J. L. E. MEYER.

TELEPHONE TRUNK RELEASE SYSTEM.

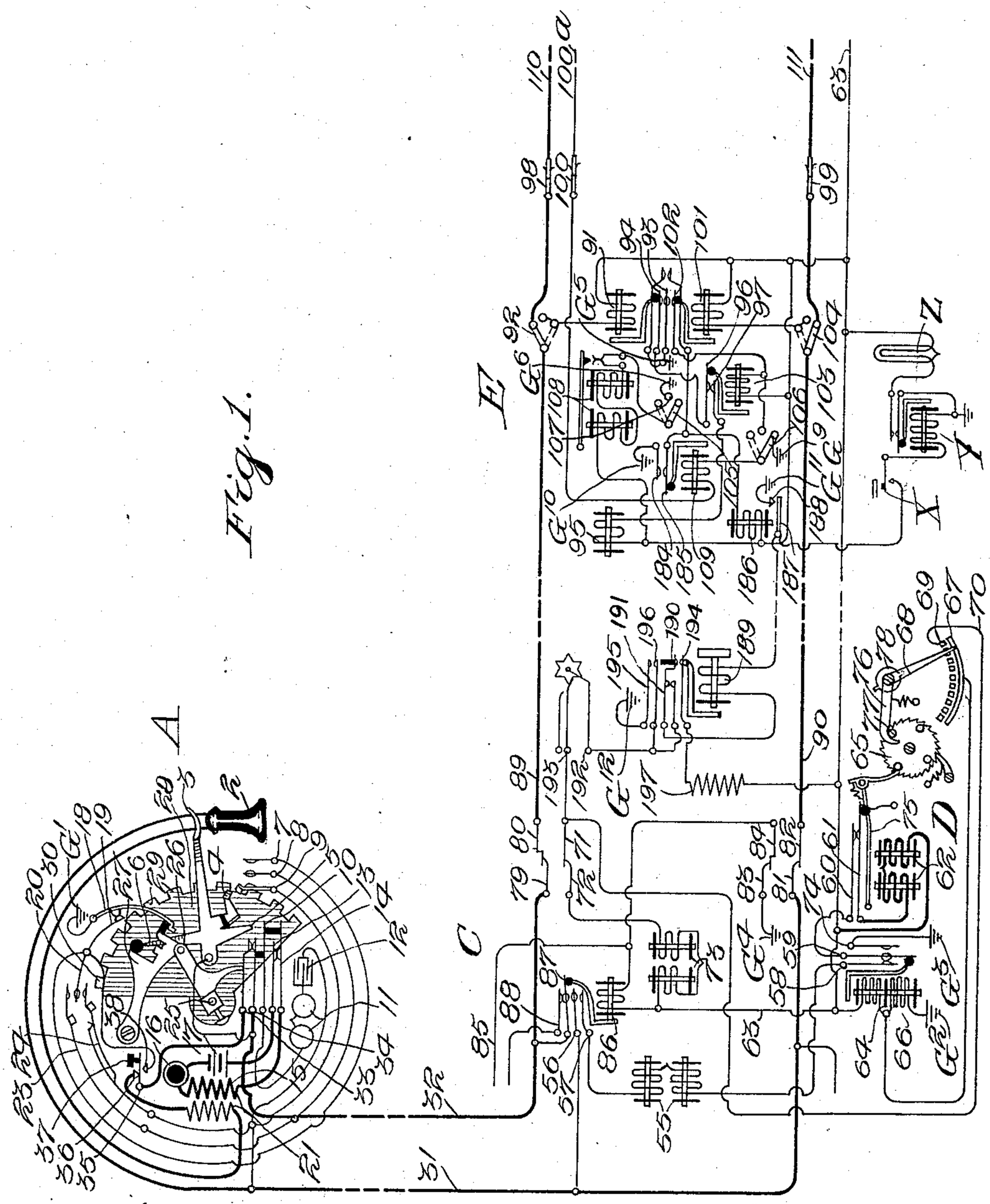
APPLICATION FILED JUNE 28, 1909.

1,161,783.

Patented Nov. 23, 1915.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses.

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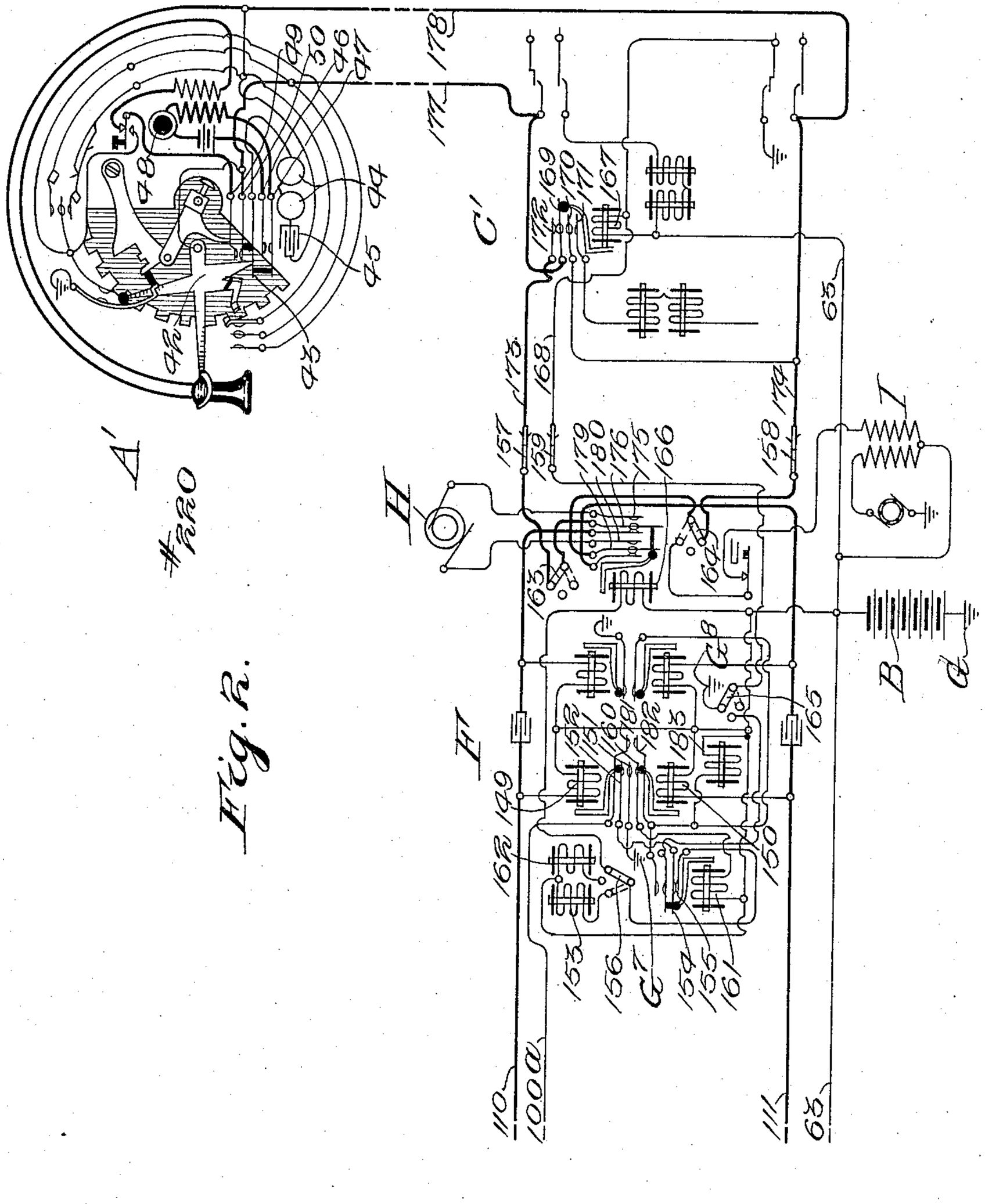

Fig. 2.

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UNITED STATES PATENT OFFICE.

JOHAN L. E. MEYER, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE TRUNK-RELEASE SYSTEM.

1,161,783. Specification of Letters Patent. Patented Nov. 23, 1915.

Application filed June 28, 1909. Serial No. 504,681.

To all whom it may concern:

Be it known that I, JOHAN L. E. MEYER, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Telephone Trunk-Release Systems, of which the following is a specification.

My invention relates to telephone exchange systems of that particular character in which line switches are employed—that is to say, switches that are individual to a line, such as a subscriber's line or a trunk line, and in which each line switch is provided with a release magnet which, when energized, serves to break or release the trunking connection established by the switch. In systems of this kind the said magnet has been energized by a trunk-release circuit including a third conductor of the trunk extending from the line switch to a selector or connector or other similar switch. It was found, however, that the said magnet occasionally failed to respond in the desired manner, particularly if the trunk was quite long.

My invention contemplates, therefore, an improved arrangement whereby the said release magnet is energized from a local ground, which local ground is closed by a relay controlled over the trunk-release circuit, whereby only a relatively small amount of current is necessary in the trunk-release circuit in order to accomplish the energizing of the release magnet, and whereby the release of any established trunking connection is made more certain.

My invention also contemplates an improved arrangement whereby the release trunk between switches serves not only as a part of the energizing circuit of the release magnet of the line switch, but also as a part of the supervisory circuit for giving a signal at one end of the trunk as soon as the other end thereof is seized by the said line switch.

To this and other useful ends my invention consists in matters hereinafter set forth and claimed.

In the accompanying drawings Figure 1 represents diagrammatically a subscriber's substation A the line conductors of which are allotted to the line switch C, a master switch D that controls the plungers of the group of line switches of which C is a member, and a first selector switch E, in a system embodying the principles of my invention. In Fig. 2 there is diagrammatically shown a connector switch F connected with the terminals of the ringer generator H, and the busy signaling machine I; and the line conductors of the substation A′ are shown allotted to the line switch C′, which is like the line switch C; and a central office battery is shown at B having its positive terminal preferably grounded at G. Figs. 1 and 2 taken together represent diagrammatically a connection established between the subscribers' stations A and A′ through the medium of central office switching apparatus comprising my improved releasing arrangement.

The substation A may be of any suitable or approved type. The one in connection with which I have elected to describe my invention comprises a receiver 2, switch hook 3 for controlling the substation circuits, which controlling operations are accomplished through the medium of any suitable means, such as the cam arms 4, 5 and 6. As the switch hook is lowered the cam arm 4 momentarily presses the release springs 7, 8 and 9 into contact, whereby the line conductors may be grounded simultaneously. When the switch hook is down the cam arm 5 is maintained in contact with the spring 10, thereby bridging across the line conductors the ringer 11 in series with the condenser 12. When the switch hook is lowered the springs 13 and 14 are also carried out of engagement, thus opening the local battery circuit which comprises the primary winding 15 in series with the transmitter 16 and battery 17. The substation ground circuit is normally broken between the coöperating ground springs 18 and 19 by the cam arm 6; but when said springs are together ground potential is provided to the ground post 20, and to the release spring 7, as is usually the case in telephones of this type. Being an automatic substation it is provided with the usual vertical and rotary impulse springs 23 and 24. The substation is, of course, provided with a dial (not shown) which is secured to the shaft 25, together with the locking dog 26. Furthermore, there is a locking cam 27 that locks the dog 26 while the receiver is on the switch hook to prevent a rotation of the dial. For operating the impulse springs 23 and 24 the

substation is provided with an impulse wheel 28 that is secured to the shaft 25. This impulse wheel carries on its periphery the so-called vertical impulse teeth 29, and one rotary impulse tooth 30, for operating the rotary impulse spring 24. The rotary impulse spring 24 is of such construction that when the dial is turned forward for the first digit the rotary impulse tooth 30 presses the impulse spring 24 onto the ground post 20, thereby grounding the rotary line conductor 31, which provides a preliminary impulse for operating the line switch C. The impulse teeth 29 are so arranged that when the dial is drawn down the impulse spring 23 is not carried into engagement with the ground post 20; but as the dial returns, first the vertical teeth 29 press the vertical impulse spring 23 onto the ground post, thereby grounding the vertical line conductor 32; and after they have completed their work the rotary impulse spring 24 is carried onto the ground post 20 once. As long as the dial is out of normal position the dog 26 permits the springs 33 and 34 to disengage, thus preventing the impulses that are delivered to either line conductor from passing to the other.

The means whereby the subscriber may signal another comprises the push button spring 35 which normally engages the contact point 36; but when the button 37 is pressed the spring 35 is carried onto the contact point 38, whereby the vertical line conductor 32 is grounded.

The line switches C and C′ and the master switch D are of the type disclosed in English Patent No. 26,301 of 1906, and in the American Telephone Journal of Chicago, Illinois, of June 6, 1908.

The first selector switch E is of the general type shown in United States Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson & Erickson. In this instance, however, the bridge-cut-off relay and the normal conductors are omitted.

The connector switch F is of the general type shown in United States Letters Patent No. 815,176, issued March 13, 1906, to Keith, Erickson & Erickson.

A clearer understanding of my improved system may be had from an explanation of its operation when employed in releasing a connection. Assume, for example, that the subscriber at station A desires to establish connection with the substation A′, the number of which latter is 220. To call the number 220 the calling subscriber operates the dial in the usual manner for each digit of the desired number. When the dial is turned forward for the first digit 2 a preliminary impulse energizes the trip magnet 55 of the line switch C. This preliminary impulse occurs when the rotary impulse tooth 30 momentarily presses the rotary impulse spring 24 onto the ground post 20, thereby closing an energizing circuit extending from the substation ground G′ through the coöperating ground springs 18 and 19, ground post 20, rotary impulse spring 24 to the rotary line conductor 31, bridge-cut-off springs 56 and 57, trip magnet 55, through the motor magnet relay springs 58 and 59, interrupter springs 60 and 61, through the winding of the motor magnet 62 to the battery lead 63. The motor magnet 62 is not energized over this circuit, due to the comparatively high resistance of the trip magnet 55. As soon as the trip magnet is energized its armature is attracted and the plunger thrust into an idle bank terminal. When the plunger enters the bank terminal an energizing circuit is closed through the motor magnet relay 64 of the master switch. The motor magnet 62 in turn energizes and operates to rotate the ratchet wheel 65, thereby placing the idle plungers opposite the next idle bank terminal. The circuit through the relay 64 extends from ground G^2 through the winding 66 to the common segment 67 of the master switch bank, through the wiper 68 to the individual segment 69 (which corresponds to the trunk terminal just engaged), conductor 70, line switch bank springs 71 and 72, through the winding of the release magnet 73 to the battery lead 63, thence through battery B to ground G. Although this circuit includes the release magnet 73, the said magnet does not operatively energize, since the relay 64 is wound to a high resistance, while the winding of the release magnet 73 is of a comparatively low resistance. The relay 64 upon energizing operates to place the spring 59 in contact with the spring 74, whereby the circuit is closed through the motor magnet 62, said circuit extending from ground G^3 through the relay springs 74 and 59, interrupter springs 60 and 61, through the winding of the motor magnet 62 to the battery lead 63, thence through battery B to ground G. The motor magnet upon energizing attracts its armature 75, whereby the pawl upon the end of the armature 75 engages the ratchet wheel 65 and rotates the latter one step. When the armature 75 is attracted against the magnet cores the interrupter springs 60 and 61 disengage, thereby breaking the energizing circuit of the motor magnet 62. The cam arm 76, being in engagement with the pin 77, is operated to advance the plunger shaft 78, and consequently all idle plungers that may be in normal position, one step to another bank terminal. Also, the master switch bank wiper 68 is carried from the contact 69, which corresponds to the trunk line engaged, to another contact corresponding to the bank terminal before which the idle plun-

gers are now resting. At the instant that the plunger enters the bank terminal the bank springs are pressed into contact as follows: 71 and 72, 79 and 80, 81 and 82, and 83 and 84. The engagement of the springs 83 and 84 establishes a positive guarding potential which is transmitted by the private normal conductor 85 to the connector private bank contact corresponding to the line of substation A. This potential protects the line of the calling subscriber from being called by another while the protected line is in use. Also, when the springs 83 and 84 engage, an energizing circuit is established through the bridge-cut-off relay 86, said circuit extending from ground G^4 through the bank springs 83 and 84, through the bridge-cut-off relay 86 to the battery lead 63, thence through battery B to ground G. This relay upon energizing operates to break the contact between the springs 56, 57 and 87, and to carry the spring 87 into contact with the spring 88. The disengagement of the springs 56, 57 and 87 disconnects the subscriber's line conductors 31 and 32 from the line switch trip magnet 55.

The guarding potential at the master switch bank for protecting the trunk line conductors 89 and 90 from being seized by another line switch extends from the battery lead 63, through the release magnet 73 and bank springs 72 and 71, conductor 70 to the individual contact 69. The closure of connection between the springs 79 and 80 extends the subscriber's vertical line conductor 32 to the trunk line conductor 89. In a similar manner the engagement of the bank springs 81 and 82 extends the subscriber's rotary line conductor 31 to the trunk line conductor 90. The trunk line conductors 89 and 90 terminate in the first selector switch E, and now, when the dial returns to normal position for the first digit, the vertical line relay is energized a number of times, depending upon the digit called. The digit called being 2, the vertical impulse spring 23 is pressed onto the ground post 20 twice, thereby closing an energized circuit each time through the vertical line relay 91 of the first selector E. This circuit extends from the substation ground G′ through the ground post and impulse spring 23 to the vertical line conductor 32, bank springs 79 and 80, side switch wiper 92, vertical line relay 91 to the battery lead 63, thence through battery B to ground G. Each time that the vertical line relay 91 energizes, the springs 93 and 94 are pressed into contact, thereby closing a circuit through the vertical magnet 95 extending from ground G^5 through the springs 93 and 94, private magnet springs 96 and 97, vertical magnet 95 to the battery lead 63, thence through battery B to ground G. The vertical magnet is thereby energized twice, and the shaft and shaft wipers 98, 99 and 100 are raised one step at a time until the shaft wipers are carried up two steps and thus brought opposite the bank level in which are located the terminals of trunk lines leading to connector switches. Immediately following the last vertical impulse the rotary impulse spring 24 is pressed onto the ground post 20, thereby energizing the rotary line relay 101 of the first selector E. The circuit of the relay 101 extends from the ground post 20 through the spring 24, rotary line 31, trunk conductor 90, side switch wiper 104 and relay 101 to the battery lead 63. The rotary line relay energizes and places the springs 102 and 93 in contact, whereby an energizing circuit is closed through the private magnet 103. The private magnet, as is well known, controls the side switch wipers 92, 104, 105 and 106. The private magnet 103, upon energizing and deënergizing, permits the side switch wipers to engage their respective contacts of the second position. When the side switch wiper 105 engages the contact point 107, an energizing circuit is closed through the rotary magnet 108, said circuit extending from ground G^6 through the side switch wiper 105, interrupter springs and windings of the rotary magnet 108 to the battery lead 63, thence through battery B to ground G. The rotary magnet upon energizing operates to rotate the shaft wipers 98, 99 and 100 into engagement with the first bank contact of the second level. If the first contact is busy a positive guarding potential is present at the private bank contact, and as soon as this contact is engaged by the shaft private wiper 100 an energizing circuit is established through the private magnet 103, said circuit extending from the grounded private bank contact to the private wiper 100, through the back-release relay 109, side switch wiper 106 (bearing in mind that the side switch is still in second position), through the private magnet 103 to the battery lead 63, thence through battery B to ground G. The private magnet 103 being of a comparatively high resistance does not permit sufficient current to flow over this circuit to energize the relay 109. This new energizing circuit maintains the private magnet in an energized position, thereby locking the side switch in second position until the private wiper 100 passes onto a contact upon which there is no guarding potential. At that moment the energizing circuit through the private magnet is broken and the said magnet deënergizes, permitting the side switch to pass to third position, whereby the energizing circuit through the rotary magnet is broken.

Furthermore, when the side switch passes to third position a guarding potential is established at the private bank contact corre-

sponding to the trunk line engaged. This potential extends from ground G^9 through the side switch wiper 106, back-release relay 109 to the shaft wiper 100, which engages the private bank contact. The subscriber's line conductors 31 and 32 are then extended to the conductors 110 and 111 of the connector, when the side switch wipers 92 and 104 engage their third-position contact points. The calling subscriber now operates the dial for the second digit 2, and in turn the vertical and rotary line relays 149 and 150 of the connector are energized. The preliminary rotary impulse for this digit operates the rotary line relay of the connector, but its operation at this time is functionless because, as is well known, in the type of selector and connector switches illustrated herein the side switch can not leave first position until after the vertical magnet has been energized at least once, and the side switch can not leave second position until after the shaft has been rotated at least one step. When the vertical line relay 149 energizes, the relay springs 151 and 152 are pressed into contact, thereby closing the circuit through the vertical magnet 153, said circuit extending from ground G^7 through the springs 151 and 152, private magnet springs 154 and 155, side switch wiper 156, vertical magnet 153 to the battery lead 63, thence through battery B to ground G. The vertical magnet operates and, by two steps in a vertical direction, brings the shaft wipers 157, 158 and 159 opposite the bank level in which are located the terminals of the line #220. Following the vertical impulses the rotary line relay energizes to place the springs 160 and 151 into contact to close a circuit through the private magnet 161 which operates to place the side switch wipers in second position. When the side switch wiper 156 engages its second-position contact point the rotary magnet 162 is placed under the control of the vertical line relay, so that when the dial is operated for the last digit 0, and the vertical relay 149 presses the springs 151 and 152 into contact ten times, an energizing circuit is closed ten times through the rotary magnet 162 instead of through the vertical magnet 153. In response to the operation of the dial for the last digit the rotary magnet operates to carry the shaft wipers 157, 158 and 159 into engagement with the tenth contact of the second level of the connector bank. Following the vertical impulses for the digit 0 the usual rotary impulse energizes the rotary line relay 150, and again the private magnet 161 is energized to permit the side switch wipers 156, 163, 164 and 165 to pass to third position. The engagement of the third-position contact point by the side switch wiper 156 places the vertical line relay 149 in control of the ringer relay 166, in the same manner in which the rotary magnet 162 came under the control of the vertical line relay when the wiper 156 passed from first to second position. When the side switch wiper 165 passes to third position a positive guarding potential is established at the private bank contact of the called line. Also, this guarding potential provides an energizing circuit for the bridge-cut-off relay 167 of the line switch C′ of the called line. This energizing circuit extends from ground G^8 through the side switch wiper 165 to the shaft wiper 159, thence over the normal conductor 168, through the winding of the bridge-cut-off relay 167 to the battery lead 63, thence through battery B to ground G. This relay upon energizing operates to separate the springs 169, 170 and 171 and to carry the springs 169 and 172 into contact. The side switch wipers 163 and 164, upon passing to third position, extend the calling subscriber's line conductors 32 and 31 to the normal conductors 173 and 174 of the called line. The calling subscriber at substation A therefore presses the signaling button 37, whereby an energizing circuit is established through the vertical line relay 149 of the connector. The connector line relay operates to close a circuit through the ringer relay 166, said circuit extending from ground G^7 through the springs 151 and 152, private magnet springs 154 and 155, side switch wiper 156, through the winding of the ringer relay 166 to the battery lead 63, thence through battery B to ground G.

The ringer relay upon energizing operates to separate the calling and called lines, and to bridge across the latter the terminals of the ringer generator H, thereby transmitting signaling current to the ringer 44 of the called substation #220. The path of the ringing current extends from the generator H through the ringer springs 175 and 176, side switch wiper 163, shaft wiper 157 to the normal conductor 173, bridge-cut-off springs 172 and 169 to the line conductor 177, switch hook 42 and spring 43, through the ringer 44, condenser 45 to the rotary line conductor 178, normal conductor 174, shaft wiper 158, side switch wiper 164, ringer relay springs 179 and 180 back to the generator H. In response to the signal the subscriber at substation #220 removes the receiver from the switch hook. When the receiver is removed the springs 46 and 47 engage, thereby closing the local battery circuit and providing the transmitter 48 with talking battery current. The springs 49 and 50 also engage and close the line circuit through the receiver. The two substations being provided with talking battery current, communication may be carried on over the conductors shown by heavy lines in Figs. 1 and 2.

The release of the central office switching apparatus occurs when the calling subscriber restores the receiver 2 to the switch hook 3, and thereby grounds the vertical and rotary line conductors 32 and 31 simultaneously, when the release springs 7, 8 and 9 come into contact. The vertical and rotary line relays 149 and 150 of the connector F thereupon energize, and place the release springs 181 and 182 in contact, which closes an energizing circuit through the release magnet 183 in series with the back-release relay 109 of the first selector switch E. This circuit extends from ground G^9 through the side switch wiper 106, back-release relay 109, shaft wiper 100, conductor 100^a, trunk-release springs 181 and 182, release magnet 183 to the battery lead 63, thence through battery B to ground G. The release magnet 183 thereupon energizes and operates to restore the shaft wipers to normal and the side switch wipers to first position. The back-release relay 109 also energizes and places the springs 184 and 185 in contact, which closes an energizing circuit for the release magnet 186 of the selector E, said circuit extending from ground G^{10} through the springs 184 and 185 and release magnet 186 to the battery lead 63, thence through battery B to ground G. The release magnet 186 upon energizing closes the armature 187 in contact with the contact point 188, thereby providing an energizing circuit for the release relay 189. This circuit extends from ground G^{11} through the contact point 188, armature 187, release relay 189, springs 190 and 191, heat coil springs 192 and 193, bank springs 71 and 72, release magnet 73 to the battery lead 63, thence through battery B to ground G. The relay 189 upon energizing operates to shift the springs 190 and 196 into engagement with the springs 194 and 195, respectively. The engagement of the springs 190 and 194 provides a new energizing circuit for the relay 189 extending from ground G^{11} to the spring 190, as before, then through the spring 194, resistance coil 197 to the battery lead 63, thence through battery B to ground G. The engagement of the springs 196 and 195 provides a circuit for the release magnet 73 extending from ground G^{12} through the springs 195 and 196, heat coil springs 192 and 193, bank springs 71 and 72, release magnet 73 to the battery lead 63, thence through battery B to ground G. The release magnet 73 thereupon energizes and attracts its armature, remaining in readiness to withdraw the line switch plunger from the bank terminal when the energizing circuit is broken at the springs 195 and 196. The relay 189 remains energized until the ground is removed from the line conductors 31 and 32 at the substation A. After the release springs 7, 8 and 9 disengage, the line relays 149 and 150 of the connector deenergize and break the release circuit when the springs 181 and 182 disengage. All of the relays and magnets energized during the release now deënergize and restore their respective switches to normal position in readiness for another operation.

The relay 189 deënergizes slowly after its energizing circuit is broken, so as to insure a sufficiently long impulse for releasing the switch C. This slow action may be obtained by placing a heavy copper ring around one end of the core of the relay. In order to make the operation of the relay 189 more positive, its springs should be adjusted to operate in the following manner during its energization: First, the springs 190 and 194 should come in contact, then the spring 190 should break contact with the spring 191, and finally the spring 196 should engage the spring 195.

It will be seen that the subscriber at substation A may operate the central office switches to establish connection with another subscriber at substation A′, and after the termination of the conversation my improved release arrangement is employed to produce an effective release of the line switch from the first selector.

It will be seen that my invention is applicable to a system of that particular type in which the subscribers are divided into groups, and in which the connectors have vertical motion to select groups, and then rotary motion to find the called subscriber in any selected group. The ten subscribers of each group—that is to say, the ten different levels of each connector—go to make up the larger group of one hundred subscribers. The trunks are also, of course, divided into groups, and the selectors have vertical motion to select groups, and then rotary motion to automatically find an idle trunk in any selected group. The special release relays 189 are energized over the third conductors of the trunks leading from the line switches C to the first selectors E, in an exchange of the character shown. It will be readily understood, however, that the switches C may be made individual to trunk lines as well as to subscribers' lines, and that the trunks leading from the switches C may terminate in connectors or other switches as well as in selectors. Obviously these variations in the use of the relays 189 may be made if desired without departing from the spirit of my invention.

The off normal contacts X are connected with the armature 187, and are opened when the selector E is actuated from normal position. The supervisory relay Y is connected with said contacts, and with ground, and is energized when the selector is seized.

The said relay Y is energized over a circuit including the windings of the relay 189 and magnet 73, but at such time the relay 189 and magnet 73 do not energize, as the resistance of the relay Y is high. The supervisory lamp Z is operated and a signal displayed as soon as the trunk is seized by the line switch. This lamp, it will be seen, is controlled by the relay Y. In this way the release trunk between the line switch and the selector is used also for supervisory purposes. It is for this reason that the initial energizing current of the relay 189 is through the contacts 71 and 72, in the manner explained instead of to battery direct. It will also be seen that normally a circuit is closed from ground through the relays Y and 189, master switch wiper 68 and upper winding of the relay 64 to the battery, but the combined resistance of these relays is so high that none of them are energized when thus connected in series.

What I claim as my invention is:—

1. A telephone exchange trunking system line switch provided with a release magnet, a circuit for energizing said magnet, a relay for controlling said circuit, a trunk-release circuit for initially energizing said relay in series with the said magnet, and another circuit closed by the relay for energizing it in multiple with said magnet.

2. A telephone exchange trunking system line switch provided with a release magnet, a release relay adapted to be energized over a circuit including said magnet, and a supervisory relay adapted to be energized in series with said magnet and relay, said supervisory relay being of sufficiently high resistance to prevent the said magnet and other relay from energizing.

3. A telephone exchange trunking system line switch provided with a release magnet, a release relay controlling the said magnet, and a supervisory relay adapted to be energized over a circuit including the winding of said release relay, said supervisory relay being of sufficiently high resistance to prevent energizing of the said release relay.

4. In a telephone exchange trunking system, a line switch provided with a release relay and a release magnet controlled by said release relay, said relay having normally open and normally closed springs, a circuit for the magnet controlled by normally open springs of said relay, a circuit for said magnet including normally closed springs of said relay, and a circuit for said relay including normally open springs thereof.

5. A telephone exchange trunking system line switch provided with a release relay and a release magnet controlled by said release relay, said relay having the springs 190, 191, 194, 195 and 196, the springs 190 and 194 adapted to close before the springs 190 and 191 open, and the springs 195 and 196 adapted to close together after the springs 190 and 191 separate, and circuits for said magnet and relay controlled by said relay, substantially as and for the purpose set forth.

6. In a telephone system, a non-numerical line switch, trunks adapted to be seized by said line switch, each trunk comprising talking conductors and an auxiliary conductor disconnected therefrom, means for automatically selecting idle trunks, a release magnet for said line switch, and a slow-acting relay in said auxiliary circuit for each trunk controlling said magnet, together with a local grounded circuit for energizing said magnet, controlled by said relay.

7. In a telephone system, a plurality of trunks, a release relay for one end of each trunk, means to be released by said relay, adapted to seize the same end of the trunk, a third conductor for each trunk, and means at the other end of each trunk for closing a release circuit over said third conductor in series with the winding of said release relay.

8. In a telephone system, automatic switches, a trunk-release circuit, a supervisory relay, a circuit for said relay including a portion of said trunk-release circuit, a signal controlled by said relay, and a switch adapted by its initial actuation from normal to open the circuit of said relay and thereby retire the said signal.

9. A telephone exchange trunking system line switch provided with a release magnet, a supervisory relay, a circuit for energizing said relay, said circuit including the winding of said magnet, the resistance of said relay being sufficient to prevent energizing of the magnet, a signal controlled by said relay, and means for automatically opening said circuit to retire the signal.

Signed by me at Portland, Multnomah county, Oregon, this 14th day of June, 1909.

JOHAN L. E. MEYER.

Witnesses:
OMER KIRBY,
L. M. ANTOINE.