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CHAIN START CIRCUIT

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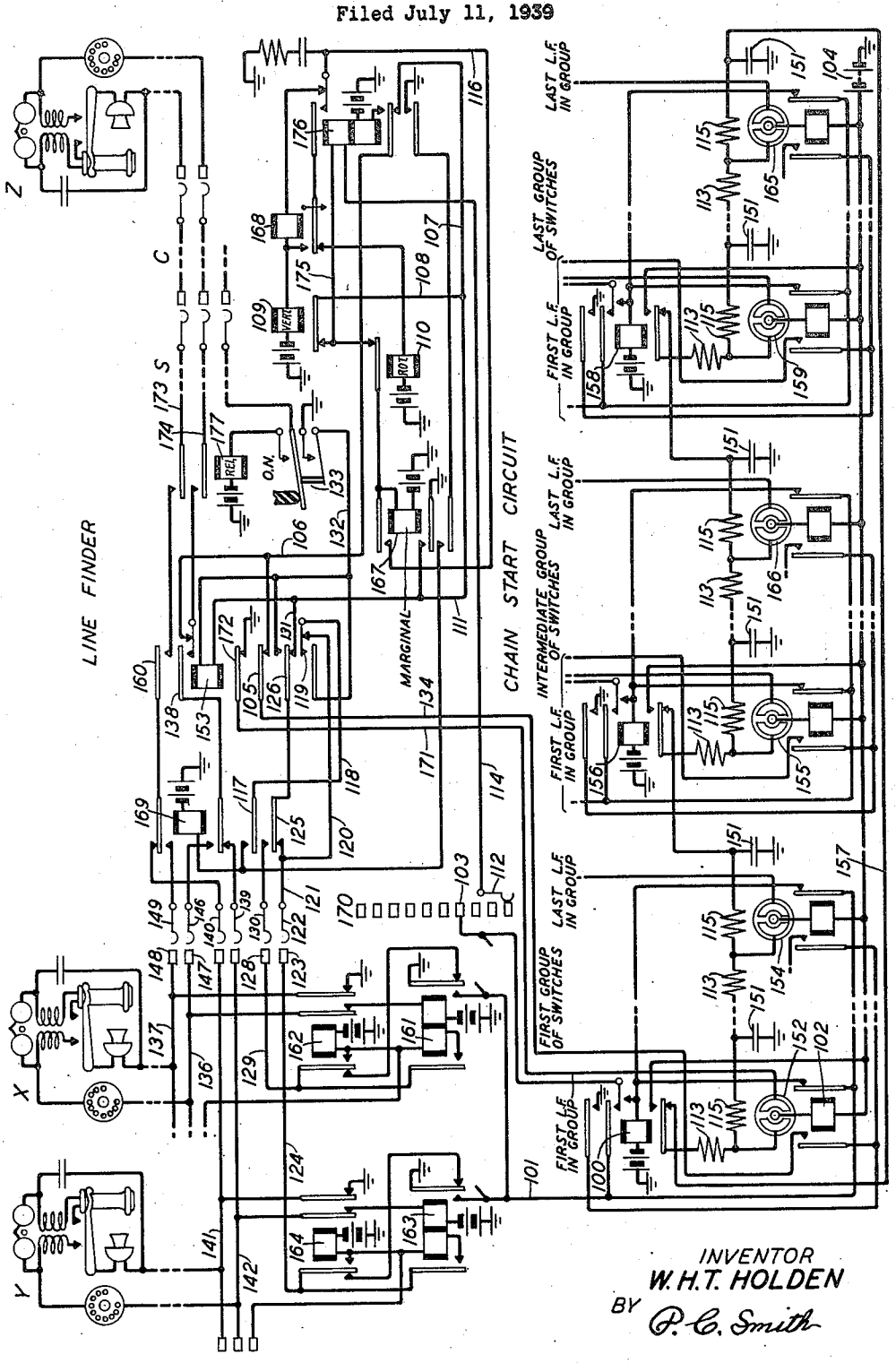

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CHAIN START CIRCUIT

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This invention relates to chain start circuits and more particularly to a start circuit that employs electronic devices which are rendered operative in a desired order to initiate the operation or selection of whatever appliances are controlled thereby. By an electronic device I mean an evacuated vessel containing a cathode, an anode and one or more control electrodes and filled to a predetermined pressure with some inert gas like neon, argon, helium and the like which, when the potential on any one of its control electrodes becomes sufficiently positive with respect to the potential of the "cathode" or current carrying electrode, breaks down and becomes conducting to allow a flow of space current between the cathode and anode until the anode potential is rendered sufficiently negative with respect to the cathode potential. Current through the device or tube can then be restarted by making the potential of the control electrode again sufficiently positive with respect to the potential of the cathode.

In the usual chain start circuit it is necessary to employ a relay that functions in response to a suitable signal to start the operation of an available one of a group of devices and thereafter to advance the start wire to a succeeding relay which, in turn, performs a similar function. Of necessity, the utility and efficiency of this kind of a circuit depends upon the speed of the relays themselves and the reliability of the contacts thereon, the failure of any one of which, in extending the start wire serially over the operated relays, will effectively block its further use. In a start circuit using electronic devices, starting operations are exceptionally fast because of the speed of tube breakdown and series contact chains, therefore, are dispensed with, thus avoiding failure through a break in the chain itself and thus resulting in a start circuit which is fast and reliable.

By way of illustration, the principle and operation of the invention will be described with reference to its application to the line-finder switches of a telephone system the lines of which terminate on terminal banks accessible to said switches, although it will be evident to all skilled in the electrical arts that the invention is adaptable to any electrical system involving the selection, preselection, or allotment of electromechanical devices adapted to a wide variety of uses.

In certain types of telephone systems in which selective switching devices are employed, particularly those adapted for the extension of connections in the full automatic manner, the subscribers' lines terminate at the central office in the multiple banks of line-finder switches, and to secure the advantages incident thereto these lines are usually divided into relatively large groups the number of finder switches reserved for preferred use by any one line group being dependent, of course, upon the size of the group and its calling rate. The groups of lines may be subdivided into smaller groups and the finder switches serving such groups are provided with as many brush sets as there are subdivisions in the group. Thus, according to one well-known practice which is herein used to illustrate the operation of the invention, the lines are divided into two hundred line groups, each being subdivided into one hundred line subgroups that appear on separate terminal banks accessible to finder switches equipped with two sets of brushes, that is, an upper set for engaging the terminals of the one hundred lines appearing in the upper bank and a lower set for engaging the terminals of the one hundred lines appearing in the lower bank. These subgroups of one hundred lines are again subdivided into smaller groups of ten lines each located on a different terminal level, and the lines in corresponding levels in the two terminal banks are grouped together as a unit with respect to a group of line-finder switches to which these lines have a preferred access when initiating calls. Accordingly, the start wire circuit which constitutes the present invention is used, in a system of this kind, to start available line-finder switches in a preferred group and in other groups if none are available in the preferred, for connection to the terminals of calling lines in response to calls initiated therefrom.

Referring to the drawing, there is shown in schematic manner two lines X and Y belonging, respectively, to the upper and lower groups of one hundred lines terminating on the multipled terminal banks of what are known as "two hundred point" switches, while directly below the circuit thereof is shown the chain start circuit which is the subject of the present invention.

The invention will be more readily understood from a detailed description of the operation of the circuits shown in the drawing.

Upon the removal of the receiver at substation X, the line relay 161 operates over the following circuit: battery, right winding of relay 161, right inner contacts of cut-off relay 162, line conductor 136, through the substation loop at X, returning to ground over the line conductor 137 and the right outer contacts of relay 162. The line relay 161 operates and, in attracting its

right front contacts, operates the group relay 100 over the following path: grounded right front contacts of relay 161, conductor 101, right contacts of relay 102, winding of relay 100, battery. Relay 100, in attracting its upper contacts, locks itself to ground on conductor 101 and also applies ground to the segment 103 of the vertical commutator 170 which is common to the major group of lines to which substations X and Y belong and which is traversed by the brush 112 when the brush shaft (not shown) is stepped vertically by a circuit shortly to be described. In attracting its lower armature, relay 100 connects positive battery 104 over the lower front contact of relay 100 to the charge path comprising an essential part of the start circuit.

The start circuit comprises an electronic tube for each line-finder switch, a relay connected to the anode thereof such as, for example, tube 152 and relay 102, respectively, two series resistances 113 and 115 for each tube the control electrode of which is connected to the mid-point thereof, and a grounded condenser 151 intermediate the second resistance 115 of one tube and the first resistance 113 of the next tube, the last condenser in the chain completing a loop to the bottom back contact of the first group relay 100 over conductor 157. The cathode of each tube is conected to a source of negative potential on a normal set of contacts of relay 153 of the line-finder circuit operatively associated with said tube. Since the total number of line-finder switches available to all the lines are divided into groups normally preferred by level group divisions, the tubes themselves partake of the same number of divisions as the line finders themselves in that the connection of positive battery 104 to the charging circuit takes place through the contacts of the group relay common to a level group of lines as, for instance, relay 100, or relay 156 or relay 158 when any or all of these relays operate in response to calls initiated from calling lines in the correlated groups as already described, for example, for line X in the level group controlling the operation of group relay 100. The object of applying positive battery 104 through the individual group relays is to insure the choice of a line-finder switch for connection with a calling line from the group of switches allocated for preferential use with the level group in which the calling line belongs, and this is done by causing the breakdown of the tube belonging to the first line-finder switch available in such a group. Should there be no line finders available in the preferred group the start circuit is arranged to cause the breakdown of the tube belonging to the first line-finder switch available in the next choice group. These selective operations continue until an available line finder is chosen.

As can be seen from the drawing and as already explained, the start circuit is essentially a closed loop of paired series resistances (113—115) with paths to ground through condensers 151 between each pair of resistances, and an impedance through a tube and a relay (102) between each two resistances of a pair to a source of positive potential 104. If the source of positive potential connected to each of the tube relays should be applied to any point of the loop, a charging circuit would be established for all the condensers through the connecting resistance network and the time taken for each of them to reach a particular potential would depend, of course, upon its remoteness from the charging source. Whence it follows that the condenser nearest the charging source would be charged to that particular potential before all others. Now since the control electrode of each tube is connected to the loop ahead of each condenser and is separated from it by one of the paired resistances 115, it further follows that the electrode of the tubes immediately preceding the condenser nearest the charging source will reach a positive potential value higher than that of the condenser itself by the value of the potential drop in the intervening resistance 115 earlier than the condenser. As the potential charge is propagated throughout the loop, the electrodes of all tubes connected thereto will be charged, in time, to the same potential, but the time at which they become so charged will be different for each tube, that of the tube most remote, electrically, from the charging source being the last to reach this value. Now if the charge to which the tube control electrodes are subjected will reach breakdown potential at different times it is obvious that the tube nearest the charging source will reach this potential value ahead of all others, and when it breaks down and thereby establishes a discharge path therethrough, the electrodes of all other tubes will be raised to no higher potential than that reached by them when the first tube breaks down, because of the direct current path for the anode battery now established through the conducting tube. Since the control electrodes of the other tubes now cannot be charged to the requisite breakdown potential, said tubes remain inoperative.

Referring, now, to the drawing for an understanding of the manner in which a charge of the loop start circuit permits the selection of an available line finder, when positive battery 104 is applied to the bottom front contacts of relay 100, the charging potential is propagated along the loop causing all the condensers 151 to begin to charge with condenser 151 to the right of tube 152 beginning to charge first and condenser 151 to the right of the last tube 165 beginning to charge last. When the first condenser is partially charged, the control electrode of tube 152 is made positive and this tube breaks down between its cathode, which is connected to ground on the back contacts of relay 153 over conductor 171, and its anode which is connected to positive battery 104 via the winding of relay 102. Space current flows through the tube 152 and relay 102 operates to perform the function of starting the line-finder switch controlled thereby to engage the terminals of the calling line, as explained hereinafter. For the purpose of further explaining at this time the operation of the chain start circuit, it will be asumed that when the line-finder switch has engaged the terminals of the calling line X, relay 153 will operate, relay 100 will release and, due to the disruption of the cathode-anode circuit at the back contacts of relay 153, tube 152 will be reset. Under these circumstances, relay 102 will release, thereby reestablishing the normal unoperated condition of the chain start circuit except for the fact that the cathode conductor 171 of tube 152, being disconnected from ground by the operation of relay 153, renders said device inoperative and thereby protects the line-finder switch taken into use for service with line X from reseizure by any other calling line in the group of line X or any

other group served by the entire chain start circuit.

If, after relay 153 has operated, another line in the same level group as line X, say line Y, initiates a call, resulting in the operation of the line relay 163 and the common group start relay 100 over the common conductor 101 and the back contacts of relay 102, then the connection of positive battery 104 over the bottom front contacts of relay 100 will not be effective again to operate tube 152 because cathode potential has been removed therefrom by the operation of relay 153, as before mentioned. Hence while the connection of positive battery 104 to the bottom front contact of relay 100 will again establish a charging circuit to all condensers 151 of the start circuit through the paired series resistances 113—115 . . . 113—115, it follows that the tube which this time will reach breakdown potential first is the one next to tube 151 since, in this case, this tube is nearest to the charging source 104. For completeness of disclosure the drawing has been made so that the first and last tube of each group of switches is shown. That is, tube 152 would be the first and tube 154 would be the last of the group of switches normally serving as first preference to the level group of lines indicated by lines X and Y. However, if tube 154 were the one immediately succeeding tube 152, then it would be the one that would be rendered conducting upon the initiation of a call by line Y following the resetting of device 152, whereupon its operation would be followed by the operation of the line-finder switch controlled thereby to engage the terminals of line Y. In this manner it is seen that, as the lines in a level group exhaust the line-finder switches normally available to them, they will, thereafter, have access to the succeeding group of preferred line finders due to the fact that the tubes of the busy line finders of their own group will have been rendered non-conducting by the operation of the relay 153 in the respective line finders. This process of selection will continue down through all groups until the last line-finder switch is taken into use.

If simultaneous calls originate among lines in different level groups, line-finder switches in each of the preferred available groups will be started simultaneously. Thus if three calls originate simultaneously, one in the level group designated by group relay 100, another in the level group designated by group relay 156, and another in the level group designated by group relay 158, then these three relays will operate in the manner already described for the operation of relay 100. Positive battery 104 will then establish three charging circuits: one through the bottom front contact of relay 158, the resistance combinations 113—115 to parallel grounds through condensers 151 on either side of the tubes of the group including those designated 159 at one end and 165 on the other and resulting in the breakdown of the tube first charged to breakdown potential which, from what has already been said, may be assumed to be tube 159 if not rendered non-conducting by the busy condition of its associated line finder; another charge path will be completed through the bottom front contact of relay 156, resistance combinations 113—115 to parallel grounds through the condensers 151 on either side of the tubes in the group that includes those designated 155 at one end and 166 at the other and resulting in the breakdown of the tube first charged to breakdown potential, which will be tube 155 if not rendered non-conducting by a busy condition of its associated line finder; while a third charging path will be completed through the bottom front contact of relay 100, the series resistance combinations 113—115 to parallel grounds on either side of the tubes in the group including tube 152 at one end and tube 154 at the other. Tube 152 will, of course, break down first if it is not rendered inoperative by the busy condition of its associated line-finder switch. The three tubes thus rendered conducting will operate their corresponding anode relays 102 and cause the operation of their respective associated line-finder switches in the manner now to be described for the switch disclosed in the drawing assumed to be associated with tube 152 which, from the previous description, was rendered conducting by the initiation of a call by the line X.

The operation of the relay 102, due to the conducting state of tube 152 and by the opening of its right contacts, temporarily removes relay 100 from control of other subscribers to prevent interference, while by the closure of its left contacts it initiates the vertical movement of the associated line finder. The circuit for initiating this vertical movement is as follows: ground, top outer contacts of relay 100, left contacts of relay 102, conductor 134, armature 105 of relay 153 and its back contact, conductor 106, bottom inner back contact of relay 176, conductors 107 and 108, interrupter contacts of the vertical magnet 109, interrupter contacts of rotary magnet 110, winding of relay 167 to battery. Relay 167 operates, and in attracting its top set of contacts, connects this ground to the winding of slow-release relay 168 and vertical magnet 109 in series, by way of the top normally made contacts of relay 176, whereupon the vertical magnet operates and steps the finder brush shaft (not shown) one step in its vertical movement. Relay 167, upon energizing, further locked itself over the following circuit: battery through the winding of said relay, interrupter contacts of magnets 110 and 109, respectively, conductors 108 and 111, bottom inner contacts of relay 167 to ground. The vertical magnet 109, at the end of its stroke, opens the locking circuit of relay 167 as well as the original energizing circuit of said relay, whereupon the relay 167 releases and opens the circuit of the vertical magnet 109. The vertical magnet thereupon releases, and in closing its interrupter contacts, again energizes relay 167 over its original energizing circuit, whereupon said relay locks up over its locking circuit, previously described, and recloses the circuit of vertical magnet 109 causing it to operate and advance the brush shaft another step. This interaction between relay 167 and the vertical magnet 109 continues until the group brush 112 of the finder reaches the grounded segment 103 of the calling group, whereupon relay 176 operates over the following circuit: battery through winding of relay 167, interrupter contacts of rotary magnet 110, conductor 175, upper winding of relay 176, conductor 114, brush 112 and segment 103 to ground on the top inner contacts of relay 100. Relay 176 operates and at its top normally closed contact opens the vertical stepping circuit. At the moment that the group brush 112 engages grounded segment 103, relay 167 is still locked up to its own bottom inner contacts since this locking circuit is opened only at the extreme limit of the stroke of the vertical magnet 109. When this occurs, however, relay 167

does not release since it has another circuit including the upper winding of relay 176 to ground on segment 103. When slow relay 168 releases, which occurs shortly after relay 176 operates, the following circuit is closed to operate the rotary magnet 110 to rotate the brushes over the calling line group: battery through the winding of magnet 110, back contacts of relay 168, top front contacts of relay 176, conductor 116, top contacts of relay 167, interrupter contacts of magnets 110 and 109, respectively, conductors 108 and 111, to ground at the bottom inner front contacts of relay 167. Magnet 110 operates, rotates the brushes one step and at the end of its stroke opens the locking circuit of the relay 167 and also moves the group brush 112 off the grounded group contact 103. Now if the first two sets of terminals encountered by the brushes are terminals of non-calling lines, the brush shifting relay 169, which was operated when relay 176 operated at the end of the vertical movement over a circuit including the bottom outer contacts of relays 167 and 176, remains operated over the following circuit: battery through the winding of relay 169, its armature 117 and front contact, conductor 118, normally made contacts 119 of relay 153, conductors 120 and 121, brush 122, test multiple 123, conductor 124, left back contacts of a cut-off relay corresponding to cut-off relay 164 of line Y to ground at the right back contacts of a line relay corresponding to line relay 163 of line Y. Therefore, the following circuit is completed to operate relay 167 to transmit another impulse to the rotary magnet 110 to advance the finder from the terminals of these two lines which are non-calling, to the next two lines: battery through the winding of relay 167, interrupter contacts of magnets 110 and 109, respectively, conductors 108, 111 and 131, armature 126 of relay 153, armature 125 and front contact of relay 169, test brush 130, test terminal 128, conductor 129, back contacts of a cut-off relay corresponding to cut-off relay 162 of line X, right back contacts of a line relay corresponding to line relay 161 of line X to ground. Relay 167, in operating, again locks up over the circuit heretofore traced, including its bottom inner armature and front contact, and again operates the rotary magnet 110 over the following circuit: ground on the bottom inner contacts of relay 167, conductors 111 and 108, interrupter contacts of the magnets 109, 110, respectively, top contacts of relay 167, conductor 116, top front contacts of relay 176, back contacts of relay 168, winding of magnet 110 to battery. The rotary magnet operates to move the brushes one step and at the end of its stroke opens the locking circuit traced for the relay 167 which, in opening its top contacts, opens the circuit of the rotary magnet. This interaction between relay 167 and rotary magnet 110 continues until one of the sets of brushes encounters a calling line, which is indicated by the absence of ground at its test terminal. It having been assumed that the calling line is substation X, no ground is present on its terminal 128 but ground is present on test terminal 123 of the non-calling substation Y. Consequently, relay 169 is held up from the ground on test multiple 123. There being no ground, however, at test terminal 128, relay 167 cannot again energize to cause the reoperation of the rotary magnet. The switch, therefore, comes to rest on the calling line multiple. During the movement of the finder over the non-calling line terminals, relay 153 is not operated since its winding is short-circuited over the following path: ground on conductor 131 as already traced, to one side of its winding and ground from the lower set of contacts on off-normal contact springs 133, now closed, conductor 132 to the other side of its winding. When, however, brush 130 reaches test terminal 128 of the substation X which is calling and therefore is not grounded, relay 153 energizes over the following circuit: battery through the winding of relay 167, interrupter contacts of magnets 110 and 109, respectively, conductors 108 and 111, winding of relay 153, conductor 132 to ground on the lower contact of off-normal switch 133. Relay 153 operates and in attracting its lowermost armature, maintains relay 169 energized from the ground on the off-normal switch 133. Relay 169, therefore, will remain energized until release takes place. In attracting its armature 172, relay 153 removes ground from the cathode of tube 152, causing thereby a disruption of the space current therethrough and the release of relay 102. In attracting its armature 126, relay 153 applies a direct ground from the off-normal switch 133 to the cut-off relay 162 of the calling line X to operate the same. This circuit is as follows: battery through the winding of relay 162, left winding of relay 161 and its left contacts, conductor 129, terminal 128, brush 130, armature 125 and front contact of relay 169, armature 126 and front contact of relay 153, conductor 132 to ground at the off-normal switch 133. The cut-off relay 162, in operating, deenergizes the line relay 161. Ground is applied to the test multiple 128 of substation X in the other finders in which it appears, to render the same non-calling, this ground being supplied over the following path: off-normal switch 133, conductor 132, armature 126 of relay 153 and its front contact, armature 125 and front contact of relay 169, brush 130 to multiples 128. Relay 161, upon releasing, also releases the group relay 100 which, in turn, removes positive battery 104 from the start charging circuit to restore the starting circuit to the control of the other lines. The cut-off relay 162 is now locked over its left front contacts to ground on the off-normal switch 133 over a previously described path.

With the operation of relay 153 the line conductors are extended to the first selector S, the tip conductor extending from one side of the station X, conductor 137, terminal 148 and brush 149, top front contacts of relay 169, armature 160 and front contact of relay 153, top outer contacts of release relay 177 to conductor 173 of selector S. The ring conductor extends from the other side of station X, conductor 136, terminal 147 and brush 146, bottom innermost front contacts of relay 169, armature 138 and front contact of relay 153, inner contacts of release relay 177 to conductor 173 of selector S. As is well known, these conductors extend to a line relay in the selector S and to a source of current thereat which will cause the relay to operate over the line loop in readiness to receive dial impulses. In response to these pulses, the selector S is then positioned on the terminals of an appropriate connector C by one series of dial impulses, the connector itself being then positioned on the terminals of the called station Z by the next two series of dial impulses transmitted from the dial at station X, all in accordance with well-known automatic telephone practice. Since this part of the operation as well as the release of the con-

nection forms no part of this invention, further description thereof is omitted.

Assume, now, that the call has been initiated by substation Y and that substation X is non-calling. In this event, ground would be present on the multiple 128 of substation X and the multiple 123 of substation Y would be ungrounded due to the attraction of the right armature of the line relay 163 of substation Y. The operations would be the same as just described up to the time the test brushes 130 and 122 reach the terminals 128 and 123, respectively. No ground being present on the test terminal 123 of line Y, relay 169 would release when relay 167 released due to the opening of its locking circuit by the rotary magnet 110. Relay 169, in releasing, connects the trunk talking conductors to the brushes 139, 140 and consequently to the talking conductors 141, 142 of substation Y, disconnecting such trunk from the brushes 146 and 149. Although in the case assumed ground is present on the test multiple 128 and the armature 125 of the relay 169 is attracted when the brush 130 reaches such contact, the relay 169 releases its armature 125 before this ground is applied long enough to permit the relay 167 to again attract its armature and for the rotary magnet 110 to energize sufficiently to actuate its pawl to give the finder another step. The relay 153 operates in this case exactly as it did in the other; that is to say, due to the removal of the shunt about its winding, caused by the brush 122 engaging the open terminal 123. In attracting its armature 126, relay 153 operates the cut-off relay 164 of substation Y.

While I have described my invention and the method and means utilized for practicing the same in connection with its specific application to a line-finder start circuit, it is to be understood that various other applications and embodiments thereof may be made by those skilled in the art without departing from the spirit of the invention as defined within the scope of the appended claims.

What is claimed is:

1. The method of operating an electronic device out of a plurality of such devices all adapted to operate upon the application of a definite potential thereto, which consists in propagating said definite potential along a circuit network joining all said devices, whereby the operation of one device precludes the further propagation of said definite potential.

2. A circuit for operating an electronic device out of a plurality of such devices, all adapted to operate upon the application of a definite potential thereto comprising a circuit network joining all of said devices, a source of said definite potential, and means for applying said source to any point of said circuit network for the propagation thereover of said definite potential whereby the operation of one of said devices establishes a conducting path through said device and through said network which precludes the further propagation of said definite potential over said circuit network.

3. A starting circuit for the selection of one of a plurality of work appliances comprising a device for each appliance adapted to become electrically conducting upon the application of a definite potential thereto, means responsive to the conductivity of a device for operating its associated work appliance, and means for applying said definite potential to a preferred one of said devices.

4. A starting circuit for the selection of one of a plurality of work appliances comprising a device for each appliance adapted to become electrically conducting upon the application of a definite potential thereto, means responsive to the conductivity of a device for operating its associated work appliance, and means for applying said definite potential progressively to all of said devices whereby the conductivity of one device arrests all other devices from attaining said definite potential.

5. A starting circuit for the selection of one of a plurality of work appliances comprising an electronic device for each appliance adapted to become electrically conducting when a definite potential is applied thereto, means responsive to the conductivity of one of said electronic devices for operating its associated work appliance, and means for applying said definite potential progressively to all of said electronic devices whereby the conductivity of one electronic device arrests all other devices from attaining said definite potential.

6. A start wire circuit for the selection of work appliances in each of a plurality of groups of such appliances comprising an electronic device for each appliance adapted to become electrically conducting upon the application of a definite potential thereto, a source of potential common to all of said electronic devices, means responsive to the conductivity of one of said electronic devices for operating its associated work appliance, and means individual to each group of electronic devices for connecting said source of potential progressively to all electronic devices whereby the electronic device nearest to said means reaches said definite potential first and whereby the resulting conductivity of said electronic device arrests all other devices from attaining said definite potential.

7. A start wire circuit for the selection of work appliances in each group of a plurality of groups of such appliances comprising an electronic device for each appliance adapted to become electrically conducting upon the application of a definite potential thereto, a source of potential common to all of said devices, means responsive to the conductivity of one of said devices for operating its associated work appliance, means individual to each group of electronic devices for connecting said source of potential progressively to all of said electronic devices, said connection being effective through said means to apply said potential first to the electronic device nearest to said means whereby said device reaches said definite potential before all other devices.

8. A start wire circuit for the selection of one of a plurality of work appliances comprising a device for each appliance adapted to become electrically conducting when a definite potential is applied thereto, means responsive to the conductivity of one of said devices for operating its associated work appliance, an impedance network connecting all of said devices comprising a resistance element on each side of each of said devices, a parallel condenser connected to ground on one side of each of said resistances, a source of potential, and means for applying said source of potential to any point of said impedance network whereby the device nearest the point of application of said potential is charged to said definite potential first and whereby the conductivity of said device prevents all other devices from being charged to said definite potential.

9. In a telephone system, a line, a line-finder

switch, electronic means individual to said line-finder switch for initiating the operation thereof, and means responsive to a call originated from said line for operating said electronic means.

10. In a telephone system, telephone lines, a plurality of automatic switches having fixed terminals in which said lines terminate, an electronic device for each of said switches, means responsive to a call initiated from one of said lines for operating the electronic device of one of said automatic switches, means responsive to said operated electronic device for causing its associated automatic switch to hunt over said terminals in search of the terminals of said calling line, and means responsive to the connection of said switch with the terminals of said line for rendering said electronic means inoperative.

11. In a telephone system, subscribers' lines arranged in a plurality of groups, automatic switches arranged in a plurality of groups for serving all of said lines and arranged to be taken for use in a given order, each group of switches arranged to serve as first choice a different one of said groups of lines, a starting circuit for all of said switches comprising a gaseous conductor device for each switch, means responsive to a call in any group of lines for operating the device of a free switch in the group normally serving such a group of lines, and means responsive to the operation of said device for initiating the operation of its associated switch.

12. In a telephone system, subscribers' lines arranged in a plurality of groups, automatic switches arranged in a plurality of groups for serving all of said lines and arranged to be taken for use in a given order, each group of switches arranged to serve as first choice a different one of said groups of lines, a starting circuit for all of said switches comprising a gaseous conductor device for each switch, means responsive to a call in any group of lines for operating the device of a free switch in the group normally serving such group of lines and to operate the device of a free switch in the next preferred group should all switches in the first group be unavailable, and means responsive to the operation of said device for initiating the operation of its associated switch.

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