F. LUBBERGER.

AUTOMATIC RELEASE FOR TELEPHONE SYSTEMS.

APPLICATION FILED JUNE 16, 1910. RENEWED MAR. 19, 1917.

1,280,782.

Patented Oct. 8, 1918.

2 SHEETS—SHEET 1.

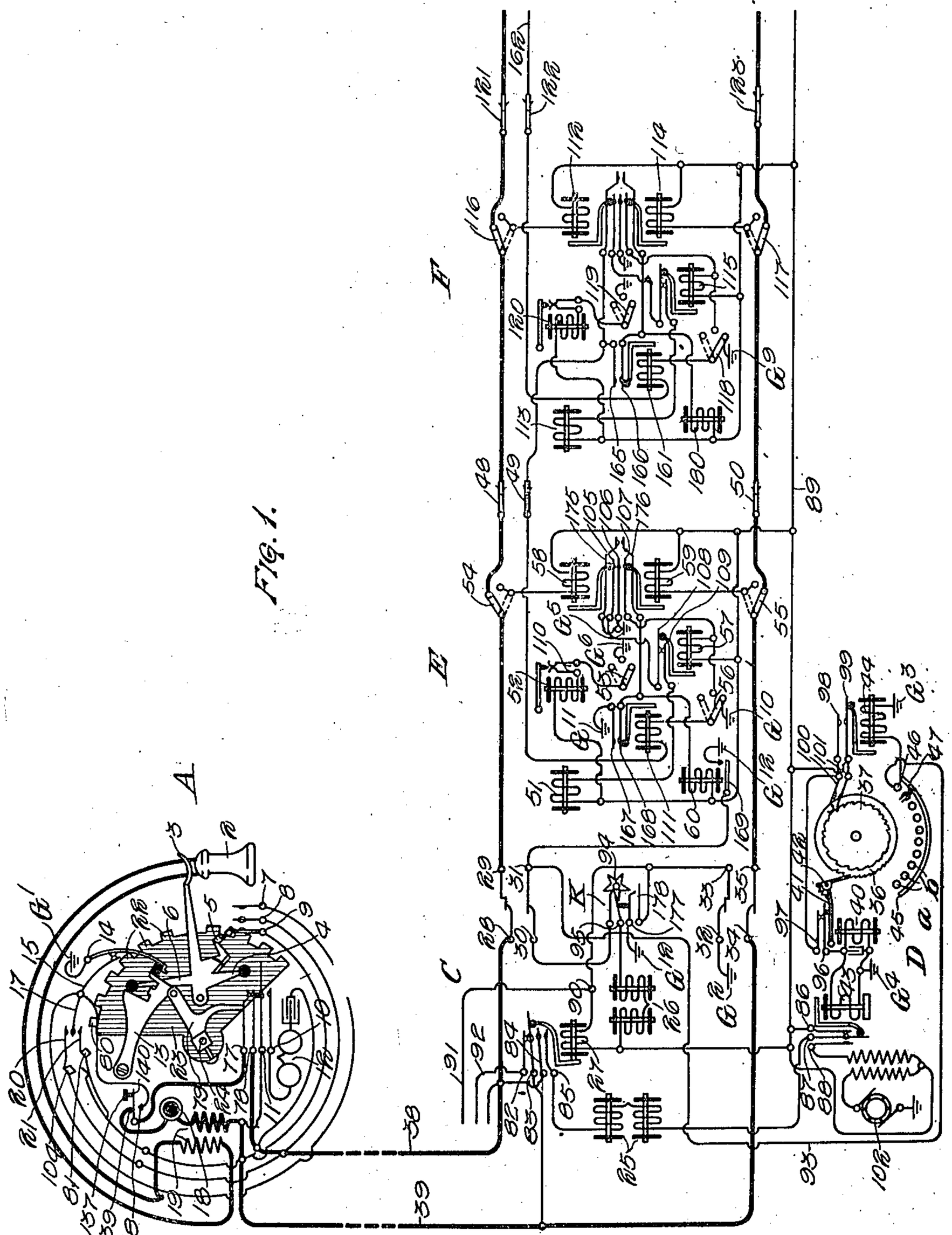

FIG. 1.

Witnesses
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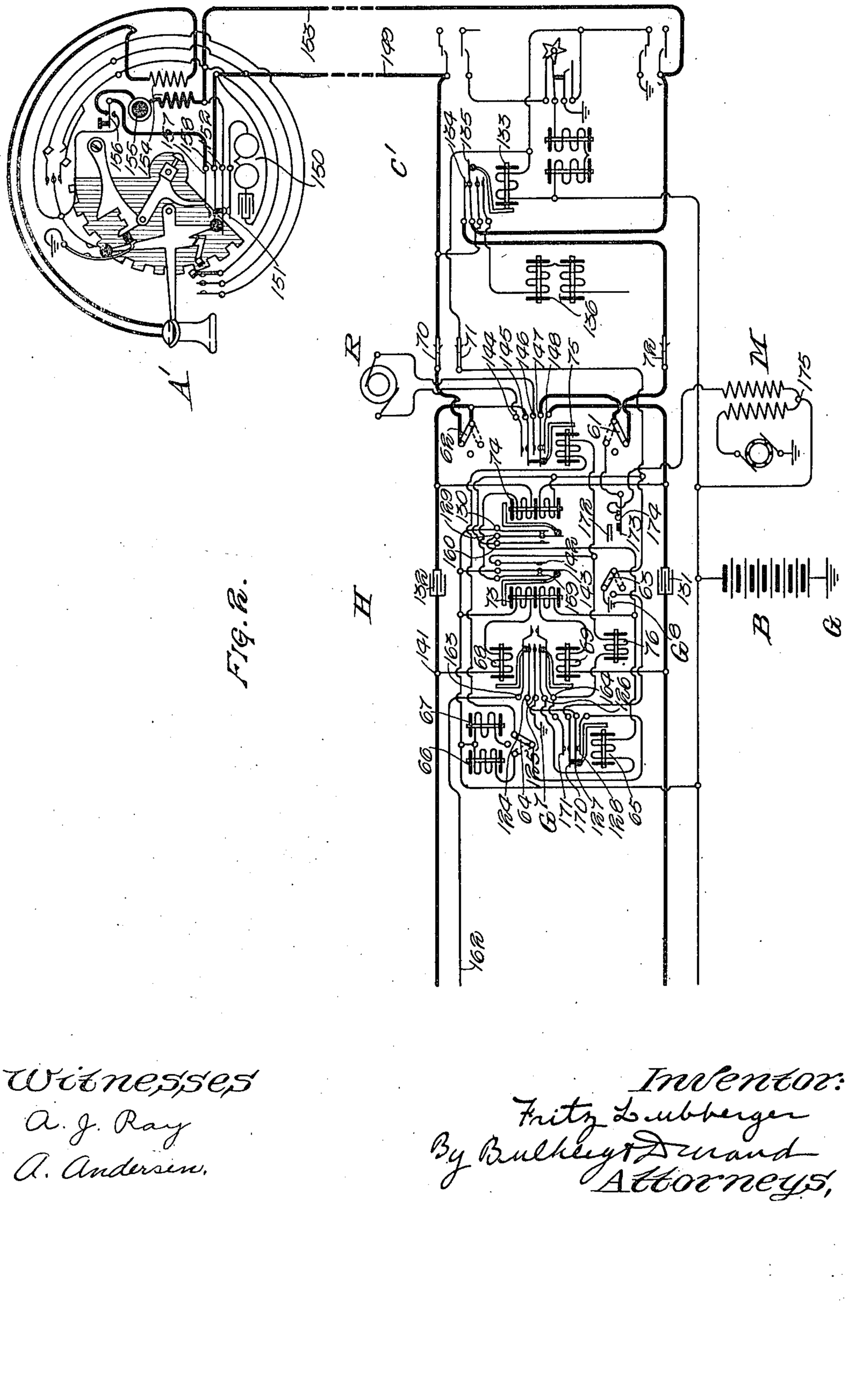

FIG. 2.

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UNITED STATES PATENT OFFICE.

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AUTOMATIC RELEASE FOR TELEPHONE SYSTEMS.

1,280,782. Specification of Letters Patent. Patented Oct. 8, 1918.

Application filed June 16, 1910, Serial No. 567,296. Renewed March 19, 1917. Serial No. 155,947.

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 Automatic Releases for Telephone Systems, of which the following is a specification.

My invention relates to telephone exchange systems of that character in which automatic switches are employed for one or more of the lines thereof. It relates more particularly to a system of that kind in which the automatic switch is adapted to be operated by the grounding of the line thereof. When this occurs the switch seizes a trunk, and the trunk remains busy until the switch is released. It is obvious, therefore, that an accidental grounding of the line will operate the switch and keep the trunk in such condition that it cannot be used by the subscribers.

It is the object of my invention to obviate this difficulty, and to make provision whereby an automatic switch, when operated by an accidental grounding of the line, will be automatically released, thereby making it impossible for a switch of this kind to remain off normal except when operated in response to a call.

In this way there is no danger of any trunk line being rendered busy and unavailable for use except when employed in the usual manner in response to a call for establishing a talking connection.

The nature and advantages of my invention will, however, hereinafter more fully appear.

In the accompanying drawings Figures 1 and 2 taken together show a complete circuit connection established between the two substations A and A′ in a system embodying the principles of my invention.

In Fig. 1 there is shown the substation A, which is connected at the central office by means of the line conductors 38 and 39 to the line switch C, this switch being individual to the substation A. The group of line switches of which the switch C is a member is controlled by a common mechanism D, usually called a master switch. The master switch controls the plungers through the medium of a shaft (not shown), with which the plungers are normally in locking engagement, in such a manner that the plungers are normally held opposite an idle trunk line leading to a first selector, such as the selector E. At K a heat coil or protecting device is shown. At F is shown a second selector similar in construction to the selector E. At H (Fig. 2) is shown a connector switch. At R a ringing current generator is shown. At M is represented a busy signaling machine. At B a battery is shown with its positive terminal preferably grounded. There may, of course, be one or more such batteries, depending upon the conditions to be met.

The substation and line switch shown at A′ and C′ in Fig. 2 are similar to the substation A and line switch C shown in Fig. 1.

The substations may be of any suitable or approved type. As here shown, the substation A comprises, among other details, a receiver 2 and a switch hook 3 for controlling the substation circuits, which controlling operations are accomplished through the medium of any suitable means, such as the cam arms 4, 5 and 6. As the switch hook is lowered the cam arm 5 momentarily presses the release springs 7, 8 and 9 into engagement, whereby the substation line conductors may be grounded simultaneously. When the switch hook is down the cam arm 4 maintains a contact between the springs 10 and 11, thereby bridging the ringer 12 across the line. The substation ground circuit is normally broken between the ground springs 14 and 15 by the cam arm 6, and these springs are also held apart by the locking dog 13 after the receiver is removed and until the dial is turned. When the dial is turned, however, the springs 14 and 15 are allowed to engage to place ground upon the ground spring 17. The substation also comprises the usual transmitter 18, induction coil 19, vertical impulse spring 20 and rotary impulse spring 21. The vertical spring 20 is forced into engagement with the ground spring 17 by the teeth 22 on the impulse wheel 23 only upon the backward rotation of said impulse wheel. The spring 21 is forced into engagement with the ground spring once upon the forward and once upon the backward rotation of the impulse wheel. The impulse wheel is rotated forward by the subscriber through the medium of a dial (not shown) secured to the shaft 24, to which latter the impulse wheel is also secured.

The line switch shown at C is of the general type disclosed in British Patent No.

26,301 of 1906, and in the *American Telephone Journal* of New York of June 6, 1908. It comprises the trip magnet 25, release magnet 26, cut-off relay 27 and a plunger (not shown) which, when released by the energization of the trip magnet, is forced into a bank of springs, causing the springs 28, 30, 32 and 34 to engage springs 29, 31, 33 and 35, respectively. Although only one set of springs (28—35) is shown, there may, however, be a plurality of such sets to which the switch C has access. In normal position the plungers of the line switches C are in engagement with a plunger shaft (not shown), which is controlled by the master switch shown at D. The master switch D controls the plungers of the group of line switches of which the switch C is a member in such a manner that the plungers stand at all times directly opposite the terminals of an idle trunk line leading to a first selector E.

The master switch D is of the general type disclosed in said British Patent No. 26,301 of 1906, and in the said *American Telephone Journal* of June 6, 1908. It comprises the ratchet wheel 36, notched wheel 37 and motor magnet 40 which, when energized, attracts the armature 41 upon the end of which is a pawl 42, thereby giving the ratchet wheel 36 a rotary motion. By means of a suitable mechanical arrangement the rotary motion of the ratchet wheel 36 is imparted to the plunger shaft, giving said shaft an oscillatory motion, thus carrying the plungers which are in locking engagement therewith back and forth in front of the banks of terminals of the trunk lines leading to the selectors E. The master switch is also provided with the operating relays 43 and 44, and the bank *a* consisting of the common segment 45 and the individual segments *b*. The wiper 47 is for the purpose of keeping one of the contacts *b* in electrical connection with the common segment 45.

The heat coil K may be any form of heat coil or protective device which will operate to open a circuit which is closed for an undue length of time. As here represented, the spring 95 normally engages the star wheel 94, thereby completing the circuit through the heat coil. This heat coil will carry the current for operating the magnet 26 for a short time without operating. If, however, this current continues for an undue length of time, sufficient heat is generated to melt the fusible material by means of which the wheel 94 is held stationary. The spring 95 thereupon causes the wheel to rotate a short distance and passes out of contact therewith. When the spring 95 is thus released the spring 177 is permitted to engage the spring 178.

The first selector E is of the general type disclosed in United States Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson & Erickson. It comprises the usual shaft (not shown) and shaft wipers 48, 49 and 50, which shaft has a vertical motion controlled by the vertical magnet 51 and a rotary motion controlled by the rotary magnet 52. The selector is also provided with the usual side switch carrying the wipers 53, 54, 55 and 56. This side switch is controlled by the private magnet 57 which, like the magnets 51 and 52, is controlled through the medium of the line relays 58 and 59. The release of the selector E is brought about by means of the release magnet 60.

The selector F is quite similar in operation to the selector E, as will hereinafter be more fully explained.

The connector H is of the general type disclosed in United States Letters Patent No. 815,176, granted March 13, 1906, to Keith, Erickson & Erickson. Like the selectors, the connector comprises the side switch carrying the wipers 61, 62, 63 and 64 controlled by the private magnet 65. The vertical and rotary magnets 66 and 67 control the vertical and rotary movements of the shaft carrying the shaft wipers 70, 71 and 72. The operations of the connector are controlled by the calling subscriber through the medium of the vertical and rotary line relays 68 and 69. The connector is also provided with the double-wound relays 73 and 74, ringer relay 75 and release magnet 76. As before stated, the substation A′ to which is alloted the line switch C′ is similar to the substation A (Fig. 1).

Having given a general description of the apparatus involving the principles of my invention, I will now describe the operations as they occur when a subscriber at substation A calls a subscriber at substation A′. whose number we will assume to be 2220. I will also describe the operation of the heat coil K should the lines become permanently grounded. When the subscriber at substation A wishes to call the subscriber A′ he removes the receiver 2 from the switch hook 3, which allows the hook to rise, thereby opening the circuit of the bells at the springs 10 and 11, and causing the engagement of the springs 77 and 78. The subscriber A now operates the dial, which, of course, operates the impulse wheel for the first digit 2. As the impulse wheel is rotated forward for the first digit 2 the cam 79 allows the springs 77 and 78 to again disengage, and also, during its forward movement, the dial momentarily grounds the conductor 39. This is accomplished by the tooth 80 striking the projection 81 on the spring 21, thereby forcing it into contact with the ground spring 17. The grounding of the conductor 39 closes an energizing circuit through the trip mag-

net 25 of the line switch C. This circuit extends from ground G′ through the springs 14 and 15, springs 17 and 21, conductor 39, springs 83, 84 and 85, trip magnet 25 and springs 87 and 86 to the battery lead 89, thence through battery B to ground G. The momentary energizing of the trip magnet 25 trips the mechanism which holds the plunger in its normal position, thereby permitting it to plunge into the bank of springs 28—35, forcing them into engagement in the manner before described. The engagement of the springs 28 and 34 with the springs 29 and 35 extends the line conductors 38 and 39 to the first selector E. The engagement of the springs 32 and 33 closes the circuit of the cut-off relay 27, and also puts a guarding ground potential on the private bank contact of the calling line in the banks of all of the connectors which have access to the said line. The circuit through the cut-off relay extends from ground G^2 through the springs 32 and 33, point 90 and cut-off relay 27 to battery lead 89, thence through battery B to ground G.

The circuit to the private bank contact extends over the circuit just traced from ground G^2 to the point 90. From the point 90 it extends over the private normal conductor 91 to the said private bank contact. The energizing of the relay 27 serves to open the circuit of the trip magnet at the springs 84 and 85 and to connect the rotary normal conductor 92 to the line conductor 39. The engagement of the springs 30 and 31 closes a circuit through the relay 44 of the master switch D. This circuit extends from ground G^3 through the relay 44, common segment 45 of the master switch bank *a*, wiper 47, contact 46, conductor 93, springs 31 and 30, star wheel 94 and spring 95 of the heat coil K, release magnet 26 of the line switch C to the battery lead 89, thence through battery B to ground G. The magnet 26 does not energize over this circuit, due to the relatively high resistance of the relay 44. The relay 44 does energize, however, to close the circuit of the relay 43 and the motor magnet 40 in parallel. This circuit extends from ground G^4 through the relay 43 and motor magnet 40 in parallel, springs 96 and 97 and springs 98 and 99 to the battery lead 89, thence through battery B to ground G. The motor magnet 40 energizes to rotate the ratchet wheel 36, and consequently the notched wheel 37, and to break its own circuit at the springs 96 and 97. The springs 100 and 101 are normally held apart by the notched wheel 37—that is, the spring 101 is of the proper length to engage the notches in the wheel 37, thereby permitting it to be separated from the spring 100. The spring 101 is permitted to engage a notch only when the plungers are directly opposite the terminals of a trunk line leading to a first selector E. Therefore, the movement of the ratchet wheel 36 upon the attraction of the armature 41 causes the springs 100 and 101 to engage, which holds the circuit of the motor magnet closed after the wiper 47 passes off the contact 46 until the spring 101 again engages a notch in the wheel 37. As was stated before, the motor magnet deënergizes as it breaks its own circuit, but is immediately energized again. Thus it energizes and deënergizes in the manner of a buzzer to rotate the notched wheel 37 one notch. Should the next trunk be busy the wiper 47 will find the next contact guarded and the circuit of the relay 44 will again be closed. Thus the master switch operates until the plungers are placed in front of an idle trunk line. The relay 43, which energizes in parallel with the motor magnet 40, serves to disconnect battery from the trip magnets of the group of line switches of which the switch C is a member. This is done by the opening of the springs 86 and 87. The engagement of the springs 87 and 88 serves to connect the busy machine 102 with the idle lines through the trip magnets, thereby giving the busy signal to a subscriber who attempts to call while the master switch is operating.

The foregoing are the operations of the central office mechanism upon the removal of the receiver and the forward rotation of the dial for the first digit 2 by the subscriber at substation A. The subscriber now removes his finger from the dial, allowing it to return to normal position. As the dial returns, the vertical impulse teeth 22 engage the cam 104 on the spring 20 in such a manner that the spring 20 is forced against the ground spring 17 twice (the dial having been rotated far enough to allow two teeth to pass the cam 104), thereby sending two ground impulses over a circuit extending from ground G′, through the springs 14 and 15, springs 17 and 20, conductor 38, springs 28 and 29, side switch wiper 54 of the selector E and vertical line relay 58 to the battery lead 89, thence through battery B to ground G. These two impulses through the relay 58 cause it to energize twice, sending two impulses through the vertical magnet 51 over a circuit extending from ground G^5 through the springs 106 and 105, springs 108 and 109 and magnet 51 to the battery lead 89, thence through battery B to ground G. The vertical magnet energizes twice to raise the shaft and shaft wipers two steps opposite the second level of bank contacts. As the rotary tooth 80 passes the spring 21 on the backward rotation of the impulse wheel, it again forces the spring 21 into momentary engagement with the ground spring 17. The grounding of the spring 21 at this time closes a circuit extending from ground G′ through the

springs 14 and 15, springs 17 and 21, line 39, springs 34 and 35, side switch wiper 55 and rotary line relay 59 to the battery lead 89, thence through battery B to ground G. The relay 59 is momentarily energized, which forces the spring 107 into contact with the spring 106, whereby a circuit is closed through the private magnet 57. This circuit extends from ground G^5 through the springs 106 and 107 and private magnet 57 to the battery lead 89, thence through battery to ground. The armature of the private magnet is momentarily attracted and then retracted, which allows the side switch to pass to second position. The passing of the side switch wiper 53 to second position closes an energizing circuit through the rotary magnet 52. This circuit extends from ground G^6 through the side switch wiper 53, interrupter springs 110 and rotary magnet 52 to the battery lead 89, thence through battery B to ground G.

The rotary armature pulls up to break the circuit of its magnet at the interrupter springs 110, to press down the armature of the private magnet and to rotate the shaft and shaft wipers one step onto the terminals of the trunk conductor leading to the second selector F. As the armature of the magnet 52 falls back it releases the private armature, which also falls back (assuming the first contact upon which the shaft wipers are rotated to be idle) and allows the side switch to pass to the third position. Had the first contact been busy the private wiper 49 would have found a guarding ground on said contact, which would complete a circuit extending from said grounded contact through the private wiper 49, back-release relay 111, side switch wiper 56 (in second position) and private magnet 57 to the battery lead 89, thence through battery B to ground G. The relay 111 does not operatively energize over this circuit. The private magnet 57 does energize, however, and locks the side switch in second position. Thus it will be seen that the magnet 52 is again energized as soon as the springs 110 engage, and rotates the shaft another step. This will continue until the private wiper strikes an idle contact, at which time the side switch will be allowed to pass to the third position, as before described. The passing of the wiper 56 to the third position serves to put a guarding potential upon the private bank contact of the trunk leading to the selector F in the banks of all the first selectors that have access to the selector F. In this position the wipers 54 and 55 extend the calling subscriber's line to the second selector F.

The operations of the second selector F for the second digit 2 are the same as were those of the selector E for the first digit. Briefly, this operation is as follows: The vertical line relay 112 operates twice in response to the grounding of the vertical line conductor at the substation A. This relay operates to close the circuit of the vertical magnet 113, which raises the shaft and wipers opposite the second level of bank contacts, which contacts are terminals of trunk conductors leading to the connector H. As is well known, in this type of switches—that is, selector and connector switches—the operations of the rotary line relay and private magnet by the preliminary grounding of the rotary line upon the forward movement of the dial are without operative results if the switch is in normal position. However, the operations of the line relay 114 and private magnet 115 in response to the grounding of the rotary line after the switch is lifted from its normal position permit the side switch carrying the wipers 116, 117, 118 and 119 to pass to the second position. The side switch wiper 119, in second position, closes the circuit of the rotary magnet 120, as before explained, which energizes to rotate the shaft wipers onto the first idle trunk leading to the connector H.

The operation of the connector H for the last two digits of the called number is slightly different from that of the selectors. When the vertical line 38 is grounded at the substation A for the third digit 2, a circuit is completed extending from ground G′ at the substation through the springs 14 and 15, springs 17 and 20, conductor 38, springs 28 and 29, side switch wiper 54, shaft wiper 48, side switch wiper 116 of the selector F, shaft wiper 121, vertical relay 68 of the connector and the upper winding of the relay 73 to the battery lead 89, thence through battery B to ground G. Both of the relays 68 and 73 energize over this circuit. The energization of the relay 73 at this time, however, is without effect. The energization of the relay 68 closes the circuit of the vertical magnet 66, said circuit extending from ground G^7 through the springs 125 and 124, springs 127 and 128, side switch wiper 64 and magnet 66 to the battery lead 89, thence through battery B to ground G. The vertical magnet energizes to raise the shaft and shaft wipers two steps opposite the second level of bank contacts. The rotary tooth 80 of the impulse wheel 23 once more forces the spring 21 into engagement with the spring 17, which closes a circuit through the rotary relay 69 of the connector. This circuit extends from ground G′ through the springs 14 and 15, springs 17 and 21, line conductor 39, springs 34 and 35, wiper 55, shaft wiper 50, side switch wiper 117, shaft wiper 123, relay 69, lower winding of the relay 73 and springs 129 and 130 to the battery lead 89, thence through battery B to ground G. The energization of the

relay 73 is without result at this time. The energization of the rotary relay 69, however, closes a circuit through the private magnet 65. This circuit extends from ground G⁷, through the springs 125 and 126, magnet 65 and springs 129 and 130 to the battery lead 89, thence through battery B to ground G. The private magnet energizes and upon deënergizing permits the side switch to pass to second position. The wiper 64, in second position, connects the vertical impulse spring 124 with the rotary magnet 67. The dial is now operated for the last digit O. The ten impulses which are sent in over the circuit previously traced through the relay 68 momentarily energize said relay ten times, which sends ten impulses through the rotary magnet to step the shaft and shaft wipers around onto the contact of the called line #2220. The final rotary impulse again energizes the rotary relay 69, which in turn closes the circuit of the private magnet 65, which energizes and deenergizes to step the side switch to third position, assuming, of course, that the called line is idle. The passing of the wipers 61 and 62 to the third position serves to connect the calling substation with the called substation through the condensers 131 and 132. When the wiper 63 passes to the third position it puts a guarding ground on the private bank contact of the called line in the banks of all the connectors that have access to the line #2220. This guarding ground extends from ground G⁸ through the wiper 63 to the private wiper 71. A circuit is also closed through the cut-off winding 133 of the line switch C′. This circuit extends from ground G⁸ through the side switch wiper 63, private wiper 71 and cut-off relay 133 to the battery lead 89, thence through battery to ground. The energizing of the relay 133 closes the rotary line at the springs 134 and 135 and also opens the circuit of the trip magnet 136.

After the dial has returned to normal position after the last digit has been called, the subscriber at substation A presses the push button 137, which forces the spring 140 into engagement with the contact 138. A circuit is thus completed extending from ground G′ through the springs 14 and 15, springs 138 and 140, springs 77 and 78, thence over the heavy conductor to the point 141, through the relay 68 and the upper winding of the relay 73 to the battery lead 89, thence through battery to ground. The relays 68 and 73 both energize to complete a circuit through the ringer relay 75. This circuit extends from ground G⁷ through the springs 125 and 124, springs 127 and 128, side switch wiper 64 ringer relay 75 and springs 142 and 143 to the battery lead 89, thence through battery B to ground G. The ringer relay is thus energized and serves to put ringing current through the bells of the called subscriber over a circuit extending from one side of the generator R through the ringer relay springs 144 and 145, side switch wiper 62 shaft wiper 70, line conductor 149, bells 150, springs 151 and 152, line conductor 153, springs 135 and 134, shaft wiper 72, side switch wiper 61 and springs 147 and 146 to the other terminal of the ringing current generator. The subscriber at substation A′ removes his receiver in response to the signal, and on so doing opens the bell circuit at the springs 151 and 152, and closes a circuit through the back-bridge relay 74 of the connector. This circuit extends from ground G⁸ through the side switch wiper 63, lower winding of said relay, ringer springs 148 and 147, side switch wiper 61, shaft wiper 72, springs 134 and 135 of the cut-off relay 133, conductor 153, primary of the induction coil 154, transmitter 155, push button springs 156, hook springs 157 and 158, conductor 149, wipers 70 and 62, upper winding of the relay 74 and springs 159 and 143 to battery. This supplies the called subscriber with talking battery current and also pulls up the relay 74. The energizing of the relay 74 supplies talking battery current to the calling subscriber's line over a circuit extending from ground G⁸ through the wiper 63, springs 160 and 129, lower winding of the relay 73, line relay 69, to and through the substation A (same as substation A′), back over the heavy conductor, through the relay 68 and the upper winding of the relay 73 to battery. The current in the windings of the relay 73 oppose each other; thus the relay does not operatively energize. As soon as the conversation is completed the apparatus used in the connection is restored to normal position upon the hanging up of the receiver at the calling substation. The release is as follows: As the switch hook 3 is lowered the cam 5 forces the springs 7, 8 and 9 into engagement momentarily. Thus a circuit is closed from ground G′ through said springs over the heavy conductors to the connector, and through the relays 68, 69 and 73 to battery. The energization of these three relays closes a circuit through the release magnet 76 of the connector in series with the back-release relay 161 of the selector F. This circuit extends from ground G⁹ of the selector F through the wiper 118, relay 161, shaft wiper 122, conductor 162, springs 163 and 164 of the connector, magnet 76 and springs 142 and 143 to battery. The energization of the relay 161 closes a circuit through the release magnet 180 of the selector F in series with the relay 111 of the selector E. This circuit extends from ground G¹⁰ of the selector E through the wiper 56, relay 111, wiper 49, springs 165 and 166 and magnet 180 to battery. The energization of the relay 111 closes

the circuit of the release magnet 60 of the selector E. This circuit extends from ground G^{11} through the springs 167 and 168 and magnet 60 to battery. The energization of the magnet 60 closes a circuit from ground G^{12} through the springs 169, 31 and 30, star wheel 94 and spring 95 of the heat coil K, and release magnet 26 of the line switch C to the battery lead 89. The energization of these various magnets holds their armatures in readiness to restore the switches to normal position as soon as the circuits of the magnets are broken. The engagement of the springs 7, 8 and 9 is only momentary upon the downward movement of the hook. Thus the energizing circuit of the line relays 68 and 69 of the connector is only momentary. The disengagement of the springs 163 and 164 breaks the circuit of the magnet 76 and relay 161 of the selector F. The relay 161, upon deënergizing, breaks the circuit of the magnet 180 and the relay 111. The deënergizing of the relay 111 breaks the circuit of the magnet 60, which magnet, upon deënergizing, breaks the circuit of the release magnet 26 of the line switch C. As has been stated, the said magnets deënergize to restore the apparatus to normal position.

Returning now to that point in the operation of the switches where the connector has rotated to the called line, but has not yet received the rotary impulse to cause the side switch to pass to the third position. Should the called line be busy the private wiper 71 will find a guarding ground on the connector private bank contact of the called line, as before explained. Now, as the rotary relay 69 is energized by the grounding of the rotary line at the substation A, the private magnet pulls up, as before described, and closes a circuit extending from ground on the wiper 71 through the side switch wiper 63 (in second position), springs 170 and 171, release magnet 76 and springs 142 and 143 (the relay 73 energizes with the relay 69) to the battery lead 89, thence through battery B to ground G. The release magnet 76 energizes to restore the connector switch to normal position. The subscriber then presses the ringing button at the substation A in the usual manner. This grounding of the vertical line acts now to raise the shaft step by step as the button is pressed. As soon as the shaft is raised one or more steps the arm 172 is lifted, thereby permitting the springs 173 and 174 to engage. The calling subscriber now receives the busy signal over a circuit extending from battery through the secondary of induction coil 175, springs 174 and 173, side switch wiper 61 (in first position), springs 147 and 148, condenser 131, thence over the heavy conductor to and through the substation A, back over the other heavy conductor through the relays 68 and 73 to the starting point. Upon hearing the busy signal the subscriber A hangs up the receiver, which restores the apparatus to normal position, as before described.

Having described the operation of the apparatus used in setting up a connection, I will now explain the function of the heat coil K shown in Fig. 1. It will be seen that the grounding of either of the line wires 38 or 39 causes the plunger of the line switch C to be thrust into the bank of springs 28—35 through the medium of the trip magnet 25. It will also be seen that after the lines are closed on the first selector E through the springs 28 and 29, and springs 34 and 35, a ground on the vertical and rotary line wires 38 and 39 will energize the respective relays 58 and 59 of the selector E. Thus it is evident that if the two sides of the line wires 38 and 39 should become accidentally grounded, the line switch C would operate to connect the line with the selector E, and the two line relays 58 and 59 thereof would be energized. The simultaneous energization of the relays 58 and 59 completes a circuit from ground G^5 through the springs 175 and 176 and release magnet 60 to the battery lead 89. The magnet 60, upon energizing, would close a circuit through the line switch release magnet 26, as has already been explained. The release magnets 60 and 26 would remain energized as long as the relays 58 and 59 remained energized. It is also evident that as long as the line switch C maintains connection with the selector E, the selector will be unavailable for use by any calling subscriber. As herein shown, however, the energizing circuit of the release magnet 26 includes the heat coil K. After this circuit has been closed for an undue length of time the heat coil K will operate to break the circuit of the magnet 26 by allowing the spring 95 to disengage the wheel 94. The deënergization of the magnet 26 will allow the line switch C to be released, whereupon the selector line relays will become deënergized, breaking the circuit of the magnet 60. The magnet 60, upon deënergizing, will allow the selector E to be restored to normal position and become available for use by the other subscribers. In its operated position the heat coil K maintains the circuit of the cut-off relay 27 by the closure of contact between the springs 177 and 178. It is evident that if the relay 27 were allowed to deënergize, the trip magnet 25 would again be connected with the grounded line and the line switch C would be operated again. Also, in its operated position the heat coil maintains a guarding potential on the connector private bank contacts of the line of the substation A from ground G^{12} which prevents said line from being called while it is in trouble.

From the foregoing it is evident that

when a line becomes accidentally grounded it occupies a trunk line leading to a first selector only long enough for the heat coil K to operate. Unless the heat coil or some similar device is used, this grounded line will occupy a trunk until the trouble is removed from the line. It is evident that the heat coil K might be provided with additional springs for closing an alarm or signal circuit, such as ordinarily used with heat coils or protective devices of this character.

It will thus be seen that I provide means for automatically releasing a switch without manual control thereof. When the switch is operated as a result of accidental grounding of the line a trunk connection is established, but this connection is then automatically released without manual control thereof—that is, without the assistance of either a subscriber or an operator. The electrothermal switch is connected in series with the release magnet of the line switch, and controls the circuit of such magnet, whereby the magnet is automatically deënergized and the switch released if the magnet remains energized too long. The magnet can remain energized long enough to release the switch in the regular and well-known manner, but if the current continues to flow for any length of time it will operate the electrothermal switch and thereby automatically release the trunking connection improperly established by the accidental grounding of the line.

For the broader purposes of my invention I do not limit myself to the exact construction shown and described, but desire to cover my invention broadly, and to that end what I claim as my invention is:—

1. In a telephone system, a subscriber's line, an automatic switch therefor for extending a connection from said line, line contacts for connecting to said line, private contacts associated with said line contacts, a release magnet for said switch, an electrothermal switch in the circuit of said magnet controlling said circuit, whereby the switch is automatically released if the magnet remains energized too long, and means controlled by said electrothermal switch for placing a guarding potential on said private contacts.

2. In a telephone system, an automatic switch, an operating magnet therefor, a cut-off relay for cutting off said operating magnet, a release magnet, an electrothermal switch in the circuit of said release magnet, whereby said switch is automatically released if said release magnet remains energized too long, and means controlled by said electrothermal switch for closing a circuit through said cut-off relay.

3. In a telephone system, a non-numerical trunking switch, an operating magnet therefor, a cut-off relay for cutting off said operating magnet, a release magnet operative upon deënergization thereof to release said switch, an electrothermal switch in the circuit of said release magnet, whereby said switch is automatically released if said release magnet remains energized too long, and means controlled by said electrothermal switch for closing a circuit through said cut-off relay.

4. In a telephone system, a subscriber's line, an automatic switch therefor for extending a connection from said line, a contact for said line for extending a connection to said line, a private contact associated therewith, release mechanism for said switch, a battery for operating purposes, automatic means for operating said release mechanism by closing connection from the battery to the line, and a thermal switch associated with said first switch controlling said release mechanism whereby the switch is automatically released if the circuit from the battery to the line is prolonged, and means controlled by said thermal switch for placing a guarding potential on said private contact.

5. In a telephone system, an automatic switch, an operating magnet therefor, a cut-off relay for cutting off said operating magnet, release mechanism for said switch, a battery for operating purposes, automatic means for operating said release mechanism by closing connection from the battery to the line, a thermal switch associated with said release mechanism whereby the switch is automatically released if the circuit from the battery to the line is prolonged, and means controlled by the thermal switch for closing a circuit through said cut-off relay.

6. In a telephone system, a subscriber's line, a progressively movable switch therefor for extending a connection from said line, line contacts for establishing connection to said line, a test contact associated with said line contacts, a release magnet for said switch, a time switch in the circuit of said magnet for controlling said circuit whereby the said progressively movable switch is automatically released if said magnet remains energized too long, and means controlled by said time switch for placing a guarding potential on said test contacts.

7. In a telephone system, a progressively movable switch, an operating magnet therefor, a cut-off relay for cutting off said operating magnet, a release magnet, a time switch in the circuit of said release magnet whereby said progressively movable switch is automatically released if said release magnet remains energized too long, and means controlled by said time switch for closing a circuit through said cut-off relay.

8. In a telephone system, a non-numerical trunking switch, an operating magnet there-

for, a cut-off relay for cutting off said operating magnet, and a release magnet operative upon deënergization thereof to release said switch, a time switch in the circuit of said release magnet whereby said non-numerical switch is automatically released if said release magnet remains energized too long, and means controlled by said time switch for closing a circuit through said cut-off relay.

9. In a telephone system, a subscriber's line, an automatic switch therefor for extending a connection from said line, a contact for said line for extending a connection to said line, a test contact associated therewith, release mechanism for said switch, a battery for operating purposes, automatic means for operating said release mechanism by closing a circuit therefor through said battery, and a time switch associated with said first switch controlling said release mechanism whereby the switch is automatically released if said circuit is prolonged, and means controlled by said time switch for placing a guarding potential on said test contact.

10. In a telephone system, a non-numerical switch, an operating magnet therefor, a cut-off relay for cutting off said operating magnet, release mechanism for said switch, a battery for operating purposes, automatic means for operating said release mechanism by closing a circuit therefor through said battery, a time switch associated with said release mechanism whereby said non-numerical switch is automatically released if said circuit is prolonged, and means controlled by said time switch for closing a circuit through said cut-off relay.

Signed by me at Chicago, Cook county, Illinois, this 13th day of June, 1910.

FRITZ LUBBERGER.

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