay 98 of the selector E is energized, as previously explained, it operates to close a circuit extending from ground G^6 through the springs 155 and 156 and relay 157 to the battery lead 120. The relay 157, upon energizing and by shifting spring 159 out of engagement with the spring 161 and into engagement with the spring 160, shifts the connection of the impulse spring 158 from the release magnet 97 to the vertical magnet 90, thereby placing the selector E in position to receive the impulses for the first digit of the desired number.

At the instant the bank springs 44 and 45 are forced into contact by the plunger of the line switch C a circuit is closed through the relay 56 of the master switch D. This circuit extends from ground G^2 through the springs 44 and 45, master switch bank contact 162, wiper 59, segment 58 and relay 56 to the battery lead 100. The relay 56, upon energizing, closes an energizing circuit through the locking relay 57. The relay 57, upon energizing, attracts its armature 62, which withdraws the pin 61 from the cam 60, unlocking the plunger shaft, and closes a circuit through the operating magnet 54. This circuit extends from ground G^7 through the magnet 54, interrupter springs 163, contact point 164 and armature 62 to the battery lead 100. Since this circuit includes the interrupter springs 163, the motor magnet 54 will continue to operate in a manner similar to that of a buzzer as long as the armature 62 remains in contact with the point 164. This continued operation of the magnet 54 gives to the ratchet wheel 55 and the plunger shaft a continuous motion to move the idle plungers toward the next trunk. After the plunger shaft has moved a short distance the wiper 59 passes off the contact 162 and allows the relays 56 and 57 to deënergize; but since the cam 60 has also been moved the armature 62 cannot drop back until the next opening passes under the pin 61. As soon as this next opening reaches a position directly under the pin 61, the said pin drops into this opening, thus locking the plunger shaft against further rotation, and allows the armature 62 to disengage the point 164 so as to open the operating circuit of the magnet 54. If the next trunk after the one occupied by the switch C had been busy, there would have been a guarding ground potential upon the next contact engaged by the wiper 59 after leaving the contact 162; consequently, the relays 56 and 57 would have remained energized while the next opening was passing the pin 61, thus causing the plungers to be carried past the busy trunk to an idle one. It will be seen that as long as the master switch D is operating, the armature 62 is disengaged from the contact point 103, thus disconnecting the battery from the winding 48 of all the line switches C to prevent the operation of any switch while its plunger is in motion. When the bank springs 139 and 140 are pressed into contact by the plunger of the secondary switch C', the master switch D' operates in the same manner as the master switch D to advance the idle plungers to

an idle trunk. While the master switch D' is operating, the separation of the armature 118 from the contact point 117 disconnects the battery from the relays 82 of all the connectors H' to prevent the secondary switches C' from being operated while their plungers are in motion. The disengagement of the armature 117 from the contact point 118 while the master switch D' is operating also opens the circuit of the relay 294. The relay 294 is a slow-acting relay and does not have time to deënergize if the master switch D' simply has to pass from one trunk to the next. If, however, the master switch has to pass over a number of busy trunks the circuit of the relay 294 is opened for a longer time and the relay deënergizes. When the relay 294 deënergizes it grounds the conductor 295 leading to the individual segments of the auxiliary master switch bank a' of the master switch D. If all the trunks from the line switch C lead to the group of secondary switches controlled by the master switch D', all the individual contacts of the bank a' will be connected with the conductor 295. The common segment of the bank a' is connected with a relay 56^a which is similar to the relay 56; and, consequently, when the conductor 295 is grounded the relay 56^a is energized and causes the master switch D to operate in the same manner as when the contacts of the bank a are grounded. Of course, as has been explained, while the master switch D is operating no line switch C can be operated. If the trunks from the primary switches C are distributed among a number of groups of secondary switches C', each provided with a separate master switch, the conductor 295 will be connected with the contacts corresponding only to the trunks which lead to the group of secondary switches controlled by the master switch D'. In this case the grounding of the conductor 295 will prevent the master switch D from stopping on any of the trunks leading to switches controlled by the master switch D', but will not prevent it from stopping on any other trunk.

The foregoing is the condition of the central office switching apparatus immediately after the removal of the receiver at the calling substation and before the calling device is operated for the first digit. As the impulse wheel 22 returns to normal position after being rotated for the first digit (2) it forces the spring 27 out of engagement with the spring 28 twice, thus twice opening the energizing circuit of the connector line relay 73. It will be seen that the release relay 83 of the connector H' is normally connected to battery through the conductor 165 and magnet 86 of the secondary switch C'; but when the switch C' is operated this connection is broken, thus preventing the relay 83 from energizing. Since the relay 83 is not energized, the operation of the relay 73 does not cause the connector to be operated. It will be remembered that the energizing circuit of the relay 80 and of the line relay 98 of the selector E passes through the springs 112 and 113 of the connector line relay 73. Now, each time the relay 73 deënergizes in response to the impulses from the substation, the separation of the springs 112 and 113 breaks the energizing circuit of the relays 80 and 98. The relay 80, upon deenergizing, permits the spring 148 to disengage the spring 149 and to engage the spring 166. The disengagement of the springs 148 and 149 disconnects ground G^5 from the winding 150 of the relay 79 and magnet 86 of the switch C', but at the same time a new circuit is closed through the magnet 86 by the relay 73. The holding circuit of the magnet 86, during the time the relay 80 is deënergized, extends from ground G^2 through the bank springs 44 and 45, springs 110 and 109 of the relay 73, thence through the winding 150 of the relay 79 and magnet 86 to the battery, as previously traced. The simultaneous deënergization of the relays 73 and 80 also closes a circuit extending from ground G^2 to and through the springs 110 and 109, as just traced, thence through the springs 148 and 166 of the relay 80, relay 81, conductor 297 and bank springs 137 and 138 of the switch C' to the battery lead 100. The relay 81, upon energizing, disconnects the conductors 144 and 143 from the condensers 167 and 168 and short-circuits the winding 169 of the relay 80 to decrease the resistance of the bridge across the conductors 143 and 144 while the impulses are being repeated to the relay 98 of the selector E. The relay 81, being a slow-acting relay, is energized by the first impulse for each digit, and remains in its energized position until after all the impulses for that digit have been transmitted. After all of the impulses for each digit have been transmitted the relay 81 deënergizes and connects the talking conductors 144 and 143 through the condensers 167 and 168 to the calling line, and also removes the short-circuit of the winding 169 to increase the resistance of the bridge sufficiently to prevent the talking currents from passing from one side of the line to the other. Each time the relay 73 deenergizes it also opens the circuit of the relay 82, but the relay 82, being slow-acting, does not have time to deënergize during this momentary interruption of its circuit.

Each time the relay 98 of the selector E deënergizes, the spring 155 disengages the spring 156 and engages the spring 158. The relay 157, being a slow-acting relay, does not have time to deënergize during the time the springs 155 and 156 are disengaged, and, consequently, the engagement of the springs 158 and 155 closes an energizing circuit

through the vertical magnet 90. This circuit extends from ground G^5 through the springs 155 and 158, 159 and 160, relay 170, magnet 90 and side switch wiper 95 to the battery lead 120. Since the digit called is 2, the vertical magnet 90 receives the impulses over the circuit just traced and operates to raise the shaft and wipers 87, 88 and 89 two steps to a position opposite the second row or level of bank contacts. As soon as the shaft leaves its lowest position the arm 171 permits the spring 172 to engage the spring 173 so as to connect the release magnet 97 with the battery B. The relay 170, which is included in the energizing circuit of the vertical magnet, is energized by the first impulse and operates to close a circuit extending from ground G^6 through the springs 174 and 175 and the private magnet 96 to the battery lead 120. Since the relay 170 is a slow-acting relay its circuit is not opened long enough to permit it to deënergize until after the last impulse is transmitted to the vertical magnet. When the relay 170 deënergizes it opens the circuit of the private magnet 96, which is in turn deënergized and allows the side switch to pass to second position. The movement of the side switch wiper 95 from first to second position shifts the battery connection from the vertical magnet 90 to the rotary magnet 91 through the relay 176. The rotary magnet 91 is thereupon energized over a circuit extending from ground G^4 through the interrupter springs 177, magnet 91, relay 176, contact point 178 and side switch wiper 95 to the battery lead 120. The magnet 91, upon energizing, operates to press down the armature of the private magnet, rotate the wipers one step and to open its own circuit. When the circuit of the rotary magnet is thus opened the rotary armature falls back, and if the first trunk engaged by the wipers is not already busy the private magnet armature falls back also and permits the side switch to pass from second to third position. If, however, the first trunk engaged by the selector wipers is already busy on account of having been seized by some other switch, the private wiper 87 finds the first private bank contact grounded. When the private wiper 87 thus engages a grounded contact it closes a circuit extending through the side switch wiper 94, contact 179 and private magnet 96 to the battery lead 120. The private magnet becomes energized by the closure of this circuit, and locks the side switch in second position to maintain the battery connection of the rotary magnet. The magnet 91 will continue to rotate the wipers step by step until the private wiper finds the non-grounded contact of an idle trunk, when the private magnet 96 deënergizes and allows the side switch to pass into third position. The relay 176, which is energized in series with the rotary magnet 91, is a slow-acting relay and remains energized for a short time after the wipers are rotated the last step. Consequently, at the instant the side switch passes to third position a guarding ground potential is established at the selector private bank contacts of the seized trunk. This guarding ground potential extends from ground G^8 through the springs 180 and 181, contact point 182, side switch wiper 94 and private wiper 87 to the contact upon which it is resting, and thence to the corresponding contact in the bank of each of the selectors which have access to the trunk conductors 183 and 184. The movement of the side switch wipers 92 and 93 from second to third position disconnects the relay 98 from the line and extends the connection over the conductors 183 and 184 to the second selector F. When the connection is thus extended to the second selector the line relay 185 is energized in the same manner as was the relay 98 when the connection was extended to the first selector E. The relay 185 operates in a manner similar to the relay 98 to close the circuit of the release relay 186. The relay 186, upon energizing, furnishes a new guarding potential for the seized trunk, and as soon as the relay 176 of the first selector deënergizes, a holding circuit is closed through the release relay 157. This circuit extends from ground G^9 through the side switch wiper 187 and springs 188 and 189 of the relay 186, private bank contact and wiper 87, side switch wiper 94, contact point 182, springs 181 and 190 and relay 157 to the battery lead 120. This circuit through the relay 157 is closed before it has time to deënergize after its former circuit is opened by the deënergization of the relay 98 when the side switch passes to third position. It is thus evident that the relay 176 must be quicker than the relay 157, the only function of the relay 176 being to furnish a guarding potential to the private bank contacts during the time elapsing after the side switch passes to third position, and before the relay 186 of the second selector energizes.

When the substation calling device is operated for the second digit the line relay 185 responds to the impulses in the same manner as did the relay 98 of the selector E, to cause the second selector F to extend the connection to an idle connector H over the conductors 191 and 192. When the connection is thus extended to the connector the line relay 194 and release relay 195 are energized in the same manner as the line and release relays of the selectors. The energization of the release relay 195 provides a guarding potential for the trunk leading to the connector, and also closes a holding circuit through the release relays 157 and 186 of the selectors E and F. This circuit

extends from ground G[10] through the side switch wiper 196, springs 198 and 197, conductor 193, private wiper 199, side switch wiper 200, springs 201 and 202 to the conductor 203. From the conductor 203 one branch of the circuit extends through the relay 186 to battery, while another branch passes through the side switch wiper 187 (which is now in third position) to and through the first selector release relay 157 over a circuit already traced.

The connector H is now in position to receive the impulses for the last two digits of the desired number. When the substation calling device is operated for the third digit (2) the relay 73 of the connector H′ operates (in the manner previously explained) to repeat the impulses to the relay 194 of the connector H. Each time the relay 194 deënergizes it closes a circuit extending from ground G[11] through the springs 205 and 204, 206 and 207 (the relay 195 remaining energized during the time the relay 194 is operating), vertical magnet 208, side switch wiper 209 and relay 210 to the battery lead 120. Since the digit called is 2, the vertical magnet 208 receives two impulses over the circuit just traced and operates to raise the shaft and wipers two steps. As soon as the shaft leaves its lowest position the release magnet 211 is connected to battery through the off-normal springs 212 and 213. The relay 210, which is included in the energizing circuit of the vertical magnet, is energized by the first impulse; but being a slow-acting relay it does not have time to deënergize until after the last impulse is transmitted. The relay 210, upon energizing, operates to close an energizing circuit through the private magnet 214. This circuit extends from ground G[12] through the springs 215 and 216 and private magnet 214 to the battery lead 120. When the relay 210 deënergizes after the last impulse is transmitted to the vertical magnet it breaks the energizing circuit of the private magnet, which in turn deënergizes and trips the side switch to second position. When the side switch wiper 209 engages its second-position contact point 217 it connects the rotary magnet 218 with the battery through the relay 210 in order that the rotary magnet may be operated by the impulses for the last digit (0). Each time the relay 194 deënergizes in response to the impulses for the last digit, a circuit is closed through the rotary magnet 218. This circuit extends from ground G[11] through the springs 205 and 204, 206 and 207, 219 and 220, magnet 218, contact point 217, side switch wiper 209 and relay 210 to the battery lead 120. Since the digit called is 0, the rotary magnet receives ten impulses and operates to rotate the wipers 221, 222 and 223 ten steps onto the terminals of the line #2220. Since the relay 210 is also included in circuit with the rotary magnet 218 it operates in the same manner for the last series of impulses as for the previous one, to cause the private magnet 214 to trip the side switch from second to third position after the wipers have reached the contacts of the called line. When the side switch wipers 224 and 225 reach their third-position contact points the connection from the calling line is extended through the shaft wipers 222 and 223 to the called line. When the side switch wiper 209 engages its third-position contact point a circuit is closed extending from ground G[13] through the interrupter 226, springs 227 and 228 of the back-bridge relay 230, ringer relay 229, side switch wiper 209 and relay 210 to the battery lead 120. Since this circuit includes the interrupter 226, the ringer relay 229 will be energized intermittently until the called subscriber answers or until the connector is released. The relay 229, upon energizing, shifts the springs 232 and 235 out of engagement with the springs 231 and 234 and into contact with the springs 233 and 236, respectively, whereby the calling and called lines are disconnected and the generator L is bridged across the called line.

When the called subscriber removes his receiver in response to the signal the spring 292 is shifted out of engagement with the spring 291 and into contact with the spring 293, thereby opening the circuit of the ringer 296 and bridging the primary talking circuit of the substation across the line conductors 237 and 238. When the primary circuit is thus bridged across the line, or as soon thereafter as the ringer relay 229 deënergizes, if it happens to be energized at the time, the called substation is provided with talking current over a circuit extending from ground G[14] through the side switch wiper 239, winding 240 of the relay 230, ringer relay springs 231 and 232, side switch wiper 225, shaft wiper 223, line 238, primary winding of the induction coil and transmitter of substation A[2], line 237, shaft wiper 222, side switch wiper 224, ringer relay springs 235 and 234 and winding 241 of the relay 230 to the battery lead 120. The relay 230 is energized upon the completion of this circuit and, by forcing the spring 227 out of engagement with the spring 228, prevents further energization of the relay 229 after the called subscriber has answered and the two subscribers may carry on an uninterrupted conversation over the heavy conductors shown in the drawings. As soon as the connection is completed with the called line that line is protected from seizure by other connectors by a guarding potential extending from ground G[14] through the side switch wiper 239, relay springs 242 and 243 and private wiper 221 to the private bank contact 244, and thence to the corresponding

contact in the bank of each of the connectors which have access to the line #2220. A circuit also extends from the ground G^{14} through the private wiper 221 and contact 244 and through the cut-off winding 245 of the line switch C^2 to the battery lead 120. The winding 145, upon energizing, attracts the armature 246, which disconnects the line switch C^2 from the line of substation A^2 to prevent the operation of the said switch when the receiver is removed.

After the conversation is completed the release of the central office switching apparatus is initiated by the restoration of the receiver to the switch hook at the calling substation. When the receiver is replaced on the hook the springs 30 and 31 are separated, thus opening the circuit of the relay 73 of the connector H'. The relay 73, upon deënergizing, opens the circuit of the relay 82 and also opens the bridge across the conductors 143 and 144 through the relay 80. The relay 82 remains energized for a short time after its circuit is opened; but when the bridge is removed from the conductors 143 and 144 the relay 80 and the line relay 194 of the connector H immediately deënergize. The relay 80, upon deënergizing, closes the circuit of the relay 81, which energizes, but without function at this time. The deënergization of the relay 194 of the connector H serves to open the circuits of the release relays 195, 186 and 157 of the connector H and selectors F and E, respectively. These release relays all deënergize after a short interval and close the energizing circuits of the release magnets of their respective switches. The energizing circuit of the release magnet 211 of the connector H extends from ground G^{13} through the springs 205 and 204, 206 and 248, release magnet 211 and springs 212 and 213 to the battery lead 120. The release circuit of the first selector E, which is similar to that of the second selector F, extends from ground G^9 through the springs 155 and 158, 159 and 161, release magnet 97 and springs 173 and 172 to the battery lead 120. The various release magnets, upon energizing, release the mechanism of their respective switches, allowing them to return to normal position. When the shaft of each switch reaches its lowest position it opens its off-normal springs to allow the release magnet to deënergize. When the connector H is released it removes the guarding potential from the private bank contacts of the called line and allows the cut-off winding 245 of the switch C^2 to deënergize to restore the switch C^2 to its line.

The deënergization of the relay 82 (the circuit of which was opened by the deënergization of the relay 73) disconnects the holding ground from the winding 49 of the line switch C and from the winding 151 of the relay 79. The deënergization of the winding 49 of the switch C allows the armature 53 and plunger arm 38 to return to normal position. When the plunger arm 38 restores, the line is disconnected from the connector H', and the separation of the bank springs 44 and 45 breaks the holding circuit through the winding 150 of the relay 79 and the magnet 86 of the secondary switch C'. The magnet 86, upon deënergizing, permits its plunger and cut-off armature 129 to be restored to normal position, thus leaving all the apparatus employed in the connection in its normal position.

Returning now to that stage of the operation when the wipers of the connector H have been placed in contact with the terminals of the called line, and before the private magnet relay 210 has fallen back, it will be explained how the calling subscriber receives the busy signal when the called line is busy. It has been seen that whenever a line is busy there is a guarding ground potential at the connector private bank contacts of the line. Thus, when the relay 210 falls back, with the wiper 221 resting upon a grounded contact of a busy line, a circuit is closed extending from the grounded contact through the wiper 221, springs 243 and 242, winding 240 of the relay 230, ringer relay springs 231 and 232, side switch wiper 225 (which is now in second position), springs 250 and 216 of the relay 210 and private magnet 214 to the battery lead 120. The relay 230 is energized upon completion of this circuit and the private magnet remains in its operated position, thus locking the side switch in second position to prevent the completion of connection with the busy line. The energization of the relay 230 causes the relay 251 to be energized over a circuit extending from ground G^{12} through the springs 215 and 252, 254 and 253, relay 251 and springs 255 and 256 to the battery lead 120. The relay 251, upon energizing, disconnects the rotary magnet 218 from the impulse spring 204, shifts the holding ground of the relay 230 and private magnet 214 from the private bank contact to ground G^{15}, and connects the busy signaling machine I with the calling line. The circuit over which the calling substation receives the busy signal extends from the battery lead 120 through the secondary winding of the induction coil 257, through the springs 258 and 259 of the relay 251, side switch wiper 224, ringer relay springs 235 and 234, condenser 260, thence over the heavy conductors shown in Figs. 1 and 2 to and through the substation A and back to the connector H, through the winding 261 of the relay 194 to ground G^{16}, thence through battery B to the starting point. The calling substation will continue to re-

ceive the busy signal until the receiver is hung up, when the switches will be released, as previously explained.

The foregoing is a description of how the subscriber at substation A may call a subscriber at a distant exchange. It will now be explained how connection may be obtained with another subscriber at his own exchange. When a subscriber at the branch exchange desires to call another substation of the same exchange he does not call the regular number, but simply prefixes a certain digit (in this instance 1) to the last two digits of any number in his exchange. For instance, if subscriber #5000 wishes to call subscriber #5040 he operates his calling device for the number 140; if he wishes to call #5020 he calls #120, etc. Some certain level of the banks of the first selector switches of the main exchange has no trunks connected to it. In this case it is assumed that the first level is the one which has no trunks, but any level may be used for this purpose, it being understood that the number which the branch exchange subscriber prefixes to the last two digits of his number must correspond to the "dead" level of the selectors. When the subscriber at substation A removes his receiver to call #120 the switches C and C′ operate in the same manner as previously explained to extend the connection to the first selector E. When the calling device is operated for the first digit (1) the selector E operates in the regular manner to raise its wipers one step to a position opposite the first level of bank contacts, after which they are automatically rotated onto the first contacts of this level. Since no trunk lines are connected to this first level, no circuit is maintained through the relay 80 of the connector H′ after the side switch of the selector E leaves the second position, and consequently the relay 80 deënergizes. Of course, the line relay 73 of the connector H′ returns to its operated position immediately after the impulse is delivered for the first digit; consequently, the deënergization of the relay 80 breaks the holding circuit of the magnet 86 of the secondary switch C′. The secondary switch is immediately released by the deënergization of the magnet 86. The separation of the bank springs 137 and 138 by the withdrawal of the plunger disconnects the battery from the relay 81 to prevent the operation of the said relay during the subsequent operations of the connector. The engagement of the springs 128, 127 and 131, upon the deënergization of the magnet 86, closes an energizing circuit through the connector release relay 83. This circuit extends from ground G^2 through the bank springs 44 and 45, springs 110 and 111 of the relay 73, springs 262 and 263 of the relay 77, relay 83, springs 264 and 265, 266 and 267, conductor 165, springs 131, 127 and 128 and magnet 86 to the battery lead 120. Although the relay 83 is energized over this circuit, sufficient current does not flow to operate the magnet 86. The engagement of the springs 268 and 269 of the relay 83 connects the impulse spring 109 with the vertical magnet 66 through the relay 84, thus placing the connector in position to respond to the impulses for the last two digits to complete the connection with the called substation. The relay 79 is maintained energized by the current flowing through the winding 154 during the following operations of the connector. Of course, the selector E is automatically released shortly after its wipers have been rotated onto a "dead" contact, because there is then no ground to maintain the relay 157 energized.

When the substation calling device is operated for the tens digit (2) the relay 73 is twice momentarily deënergized, each time closing a circuit through the vertical magnet 66. This circuit extends from ground G^2 to the spring 110, as previously traced, thence through the spring 109 (with which the spring 110 engages), springs 268 and 269 of the slow-acting relay 83 (which remains energized during the operation of the relay 73), private magnet relay 84, vertical magnet 66 and side switch wiper 70 to the battery lead 100. The vertical magnet receives two impulses over this circuit and operates to raise the shaft and wipers 63, 64 and 65 two steps to a position opposite the second level of bank contacts. The private magnet relay 84 operates in the same manner as the relay 210 of the connector H to close the circuit of the private magnet 72. The relay 84 deënergizes after the last impulse is transmitted to the vertical magnet and opens the circuit of the private magnet 72, which in turn deënergizes and permits the side switch to pass to second position, thereby placing the rotary magnet 67 under control of the relay 73.

Each time the relay 73 deënergizes in response to the impulses for the last digit a circuit is closed through the rotary magnet 67. This circuit extends from ground G^2 to and through the springs 110 and 109, as previously traced, through the springs 268 and 269, relay 84, springs 270 and 271, rotary magnet 67 and side switch wiper 70 to the battery lead 100. The relay 84 being included in this circuit is also energized by the first impulse and again closes the circuit of the private magnet 72. The relay 84 deënergizes again after the last impulse is transmitted to the rotary magnet and again opens the energizing circuit of

the magnet 72, which then trips the side switch to third position. Upon reaching third position the side switch wiper 70 connects the ringer relay 78 with battery. The ringer relay is thereupon intermittently energized over a circuit extending from ground G^{17} through the interrupter 274, springs 272 and 273 and relay 78 to the battery lead 100. Each time the relay 78 energizes it operates in a manner similar to the relay 229 of the connector H to disconnect the calling and called lines and to connect the generator L' with the called line. When the called subscriber answers, the substation is provided with talking battery current through the two windings of the back-bridge relay 77, just as in the case of the connector H. When the relay 77 energizes, the springs 262 and 266 are forced out of engagement with the springs 263 and 267, respectively. The separation of the springs 262 and 263 removes the short-circuit from the resistance 275, and the separation of the springs 267 and 266 removes the short-circuit from the relay 276, thus allowing current to flow through the relay 276 and resistance 275 in series with the relay 83. The relay 276 is energized by this current and operates to force springs 265 and 273 out of engagement with the springs 264 and 272, respectively. The disengagement of the springs 272 and 273 opens the circuit of the ringer relay 78 to prevent its further operation after the called subscriber has answered. The disengagement of the springs 265 and 264 opens the short-circuit of the relay 276 at a second point, and thus prevents the energization of the relay when the called subscriber hangs up first, and allows the back-bridge relay to deënergize. With this arrangement the bell at the called substation will not be rung a second time in case the called subscriber hangs up his receiver before the switches are released.

The release of the central office switches is brought about by the restoration of the receiver to the hook at the calling substation. The disengagement of the springs 31 and 30 at the substation by the downward movement of the switch hook opens the energizing circuit of the connector line relay 73. The relay 73, upon deënergizing, opens the energizing circuits of the relays 83 and 82. The relay 83, upon deënergizing, closes the circuit of the release magnet 74. This circuit extends from the ground G^2 through the springs 44 and 45, 110 and 109, 268 and 277, release magnet 74 and off-normal springs 75 and 76 to the battery lead 100. The magnet 74, upon energizing, restores the connector H' to normal position, whereupon the shaft forces the spring 75 out of engagement with the spring 76 to allow the release magnet to deënergize. When the relay 82 deënergizes it causes the release of the line switch C, in the manner already explained.

Returning now to that stage of the operation of the connector H' when the wipers have been placed in contact with the desired line, before the private magnet relay 84 deënergizes, it will be explained how the calling subscriber is given the busy signal in case the called line is busy. When the private magnet relay deënergizes (with the private wiper 63 in engagement with a grounded contact of the busy line, and the side switch in second position), a circuit is closed extending from the grounded bank contact through the wiper 63, side switch wiper 69 (in second position), springs 278 and 279, relay 280, springs 281 and 282 of the relay 84 and private magnet 72 to the battery lead 100. The current flowing over this circuit maintains the private magnet in an energized position, thus locking the side switch in second position. The relay 280 is also energized by the closure of this last circuit and operates to disconnect the rotary magnet 67 from the impulse spring 109, shift the holding ground of the relay 280 and magnet 72 from the grounded bank contact to ground G^{19} by way of the springs 279 and 283, 284 and 285 and side switch wiper 71, and to connect the busy signaling machine I' with the calling line. The circuit over which the calling substation receives the busy signal extends from the battery lead 100 through the secondary winding of the induction coil 85, springs 286 and 287 of the relay 280, contact point 288, side switch wiper 68, ringer relay springs 289 and 290, condenser 291, thence to and through the substation A and back through the winding 108 of the relay 73 to ground, and thence through battery B to the starting point. During the time the calling substation is receiving the busy signal the connection between the calling and called lines is maintained open on one side by the magnet 72, which is energized, and on the other side by the side switch wiper 68, which is in second position. The connector is released from this position in the same manner as when connection is obtained with an idle line.

The connector H' is used only when a branch exchange subscriber calls another subscriber of the same branch exchange. To enable branch exchange subscribers to be called from the main exchange, or from another branch exchange, each branch exchange is provided with one or more connectors similar to the connector H (Fig. 3), which would be connected to trunks leading from the bank contacts of second selectors in the main exchange. The main exchange subscribers would call the branch exchange subscribers in the regular way, using all four digits of the number.

From the foregoing it will be seen that I provide a system in which a subscriber of one group may call another of the same group without extending the call through the main or central station. The contacts 41 and 43 serve as a terminal for two trunks. One trunk leads to the connector H′ and the other trunk leads to the non-numerical switch C′. Means are provided, as described, for preventing operation of the connector when the call is through the line switch C′ and the selector E. In the selector E the bank level serves as a means for preventing use thereof when the call is through the connector. By the calling dial at the substation the calling subscriber determines which trunk is to be used, the one leading to the switch H′ or the one leading to the switch C′. These switches are controlled over line circuits including the two sides of the calling line in series. During promotion of the talking current, as indicated in heavy lines, the connector H′ is connected therewith, but in an inoperative condition. By a "connector" I mean a switch capable of operation in accordance with two digits of the called number. By a "selector" I mean a switch capable of operation in accordance with one digit of the called number—that is, capable of automatically selecting an idle trunk in a predetermined group.

The arrangement of the switches in a complete system, such as is disclosed in the foregoing, is, as stated, represented diagrammatically in Fig. 5. In this figure there are shown a number of branch or subexchanges, each provided with primary switches C, secondary switches C′ and connectors H and H′. To each subexchange there is allotted at the main exchange a group of first selector switches E and a group of second selector switches F.

What I claim as my invention is:—

1. In a telephone system, a trunk for local calls, a trunk for calls through another exchange or station, a set of contacts serving as a terminal for both trunks at one end thereof, an automatic switch for connecting with said terminal to extend a call over either trunk, automatic means for completing calls from one trunk, and means for completing calls from the other trunk.

2. In a telephone system, a plurality of trunks, a single terminal affording access to all of said trunks, whereby the trunks are connected in multiple to said terminal, and an automatic switch allotted to the other end of each trunk for extending connection therefrom, each trunk comprising a pair of voice-current conductors.

3. In a telephone system, a plurality of talking trunks, a terminal common to all of said trunks, whereby said terminal is necessary for extending a call over any trunk, an automatic switch for determining the proper trunk for use in making any call, and automatic means for extending a connection from said trunks.

4. In a telephone system, a plurality of trunks, a terminal common to all of said trunks, means for engaging said terminal to connect a calling line with said trunks, means controllable at the calling substation for electing which trunk is to be used in completing the call, and automatic means for extending a connection from said trunks.

5. In a telephone system, calling mechanism for transmitting impulses for sending either local or trunking calls, a pair of trunks, a single terminal for said trunks, whereby both trunks lead from the same terminal, a connector at the end of one trunk for use in establishing local calls, a trunking switch at the end of the other trunk for use in establishing trunking calls, subscribers' lines terminating at said connector, trunk lines leading from said trunking switch, a first selector for each trunk line, said connector having a relay for controlling the said selectors when connection through a selector is necessary, and said selectors having means for preventing use thereof when connection is necessary through the connector.

6. In a telephone system, calling mechanism for transmitting impulses for sending calls, a selector, a connector controlled by said impulses, means for connecting with said connector and selector, and means in the selector for preventing continued use thereof when the call must pass through the connector.

7. In a telephone system, calling mechanism for transmitting impulses for sending calls, a connector controlled by said impulses, a selector, means in the connector for controlling the selector when the call must not pass through the connector, and means in the selector for preventing use thereof when the call must pass through the connector.

8. In a telephone system, calling mechanism for transmitting impulses for sending calls, a terminal, a pair of trunks connected therewith, a connector at the end of one trunk controlled by said impulses, a non-numerical trunking switch at the end of the other trunk, a non-numerical trunking switch for connecting with said terminal, a selector, means in said connector for controlling said selector when the call is through the selector, and means in the selector for preventing use thereof when the call is through the connector.

9. In a telephone system, calling mechanism for transmitting impulses for sending calls, a switch controlled by said impulses, another switch, means in the first switch for controlling the second switch when the call must pass through the second switch,

means for preventing use of the second switch when the call must pass through the first switch, and means for preventing use of the first switch when the call is through the second switch.

10. In a telephone system, calling mechanism for transmitting impulses for sending calls, a connector controlled by said impulses, a selector, means in the connector for controlling the selector, means for preventing operation of the connector when the selector is operated to extend a call, means for automatically restoring the selector to normal when the call is through the connector, and means for controlling the connector in accordance with the last two digits of the called number.

11. In a telephone system, calling mechanism for transmitting impulses for sending calls, a connector controlled by said impulses, a selector having a plurality of levels and operable to any level and having means for automatically releasing when raised to a particular level, means for rendering the connector operative when the selector is thus released, and means for preventing operation of the connector when the selector is raised to some other level.

12. A telephone exchange system comprising a combination connector and repeater, a talking circuit from which the said combination instrument is excluded when used as a repeater, a talking circuit in which the said instrument is included when used as a connector, and switching means in said first-mentioned circuit controlled by the said instrument when used as a repeater.

13. In a telephone system, means for forming a talking circuit, a plurality of connectors, means for operating said connectors, and means for temporarily rendering the same inoperative by the formation of said circuit, each connector being operative in accordance with two digits of a called number.

14. In a telephone system, a trunk for local calls, a trunk for calls through another exchange or station, a set of bank contacts serving as a terminal for both trunks at one end thereof, means for connecting with said terminal to extend a call over either trunk, means for completing calls from one trunk, controllable over the two sides of the trunk in series, and automatic means for completing calls from the other trunk, controllable over the two sides of the trunk in series.

15. In a telephone system, a plurality of trunks, a single terminal affording access to all of said trunks, whereby the trunks are connected in multiple to said terminal, and means allotted to the other end of each trunk for extending connection therefrom, controllable over the two sides of the trunk in series, each trunk comprising a pair of voice-current conductors.

16. In a telephone system, a plurality of talking trunks, automatic switches controllable over the two sides of the trunks in series, a bank terminal common to all of said trunks, whereby said terminal is necessary for extending a call over any trunk, means for determining the proper trunk for use in making any call, and automatic means for extending a connection from said trunks.

17. In a telephone system, a plurality of trunks, a terminal common to all of said trunks, means for engaging said terminal to connect a calling line with said trunks, automatic switches controllable over the two sides of the trunks in series, and means controllable from the calling substation for electing which trunk is to be used in completing the call.

18. In a telephone system, calling mechanism for transmitting impulses for sending calls, a pair of trunks, a single terminal for said trunks, whereby both trunks lead from the same terminal, a connector at the end of one trunk controlled by said impulses, a trunking switch at the end of the other trunk, subscribers' lines terminating at said connector, trunk lines leading from said trunking switch, a first selector for each trunk line, said connector having a relay for controlling the said selectors when connection through a selector is necessary, each selector controllable over the two sides of a trunk in series, and said selectors having means for preventing use thereof when connection is necessary through the connector.

19. In a telephone system, a central station, a plurality of subcentral stations, subscribers' lines terminating at the subcentral stations, trunk lines connecting the subcentral stations with the central station, means for extending a call through the central station from a calling subcentral station to a called subcentral station, controllable over the two sides of a line circuit in series, and means affording direct connection between the lines of calling and called subscribers of the same subcentral station, controllable over the two sides of a line circuit in series.

20. In a telephone system, a central station, subcentral stations, trunk lines connecting the central station with the subcentral stations, telephone lines terminating at the subcentral stations, connectors at the subcentral stations for connecting a telephone line of one subcentral station with a telephone line of another subcentral station, controllable over the two sides of a line circuit in series, and other connectors for connecting a calling line with a called line of the same subcentral station, controllable over the two sides of a line circuit in series.

21. In a telephone system, a connector for finding the called subscriber's line, when the call is local, provided with a relay for repeating the calling impulses when the call is

to another station, and means independent of the ground at the substation for controlling said connector.

22. In a telephone system, a connector, means for controlling said connector in accordance with the last two digits of a called number, a selector, said connector having a relay for controlling said selector, a trunk line, and a circuit including the two sides of said trunk line in series controlled by said relay to control the selector.

23. In a telephone system, a line circuit, a connector, means for controlling said connector, in accordance with the last two digits of the called number, over the two sides of a line circuit in series, and a plurality of selectors, said connector having a relay for successively controlling said selectors.

24. In a telephone system, a selector, a connector, means for connecting a calling line with said connector and selector, means in the selector for preventing continued use thereof when the call must pass through the connector, and means at the calling substation for controlling the said selector and connector over the two sides of a line circuit in series.

25. In a telephone system, a calling substation, a connector, a selector adapted to be connected thereto, means in the connector for controlling the selector when the call must not pass through the connector, means in the selector for preventing use thereof when the call must pass through the connector, and means at the calling substation for controlling the said selector and connector over the two sides of a line circuit in series.

26. In a telephone system, a terminal, a pair of trunks connected therewith, a connector at the end of one trunk, a non-numerical trunking switch at the end of the other trunk, a non-numerical trunking switch for connecting with said terminal, a selector, means in said connector for controlling said selector when the call is through the selector, means in the selector for preventing use thereof when the call is through the connector, and metallic line circuits over which said connector and selector are controlled.

27. In a telephone system, a switch, another switch, means in the first switch for controlling the second switch when the call must pass through the second switch, means for preventing use of the second switch when the call must pass through the first switch, means for preventing use of the first switch when the call is through the second switch, and metallic line circuits over which said switches are controlled to extend calls.

28. In a telephone system, a line circuit, a connector, a selector, means in the connector for controlling the selector over the two sides of a line circuit in series, means for preventing operation of the connector when the selector is operated to extend a call, means for automatically restoring the selector to normal when the call is through the connector, and means for controlling the connector in accordance with the last two digits of the called number.

29. In a telephone system, a connector, a selector having a plurality of levels and having means for automatically releasing when raised to a particular level, means for rendering the connector operative when the selector is thus released, means for preventing operation of the connector when the selector is raised to any other level, and metallic line circuits for controlling said connector and selector.

30. A telephone exchange system comprising a combination progressively movable connector repeater for connecting a calling and a called line in a talking circuit, said repeater controlled over two sides of the talking circuit in series.

31. A telephone exchange system comprising a combination connector and repeater, a talking circuit from which the said combination instrument is excluded when used as a repeater, a talking circuit in which the said instrument is included when used as a connector, and switching means in said first-mentioned circuit controlled by the said instrument when used as a repeater, said instrument being controllable over the two sides of a portion of the talking circuit in series.

32. In a telephone exchange system, a line circuit, calling mechanism for transmitting impulses over two sides of said circuit in series for sending calls, and a combination connector and repeater controlled by said impulses having provisions for preventing operation thereof as a connector for any call in which it is operative as a repeater.

33. In a telephone system, a trunk terminal, means including a line circuit for connecting with said terminal, and a plurality of automatic step-by-step switches allotted to and trunk-connected with said terminal, whereby said terminal is common to all of said switches, each switch controllable over the two sides of said line circuit in series.

34. In a telephone system, line circuits, a connector, a plurality of selectors, another connector, and a relay for the first connector, said selectors and second connector being successively controllable by said relay over two sides of any of said line circuits in series.

35. In a telephone system, a talking circuit, a plurality of connectors connected with said circuit, a plurality of selectors connected with the circuit between said connectors, and circuits for controlling said connectors and selectors including the two sides of said talking circuit in series.

36. In a telephone system, means for forming a talking circuit, a plurality of con-

nectors, means for operating said connectors, and means for temporarily rendering the same inoperative by the formation of said circuit, each connector being operative in accordance with two digits of a called number, and each connector controllable over the two sides of a line circuit in series.

37. In a telephone system, a common battery from which current is supplied for talking purposes and for operating the system, a trunk for local calls, a trunk for calls through another exchange or station, a set of contacts serving as a terminal for both trunks at one end thereof, an automatic switch for connecting with said terminal to extend a call over either trunk, automatic means for completing calls from one trunk, and means for completing calls from the other trunk.

38. In a telephone system, a common battery from which current is supplied for talking purposes and for operating the system, a plurality of trunks, a single terminal affording access to all of said trunks, whereby the trunks are connected in multiple to said terminal, and an automatic switch allotted to the other end of each trunk for extending connection therefrom, each trunk comprising a pair of voice-current conductors.

39. In a telephone system, a common battery from which current is supplied for talking purposes and for operating the system, a plurality of talking trunks, a terminal common to all of said trunks, whereby said terminal is necessary for extending a call over any trunk, an automatic switch for determining the proper trunk for use in making any call, and automatic means for extending a connection from said trunks.

40. In a telephone system, a common battery from which current is supplied for talking purposes and for operating the system, a plurality of trunks, a terminal common to all of said trunks, means for engaging said terminal to connect a calling line with said trunks, and means controllable from the calling substation for electing which trunk is to be used in completing the call.

41. In a telephone system, calling mechanism for transmitting impulses for sending calls, a common battery from which current is supplied for talking purposes and for operating the system, a pair of trunks, a single terminal for said trunks, whereby both trunks lead from the same terminal, a connector at the end of one trunk responsive to said impulses, a trunking switch at the end of the other trunk, subscribers' lines terminating at said connector, trunk lines leading from said trunking switch, a first selector for each trunk line, said connector having a relay for controlling the said selectors when connection through a selector is necessary, and said selectors having means for preventing use thereof when connection is necessary through the connector.

42. In a telephone system, a common battery from which current is supplied for talking purposes and for operating the system, a central station, a plurality of subcentral stations, subscribers' lines terminating at the subcentral stations, trunk lines connecting the subcentral stations with the central station, means for extending a call through the central station from a subcentral station to a called subcentral station, and means affording direct connection between the lines of calling and called subscribers of the same subcentral station.

43. In a telephone system, a common battery from which current is supplied for talking purposes and for operating the system, a central station, subcentral stations, trunk lines connecting the central station with the subcentral stations, telephone lines terminating at the subcentral stations, connectors at the subcentral stations for connecting a telephone line of one subcentral station with a telephone line of another subcentral station, and other connectors for connecting a calling line with a called line of the same subcentral station.

44. In a telephone system, calling mechanism for transmitting impulses for sending either local or trunking calls, a common battery from which current is supplied for talking purposes and for operating the system, a connector for finding the called subscriber's line, when the call is local, provided with a relay for repeating the calling impulses when the call is to another station.

45. In a telephone system, a common battery from which current is supplied for talking purposes and for operating the system, a connector, means for controlling said connector in accordance with the last two digits of a called number, and a selector, said connector having a relay for selectively controlling said selector.

46. In a telephone system, a common battery from which current is supplied for talking purposes and for operating the system, a connector, means for controlling said connector in accordance with the last two digits of the called number, and a plurality of selectors, said connector having a relay for successively controlling said selectors.

47. In a telephone system, calling mechanism for transmitting impulses for sending calls, a common battery from which current is supplied for talking purposes and for operating the system, a selector, a connector responsive to said impulses, means for connecting a calling line with said connector and selector, and means in the selector for preventing continued use thereof when the call must pass through the connector.

48. In a telephone system, calling mechanism for transmitting impulses for sending calls, a common battery from which current is supplied for talking purposes and for operating the system, a connector responsive to said impulses, a selector, means in the connector for controlling the selector when the call must not pass through the connector, and means in the selector for preventing use thereof when the call must pass through the connector.

49. In a telephone system, calling mechanism for transmitting impulses for sending calls, a common battery from which current is supplied for talking purposes and for operating the system, a terminal, a pair of trunks connected therewith, a connector responsive to said impulses at the end of one trunk, a non-numerical trunking switch at the end of the other trunk, a non-numerical trunking switch for connecting with said terminal, a selector to which said first-mentioned non-numerical switch is adapted to extend connection, means in said connector for controlling said selector when the call is through the selector, and means in the selector for preventing use thereof when the call is through the connector.

50. In a telephone system, calling mechanism for transmitting impulses for sending calls, a common battery from which current is supplied for talking purposes and for operating the system, a switch responsive to said impulses, another switch, means in the first switch for controlling the second switch when the call must pass through the second switch, means for preventing use of the second switch when the call must pass through the first switch, and means for preventing use of the first switch when the call is through the second switch.

51. In a telephone system, calling mechanism for transmitting impulses for sending calls, a common battery from which current is supplied for talking purposes and for operating the system, a connector responsive to said impulses, a selector, means in the connector for controlling the selector, means for preventing operation of the connector when the selector is operated to extend a call, means for automatically restoring the selector to normal when the call is through the connector, and means for controlling the connector in accordance with the last two digits of the called number.

52. In a telephone system, calling mechanism for transmitting impulses for sending calls, a common battery from which current is supplied for talking purposes and for operating the system, a connector responsive to said impulses, a selector having a plurality of levels and having means for automatically releasing when raised to a particular level, means for rendering the connector operative when the selector is thus released, and means for preventing operation of the connector when the selector is raised to any other level.

53. A telephone exchange system comprising a selector and a connector adapted to be operated in accordance with the last digit of a called number, means controlled by said connector for repeating impulses to operate said selector switch, and a common battery from which current is supplied for talking purposes and for operating the system.

54. A telephone exchange system comprising a common battery from which current is supplied for talking purposes and for operating the system, a combination connector and repeater, a talking circuit from which the said combination instrument is excluded when used as a repeater, a talking circuit in which the said instrument is included when used as a connector, and means in said first-mentioned circuit controlled by the said instrument when used as a repeater.

55. In a telephone exchange system, calling mechanism for transmitting impulses for sending calls, a combination connector and repeater responsive to said impulses having provisions for preventing operation thereof as a connector for any call in which it is operative as a repeater, and a common battery from which current is supplied for talking purposes and for operating the system.

56. In a telephone system, a common battery from which current is supplied for talking purposes and for operating the system, a connector, a plurality of selectors, another connector, and a relay for the first connector, said selectors and second connector being successively controllable by said relay.

57. In a telephone system, a common battery from which current is supplied for talking purposes and for operating the system, a talking circuit, a plurality of connectors connected with said circuit, and a plurality of selectors connected with the circuit between said connectors.

58. In a telephone system, calling mechanism for transmitting impulses for sending calls, a common battery from which current is supplied for talking purposes and for operating the system, means for forming a talking circuit, a plurality of connectors, means for operating said connectors in accordance with said impulses, and means for temporarily rendering the same inoperative by the formation of said circuit, each connector being operative in accordance with two digits of a called number.

59. In a telephone system, calling mechanism for transmitting impulses for sending calls, a pair of trunks, a single terminal for

said trunks, whereby both trunks lead from the same terminal, a connector responsive to said impulses at the end of one trunk, a trunking switch at the end of the other trunk, subscribers' lines divided into groups terminating at said connector, trunk lines leading from said trunking switch, a first selector for each trunk line, said connector having a relay for controlling the said selectors when connection through a selector is necessary, and said selectors having means for preventing use thereof when connection is necessary through the connector, said connector 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.

60. In a telephone system, calling mechanism for transmitting impulses for sending calls, subscribers' lines divided into groups, a connector responsive to said impulses, a selector, means for connecting with said connector and selector, and means in the selector for preventing continued use thereof when the call must pass through the connector, said connector 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.

61. In a telephone system, calling mechanism for transmitting impulses for sending calls, subscribers' lines divided into groups, a terminal, a pair of trunks connected therewith, a connector responsive to said impulses at the end of one trunk, a non-numerical trunking switch at the end of the other trunk, a non-numerical trunking switch for connecting with said terminal, a selector, means in said connector for controlling said selector when the call is through the selector, and means in the selector for preventing use thereof when the call is through the connector, said connector 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.

62. In a telephone system, calling mechanism for transmitting impulses for sending calls, subscribers' lines divided into groups, a connector responsive to said impulses, a selector, means in the connector for controlling the selector, means for preventing operation of the connector when the selector is operated to extend a call, means for automatically restoring the selector to normal when the call is through the connector, and means for controlling the connector in accordance with the last two digits of the called number, said connector 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.

63. In a telephone system, calling mechanism for transmitting impulses for sending calls, subscribers' lines divided into groups, a connector responsive to said impulses, a selector having a plurality of levels and having means for automatically releasing when raised to a particular level, means for rendering the connector operative when the selector is thus released, and means for preventing operation of the connector when the selector is raised to any other level, said connector 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.

64. In a telephone system, a trunk for local calls, a trunk for calls through another exchange or station, a set of bank contacts serving as a terminal for both trunks at one end thereof, means for connecting with said terminal to extend a call over either trunk, means for completing calls from one trunk, controllable over the two sides of the trunk in series, automatic means for completing calls from the other trunk, controllable over the two sides of the trunk in series, and common battery means for supplying talking current through said trunks.

65. In a telephone system, a plurality of trunks, a single terminal affording access to all of said trunks, whereby the trunks are connected in multiple to said terminal, means allotted to the other end of each trunk for extending connection therefrom, controllable over the two sides of the trunk in series, each trunk comprising a pair of voice-current conductors, and common battery means for supplying talking current through said trunks.

66. In a telephone system, a plurality of talking trunks, automatic switches controllable over the two sides of the trunks in series, a bank terminal common to all of said trunks, whereby said terminal is necessary for extending a call over any trunk, means for determining the proper trunk for use in making any call, automatic means for extending a connection from said trunks, and common battery means for supplying talking current through said trunks.

67. In a telephone system, a plurality of trunks, a terminal common to all of said trunks, means for engaging said terminal to connect a calling line with said trunks, automatic switches controllable over the two sides of the trunks in series, means controllable at the calling substation for electing which trunk is to be used in completing the call, and common battery means for supplying talking current through said trunks.

68. In a telephone system, a central station, a plurality of subcentral stations, subscribers' lines terminating at the subcentral stations, trunk lines connecting the subcentral stations with the central station, means for extending a call through the central station from a calling subcentral station to a called subcentral station, controllable over the two sides of a line circuit in series, means

affording direct connection between the lines of calling and called subscribers of the same subcentral station, controllable over the two sides of a line circuit in series, and common battery means for supplying talking current through the subscribers' lines.

69. In a telephone system, subscribers' lines, means including a progressively movable connector for establishing a connection between a calling and a called subscriber's line when the call is local, another progressively movable selective trunking switch, said connector provided with a relay for repeating the calling impulses to said trunking switch when the call is to another station, means independent of the ground at the substation for controlling said connector, and common battery means for supplying talking current through the subscribers' lines.

70. In a telephone system, a line circuit, a progressively movable connector, means for controlling said connector, in accordance with the last two digits of the called number, over the two sides of a line circuit in series, a plurality of selectors, said connector having a relay for successively controlling said selectors, and common battery means for supplying talking current to said line circuit.

71. A telephone exchange system comprising a combination progressively movable connector repeater for connecting a calling and a called line in a talking circuit, said connector repeater controlled over two sides of the talking circuit in series, and common battery means for supplying talking current to said circuits.

72. In a telephone exchange system, calling mechanism for transmitting impulses for sending calls, a combination connector and repeater responsive to said impulses having provisions for preventing operation thereof as a connector for any call in which it is operative as a repeater, a metallic circuit, and common battery means for supplying talking current to said circuit.

73. In a telephone system, metallic line circuits, a progressively movable connector, a plurality of selectors, another connector, a relay for the first connector, said selectors and second connector being successively controllable by said relay over said metallic line circuits, and common battery means for supplying talking current to said line circuits.

74. In a telephone system, a talking circuit, a plurality of progressively movable connectors connected with said circuit, a plurality of selectors connected with the circuit between said connectors, metallic line circuits for controlling said connectors and selectors, and common battery means for supplying talking current to said talking circuit.

75. In a telephone system, a bank trunk terminal, means comprising a movable element for connecting with said terminal, and a plurality of automatic step-by-step switches allotted to and trunk connected with said terminal whereby said terminal is common to all of said switches.

76. In a telephone system, a bank trunk terminal, means for connecting with said terminal, and a plurality of automatic step-by-step switches allotted to and trunk connected with said terminal whereby said terminal is common to all of said switches.

77. In a telephone system, a common battery from which current is supplied for talking purposes and for operating the system, a bank trunk terminal, means comprising a movable element for connecting with said terminal, and a plurality of automatic step-by-step switches allotted to and trunk connected with said terminal, whereby said terminal is common to all of said switches.

78. In a telephone system, a common battery from which current is supplied for talking purposes and for operating the system, a bank trunk terminal, means for connecting with said terminal, and a plurality of automatic step-by-step switches allotted to and trunk connected with said terminal whereby said terminal is common to all of said switches.

79. In a telephone system, a trunk line, said trunk line having a pair of branches, a switch in one branch, a line associated with said switch, means for operating said switch to extend a connection from said branch to said line, a switch in the other branch, a line associated with said second switch, means for operating said second switch to extend a connection from said trunk to said second line, said first switch inoperative to extend a connection to said first line when the second switch is operated to extend said connection to said second line, and means under the control of means in said second line for rendering said first switch operative.

80. In a telephone system, a trunk line, said trunk line having a pair of branches, a switch in one branch, a line associated with the said switch, means for operating said switch to extend a connection from said trunk to said line, a switch in the other branch, a third switch, a line associated with said second switch extending to said third switch, means for operating said second switch to extend a connection from said trunk to said second line, said first switch inoperative to extend a connection to said first line when the second switch is operated to extend said connection to said second line, and means under the control of said third switch for rendering said first switch operative.

81. In a telephone system, a plurality of branch exchanges, subscribers' lines connected with said branch exchanges, means

for establishing a connection between two of said subscribers' lines, said means including a trunk line having a terminal in a branch exchange, a branch for said trunk extending toward said main exchange, a local branch for said trunk, and means for disconnecting the main branch and connecting the local branch when a call is made with a subscriber in the same branch exchange.

82. In a telephone system, a plurality of subscribers' lines divided into groups and subgroups, a plurality of trunk lines having a common terminal, means for first extending a connection from said terminal over one of said trunk lines, and means for then breaking the connection with said trunk and connecting the other trunk with said terminal if it is desired to extend the connection to a subscriber in a group reached by said second trunk.

83. In a telephone system, subscribers' lines divided into groups, a trunk having a terminal and a pair of branches associated therewith, one of said branches extending toward a plurality of said groups, while another of said branches extends toward but one of said groups, means for first extending a connection over said first branch, and means for then completing the connection over the second branch if a subscriber's line in its particular group is desired.

84. In a telephone system, subscribers' lines divided into groups, means for establishing a connection between two of said lines, said means including a trunk having a single terminal adapted to be seized by a calling subscriber and a pair of branches extending from said terminal, one branch extending toward certain of said subscribers' lines and the other branch extending toward other of said lines, and means for first extending the call over said one branch and completing the connection over said other branch if it is desired to establish a connection with a subscriber reached by said last-mentioned branch.

85. In a telephone system, two groups of subscribers' lines, automatic apparatus for trunking to one group, automatic apparatus for trunking to the other group, said apparatus being accessible to a subscriber to set up a connection with a desired subscriber in either group, means whereby when the subscriber operates to set up a connection with the desired subscriber's line the trunking apparatus builds connections toward both groups until the step in the calling operation is reached which determines definitely the group in which the desired subscriber's line is located, means for then releasing the connection in the direction of the other group, and a switch acting as a repeater and as a connector during the same connection.

86. In a telephone system, main and branch exchanges, subscribers' lines connected with said branch exchanges, trunking apparatus at said exchanges, means whereby a subscriber in making a call operates said apparatus to first determine the main exchange and then the branch exchange with which the desired called subscriber is connected, a trunk at a branch exchange leading to the trunking apparatus at a main exchange, a second trunk in the same branch exchange leading to trunking apparatus in that exchange, means whereby a subscriber at said branch exchange, when initiating a call, first extends a connection over the trunk extending to said main exchange, and means for then breaking said connection and extending the connection over said local trunk when it is determined that the call is for a subscriber in the same branch exchange.

87. In a telephone system, main and branch exchanges, subscribers' lines connected with said branch exchanges, trunking apparatus at said exchanges, means whereby a subscriber in making a call operates said apparatus to first determine the main exchange and then the branch exchange with which the desired called subscriber is connected, a trunk at a branch exchange leading to the trunking apparatus at a main exchange, a second trunk in the same branch exchange leading to trunking apparatus in that exchange, means whereby a subscriber at said branch exchange, when initiating a call, first extends a connection over the trunk extending to said main exchange, means for then breaking said connection and extending the connection over said local trunk when it is determined that the call is for a subscriber in the same branch exchange, and means for releasing the switching apparatus at the main exchange when the connection is shifted to the local trunk.

88. In a telephone system, a central station, a plurality of subcentral stations, subscribers' lines terminating at the subcentral stations, trunk lines connecting the subcentral stations with the central station, means for extending a call through the central station from a calling subcentral station to a called subcentral station, controllable over the two sides of a line circuit in series, means affording direct connection between the lines of calling and called subscribers of the same subcentral station, controllable over the two sides of a line circuit in series, said last means comprising only two trunking switches, one non-numerical in character and one numerical in character, and common battery means for supplying talking current through the subscribers' lines.

89. In a telephone system, a line, means for establishing a connection with said line,

a pair of progressively movable switches individual to said line for extending a connection from said line via one of said switches, and for extending another connection from said line via the other of said switches, means responsive to the extension of said connection over said one switch for rendering the other of said switches inoperative to extend a connection, and means responsive to the release of the connection over said one switch for rendering said other switch operative.

90. In a telephone system, a line, means for establishing a connection with said line, a pair of progressively movable switches individual to said line for extending a connection from said line via one of said switches, and for extending another connection from said line via the other of said switches, and means for preventing the extension of a connection over one of said switches until a connection has been set up and released over the other of said switches.

91. In a telephone system, a trunk having a main portion and a plurality of branch portions, means for making local calls over the main portion and one branch portion, and means for making long distance calls over the main portion, and another branch portion, and electrically controlled means for automatically breaking the connection after a call is completed.

92. In a telephone system, a trunk, a switch at one exchange, a switch at another exchange branch connections from said trunk to said switches, and means for controlling said switches over said trunk.

93. In a telephone system, a trunk having a main portion and a plurality of branch portions, means for making local calls over the main portion and one branch portion, means for making long distance calls over the main portion and another branch portion, one of said branches being normally open, and a relay controlled over the branch to close said open branch.

94. In a telephone system, an automatic switch including line wipers, and means controlled by said switch for establishing a trunking connection, said trunking connection being independent of and excluding said line wipers, and said switch including means for repeating impulses over said trunking connection.

95. In a telephone system, a trunk having a main portion and a plurality of branch portions, circuit means for making local calls over the main portion and one branch portion, and automatic means for making long distance calls over the main portion and another branch portion, and electrically controlled means for automatically breaking the connection after a call is completed.

96. In a telephone system, an automatic switch including line wipers and automatic means controlled by said switch for establishing a trunking connection, said trunking connection being independent of and excluding said line wipers, and said switch including automatic means for repeating impulses over said trunking connection.

97. In a telephone system, a main exchange, a branch exchange, subscribers' lines terminating at said branch exchange, a trunk line having a terminal adapted to be connected with said subscribers' lines and provided with two branches, one extending toward the main exchange and the other extending toward switching mechanism in said branch exchange, impulse transmitting devices on said subscribers' lines, a repeater in said trunk for repeating impulses over said trunk toward the main exchange, and means in said repeater for switching the connection from said main branch to said local branch when it is determined that the called subscriber is in the same branch exchange as the calling subscriber.

98. In a telephone system, a main exchange, a branch exchange, a plurality of groups of subscribers' lines connected with said branch exchange, a trunk at said branch exchange extending toward said main exchange, a second trunk local to said branch exchange, means by which a subscriber in establishing a connection first extends such connection over the trunk extending toward the main exchange, and means for then shifting said connection to the local trunk and for connecting said local trunk with the particular group of local subscribers in which the desired called subscriber is located.

99. In a telephone system, subscribers' lines, a main and a branch exchange, a connecting circuit in said branch exchange, repeating mechanism in said circuit, a trunk line leading from said branch to said main exchange, means for connecting said trunk with said connecting circuit, a trunk local to said branch exchange, means for connecting a calling line with said connecting circuit, means controlled by said repeating mechanism for then extending connection to said main exchange over said main exchange trunk, and means for then controlling said repeater to cause it to disconnect said main exchange trunk and connect said branch exchange trunk with the subscriber's line when it is desired to make connection with a subscriber in the same branch exchange.

100. In a telephone system, subscribers' lines, a main and a branch exchange, a connecting circuit in said branch exchange, repeating mechanism in said circuit, trunk lines leading from said branch to said main exchange, a trunk local to said branch exchange, means controlled by a subscriber in making a call for connecting his line with said connecting circuit, a non-numerical

trunk-selecting switch at one end of said connecting circuit controlled by said repeating mechanism for selecting an idle trunk to said main exchange to thus extend the connection from the calling subscriber's line to the main exchange, and means for then controlling said repeater to disconnect the main exchange trunk from a subscriber's line and connect his branch exchange trunk thereto when it is desired to make connection with a subscriber in the same branch exchange.

101. In a telephone system, a trunk line having two branches, an automatic switch for each branch, means for operating one of said switches to extend a connection from said trunk line over one branch and for operating said other switch to extend a connection from said trunk line over the other branch and for releasing the first extended connection.

102. In a telephone system, a trunk line, a pair of automatic switches individual to said trunk line, means for operating one switch to extend a connection from said trunk line to another line, means for operating the other switch to extend a connection from the trunk line to still another line, and means controlled from the first switch to break the first extended connection.

103. In a telephone system, a trunk line having two branches, an automatic switch for each branch, electromagnetic means for operating one of said switches to extend a connection from said trunk line over one branch and for operating said other switch to extend a connection from said trunk line over the other branch and for releasing the first extended connection.

104. In a telephone system, a trunk line, a pair of automatic switches individual to said trunk line, electromagnetic means for operating one switch to extend a connection from said trunk line to another line, electromagnetic means for operating the other switch to extend a connection from the trunk line to still another line, and electromagnetic means controlled from the first switch to break the first extended connection.

Signed by me at Chicago, Cook county, Illinois, this 29th day of November, 1909.

FRITZ LURBERGER.

Witnesses:
EDWARD D. FALES,
ARTHUR J. RAY.