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AUTOMATIC TELEPHONE SYSTEM.

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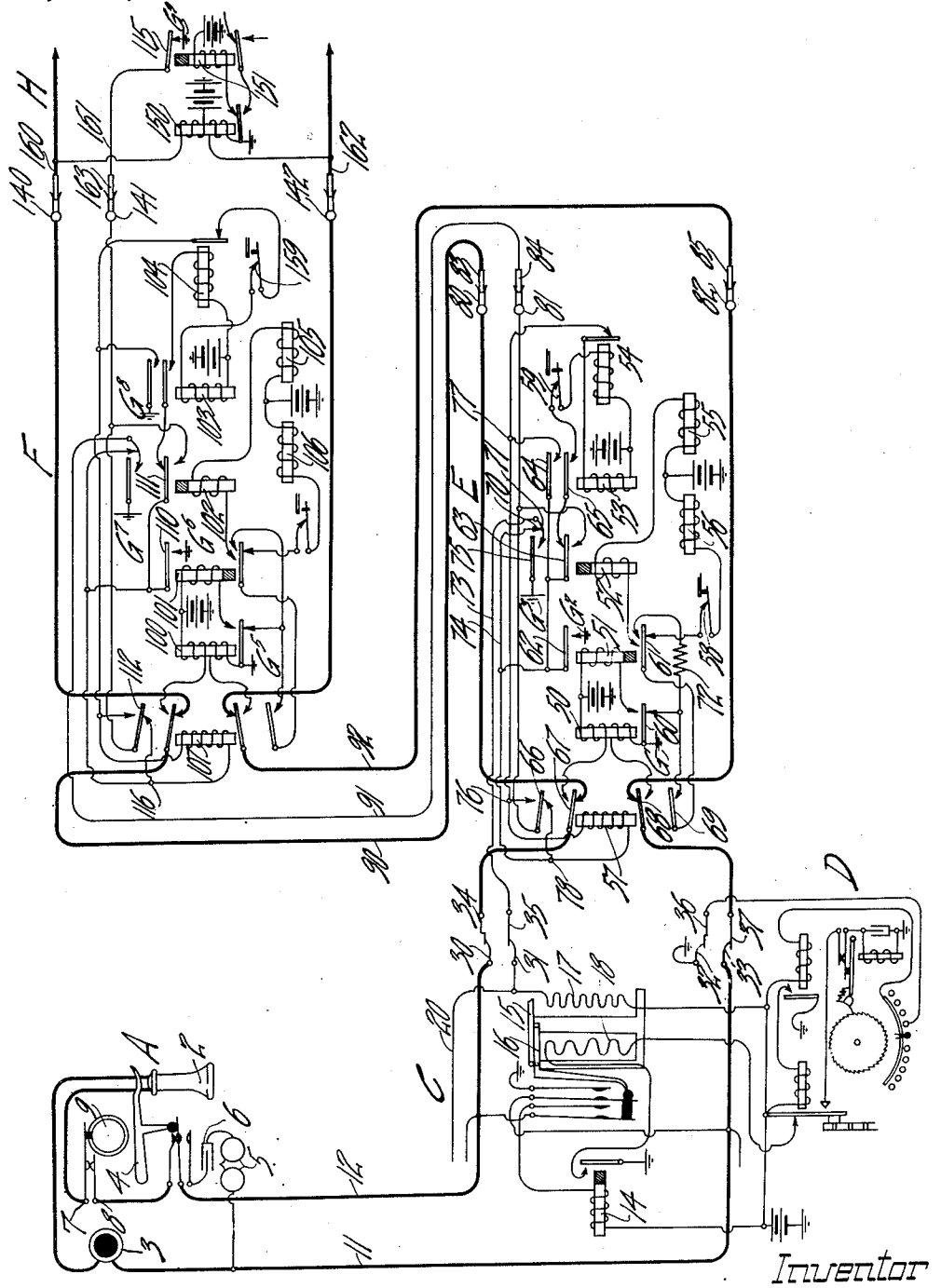
1,355,917. Patented Oct. 19, 1920.



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AUTOMATIC TELEPHONE SYSTEM.

1,355,917. Specification of Letters Patent. Patented Oct. 19, 1920.

Application filed May 23, 1917. Serial No. 170,337.

To all whom it may concern:

Be it known that I, GEORGE E. SCHOMAKER, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

My invention relates in general to automatic telephone systems and more particularly to automatic systems of the type commonly known as "two-wire," in which automatic switches at the exchange are controlled over the two sides of a calling subscriber's line in series; and the principal object of the invention is the provision of new circuits for selector switches, with a view to rendering them immune from certain inherent defects which prior to my invention have been a source of considerable trouble.

In systems of the above general character the subscribers' lines are usually provided with individual line switches, and upon the removal of the receiver at a calling substation the line switch associated therewith at the exchange is operated to extend the line circuit through to the first of the numerical trunking switches to be used in establishing the connection. The selected numerical switch, commonly known as a first selector, is responsive to momentary interruptions of the line circuit subsequently produced by the operation of a calling device with which the substation is provided. In the practical operation of such systems, it happens quite frequently that a calling subscriber, in removing his receiver to initiate the call, will accidentally manipulate his switch hook so as to send a preliminary impulse over the line circuit immediately after the line switch has operated and before he has operated his calling device. In other words, if the receiver is carelessly removed, the first closure of the line circuit may be followed by one or more interruptions before the receiver is completely disengaged from the hook. When this occurs, it follows as a matter of course that when the calling subscriber operates his calling device the first selector will already have been operated and that a wrong number will therefore be obtained.

My invention cures the difficulty explained above by providing a selector circuit such that when a connection is extended to a selector embodying my invention, a sequence of operations involving the deënergization of slow-acting relays takes place in the selector switch before the circuits for the operating magnets thereof are fully prepared, thus introducing a time interval during which interruptions of the line circuit will be of no effect.

In addition to eliminating troubles due to the source above mentioned, my invention enables a selector switch wired in accordance therewith to pass over open or defective trunks during the period of idle trunk selection, thus permitting the selector switch to automatically select not only an idle trunk, as is usual, but also a trunk the conductors of which are electrically continuous, and even to a certain extent causing the selector to reject trunks which terminate in selectors not in working condition.

The precise manner in which the foregoing and other useful objects are attained may be readily understood from the following detailed specification in which the operation of the circuits will be fully described, reference being had to the accompanying drawing.

In the drawing, the figure shows my invention diagrammatically.

In the drawing the reference character A indicates a calling automatic substation whose line conductors 11 and 12 have been extended through the medium of the individual line switch C to the trunk line terminating in the selector E. The selector E has been operated to further extend the connection to the trunk line comprising conductors 90, 91 and 92 and terminating in the second selector F, which in turn has been operated to establish connection with the connector H. Of this latter switch, only the line and the release relays 150 and 151 are shown in the drawing. Inasmuch as the general construction and the trunking involved in an automatic telephone system of this character is well known, only a brief general description will be given, reference being had to prior patents hereinafter mentioned.

The substation A may be of any approved type such, for example, as the substation shown in the British patent to Martin, No,

1419 of 1910. As represented herein, it comprises essentially the receiver 2, transmitter 3, switch hook 4, ringer 5, and condenser 6. Being an automatic substation there is also provided a pair of impulse springs 7 and 8 controlled by impulse wheel 9 through the medium of a finger hole dial (not shown). The line conductors 11 and 12 of the substation A extend to the exchange where they terminate in the individual line switch C which is of the general type of line switch disclosed in the British patent to James, No. 26,301 of 1906; being, however, of the particular type shown in U. S. Letters Patent, No. 1,078,690, granted Jan. 17, 1912, to Frank Newforth. Through the medium of line switch C, the line of substation A, when calling, is given access to a plurality of trunk lines each terminating in a first selector switch such as the selector E.

The line switch C and a plurality of similar line switches are controlled in their trunk selecting operations by means of a master switch which is shown in the drawing and indicated by the reference character D. The master switch D is of the general type of master switch disclosed in the above mentioned British patent to James, No. 26,301 of 1906; being, however, more nearly of the type disclosed in the British patent to Martin, No. 1419 of 1910, also previously referred to. As is well known, the function of the master switch is to maintain the plungers of all the idle line switches which it controls in position before the terminals of an idle trunk line.

The selector switch E, in which one of the trunk lines accessible to the line switch C terminates, is of the general type of selector switch disclosed in U. S. Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson, and Erickson; the side switch and private magnet being omitted, however, and the circuits being modified in accordance with the two-wire system of control. The circuits are further modified in order to accomplish the objects of my invention, as will be explained fully hereinafter.

The second selector F is similar to the first selector E except for slight circuit changes which will be pointed out in the description of the operation.

The connector H may be of any type which is adapted for operation in a two-wire system of the character described. A connector suitable for this purpose is shown in the patent to Newforth No. 13901, reissued April 13, 1915.

While I have shown throughout the drawing a plurality of batteries, it is to be understood that there is preferably but one battery having its positive pole grounded, the various battery leads shown in the drawing being connected together and extended to the negative pole thereof. In order not to encumber the drawing, separate reference characters have not been applied to the different batteries and when in the specification a circuit is traced "to battery" it will be understood that the circuit extends to the live or ungrounded pole of the common battery.

Having given a general description of the apparatus involved, I will now proceed to describe more in detail the operation of the same in establishing the connection shown in the drawing, particular attention being paid to the features of the operation with which my invention is concerned. In the following, it will be assumed that the subscriber at the substation A desires to call the subscriber at another substation in the exchange (not shown) which latter substation is accessible to the connector H. When the calling subscriber at substation A removes his receiver to initiate the call, an energizing circuit is completed over the line conductors 11 and 12 for the line relay 14 of the line switch C in the usual well known manner. Upon attracting its armature, the line relay closes a circuit for the pull-in winding 18. Upon energizing, the pull-in winding operates both the plunger arm 15 and the cut-off armature 16; the former, through the medium of its plunger (not shown) forcing the bank springs 30 to 33, inclusive, into engagement, respectively, with contacts 34 to 37, inclusive; and the latter disconnecting the lines 11 and 12, respectively, from ground and from the line relay 14. By the engagement of the bank springs 30 and 33 with contacts 34 and 37, respectively, the line conductors 11 and 12 are extended through normally closed contacts of the switching relay 57 to the double-wound line relay 50 of the selector E. The line relay 50 is accordingly energized over the loop circuit including the substation A and upon attracting its armature, closes a circuit for the slow-acting release relay 51. Upon energizing, the release relay 51 closes a holding circuit for the line switch C which may be traced as follows: Ground at G^2, working contact of armature 62 and the said armature, conductor 74, contact 70, spring 71, conductor 73, contact 35, spring 31, and the holding winding 17 to battery. Since the line relay 14 is slow acting, it retains its armature to maintain the pull-in winding 18 energized until after the above holding circuit has been established. A branch of the holding circuit extends by way of conductor 20 to multiple test contacts in the banks of the connector switches having access to the line of substation A where by a ground potential on the said contacts, the line is made busy. By the engagement of bank spring 32 with contact 36 the master switch D is operated in the usual manner to

advance the plungers of the remaining idle line switches of the group which it controls into position before the terminals of the next idle trunk line.

Returning now to the selector E, when ground G^2 is connected to the conductor 74 by the energization of the relay 51, a circuit for the switching relay 57 is closed which extends as follows: ground at conductor 74, winding of relay 57, interrupter contact of the rotary magnet 54, and the winding of relay 53 to battery. Relay 53 is of somewhat lower resistance than relay 57 and is moreover wound with a smaller size wire, so that it contains a much smaller number of turns; relay 53 therefore is not energized upon the closure of the above circuit. Relay 57, however, is energized and attracts its armatures to the position shown in the drawing, thereby breaking the circuit of the line relay 50. Upon deënergizing, relay 50 closes a circuit for the low resistance slow-acting relay 52 as follows: ground at G^1, armature 60 and its resting contact, resistance 72, working contacts of armature 61, winding of relay 52, and the winding of the vertical magnet 55 to battery. Owing to the inclusion of the resistance 72 in the above circuit, the vertical magnet 55 is not operated. Relay 52, however, energizes and at its armature 75 connects ground G^3 to conductor 73 by way of spring 71, at the same time separating the said spring from contact 70. By this operation ground G^3 is substituted for ground G^2 in the holding circuit of the line switch C. By attracting its armature 63, relay 52 prepares an energizing circuit for relay 53 which will be described shortly. An instant after the relay 52 has energized, the slow-acting relay 51 deënergizes, its circuit having been broken by the deënergization of the line relay 50. By the deënergization of relay 51, ground G^2 is disconnected from conductor 74 at armature 62 and at the same time the circuit of relay 52 is broken at armature 61. Thus it will be seen that since the previously described energizing circuit of relay 57 includes the grounded conductor 74, the circuits of this relay and the relay 52 will be broken simultaneously. Owing to the fact that relay 52 is slow-acting, however, relay 57 deënergizes first and again closes the circuit of the line relay 50. Relays 50 and 51 now energize in rapid succession with the result that ground G^2 is again connected to conductor 74. The relay 57 is not again energized, however, for since the slow-acting relay 52 still retains its armatures, ground G^2 is connected to the junction of relays 53 and 57 by way of armature 63, thus short-circuiting relay 57 and completing an energizing circuit for relay 53 which may be traced as follows: ground at G^2, working contact of armature 62 and the said armature, armature 63 and its working contact, armature 66 and its resting contact, junction point 76, interrupter contact of the rotary magnet 54, and the winding of relay 53 to battery. The upper terminal of relay 57 being connected to junction point 76 and its lower terminal being connected to conductor 74, this relay is short-circuited as above mentioned. Relay 53, upon energizing, prepares a circuit for the rotary magnet 54 which will be described later, and at its armature 64 completes a locking circuit for itself by connecting ground G^2 to junction point 77 as follows: ground at G^2, working contact of armature 62 and the said armature, and armature 64 and its working contact to junction point 77. This last described connection or locking circuit is effective to maintain relay 57 short-circuited and the relay 53 energized after the deënergization of the slow-acting relay 52 which occurs an instant later.

The foregoing operations, whereby the line switch C has been operated to extend the line of the substation A to the selector E, resulting finally in the continued energization of the relays 50, 51 and 53 of the selector, have taken place automatically in response to the removal of the receiver at substation A. It will be seen that immediately following the operation of the line switch C and the extension of the line conductors to the selector switch, a series of relay operations occur automatically at the selector, involving the energization and deenergization of every relay in the switch except relay 53, which latter relay is not deenergized. These operations serve to prevent any possibility of closing the circuit of the vertical magnet 55 until after a definite time has elapsed, depending on the speed at which the relays operate. To explain this a little more fully, the vertical magnet circuit, as is well known, is closed by a momentary deënergization of the line relay 50, relay 51 remaining energized, and extends as follows: ground at G^1, armature 60 and its resting contact, resting contact of armature 69 and the said armature, armature 61 and its left-hand working contact, winding of relay 52, and the winding of the vertical magnet 55 to battery. This circuit is prepared at the first energization of relay 51, but relay 51 also closes the circuit of relay 57, and this latter relay, upon energizing, opens the circuit of the vertical magnet at its armature 69. The vertical magnet is thus prevented from energizing until relay 57 has deënergized and relays 50 and 51 have again become energized. Looking at this feature of the operation from another angle, it will be seen that during the energization of relay 57, the line conductors are disconnected from the line relay 50 and are

extended through to the line wipers 80 and 82. From this it follows that the selector switch is entirely free at this time of any control which may be exercised over the line conductors. The time interval introduced as above explained is not very long, being approximately one second or slightly over in duration; but it has been found in practice to be ample to obviate practically all wrong number troubles due to carelessness in the subscribers when removing their receivers.

Having described in detail the extraordinary operations of the selector E in accordance with my invention, I will now proceed to consider briefly its usual operation in extending the connection to the called line. When the subscriber at substation A operates his calling device in accordance with the first digit of the called number, a series of interruptions is produced in the circuit of the line relay 50 in the usual manner. At each interruption of its circuit, the line relay 50 deënergizes momentarily and sends an impulse from ground G^1 over the path previously traced through the relay 52 and the vertical magnet 55 to battery. In response to these impulses, the vertical magnet operates to raise the switch shaft step-by-step until the wipers 80, 81 and 82 arrive at the horizontal level of bank contacts which constitute terminals of the trunk lines extending to the desired main group of subscribers' lines. The slow-acting relay 52 is energized in series with the vertical magnet and retains its armatures in operated position during the series of impulses. At the first upward movement of the shaft, the off-normal springs 59 are closed to prepare a circuit for the rotary magnet 54 which circuit is held open, however, during the vertical movement of the switch by the relay 52. At the end of the series of impulses, relay 52 deënergizes and closes the rotary magnet circuit which extends as follows: ground at G^2, working contact of armature 62 and the said armature, armature 63 and its resting contact, armature 65 and its working contact, off-normal springs 59, and the winding of the rotary magnet 54 to battery. Upon energizing, the rotary magnet operates to rotate the wipers 80, 81 and 82 into engagement with the first set of bank contacts in the level opposite which they were raised. Near the end of its stroke, the rotary magnet opens its interrupter contact, thereby breaking the energizing circuit of the relay 53. Upon deënergizing, the relay 53 breaks the circuit of the rotary magnet which accordingly retracts its armature and again closes its interrupter contact. Neglecting for the present any question of open or defective trunk lines, which will be referred to later, the operation now depends upon whether the first trunk line, the terminals of which are now engaged by the switch wipers, is busy or not. If this trunk line is busy, the test contact with which the private wiper 81 is in engagement will have ground potential upon it, which ground potential will serve to maintain the switching relay 57 short-circuited and also to again energize the relay 53. The rotary magnet circuit is, therefore, again completed and the same cycle of operation is repeated, whereby the switch wipers are advanced into engagement with the next set of contacts. It will be seen then, that the relay 53 will operate as an interrupter or stepping relay to advance the switch wipers through the medium of the rotary magnet as long as the private wiper 81 continues to engage grounded or busy test contacts. When a non-busy or ungrounded test contact is reached, assumed to be the test contact 84, the relay 53 cannot again energize; but the switching relay 57, being no longer short-circuited, instantly energizes in series with the said relay 53, which as before mentioned, is inoperative on this circuit. By the attraction of its armature 69, the switching relay 57 opens the circuit of the release magnet 56 to guard against the release of the switch upon the deënergization of relays 50 and 51; shifts, at its armature 66, the private wiper 81 from connection with its upper terminal and into connection with its lower terminal and the conductor 74; and at its armatures 67 and 68 disconnects the incoming line conductors from the windings of the line relay 50 and extends them instead by way of line wipers 80 and 82, bank contacts 83 and 85, conductors 90 and 92, and normally closed contacts of the switching relay 107 to the double-wound line relay 100 of the second selector F.

The line relay 100 is accordingly energized over the calling subscriber's loop and completes the usual circuit for the slow-acting release relay 101. Upon energizing, relay 101 completes a holding circuit extending back to the selector E and the line switch C over the following path: ground at G^6, working contact of armature 110 and the said armature, conductor 91, bank contact 84, private wiper 81, armature 66 and its working contact to junction point 78; where the circuit divides, one branch extending by way of the winding of relay 57 and the winding of relay 53 to battery, and the other branch extending by way of conductors 74 and 73 as previously traced through the holding winding 17 of the line switch C to battery. It is understood that the described holding circuit is completed before the slow-acting release relay 51 of the selector E has had time to deënergize.

Owing to a slight difference in the circuits of selectors F and E, the energization of relays 100 and 101 as stated, are the only

relay operations at the selector F which take place when connection is extended thereto.

The calling subscriber may now operate his calling device in accordance with the second digit of the desired number, thereby producing a series of interruptions in the circuit of the line relay 100 of the selector F. The line relay 100 is accordingly deënergized a number of times and at each deënergization, transmits an impulse from ground G^5 through the slow-acting relay 102 and the vertical magnet 105 to battery. In response to these impulses, the vertical magnet operates to raise the switch shaft step-by-step until the wipers 140, 141, and 142 arrive at the horizontal level of the bank contacts which constitute the terminals of trunk lines extending to the desired group of connector switches. The slow-acting relay 102 is energized in series with the vertical magnet and retains its armatures attracted during the series of impulses. Thus it will be seen that during the vertical movement of the switch ground G^6 is replaced by ground G^7; this operation is of no particular consequence just at the present time. At the first upward movement of the shaft, the off-normal springs 159 are closed thereby completing an initial energizing circuit for relay 103 which may be traced as follows: ground at G^6, working contact of armature 110 and the said armature, armature 111 and its working contact, armature 112 and its resting contact, interrupter contact of the rotary magnet 104, off-normal springs 159, and the winding of relay 103 to battery. Upon energizing, relay 103 locks itself to ground G^8 at its upper armature in an obvious manner, and at its lower armature prepares a circuit for the rotary magnet 104 which, however, remains open during the vertical operation of the switch at armature 111 of relay 102. It should be mentioned at this point that by the closure of off-normal springs 159 the switching relay 107 was connected in series with the relay 103; but since the junction of these two relays has already been connected to ground as already described, the relay 107 is short-circuited and remains inoperative for the present. When the slow-acting relay 102 deënergizes at the end of the series of impulses, it completes at the resting contact of its armature 111 the previously mentioned circuit of the rotary magnet 104. Upon energizing, the rotary magnet operates to rotate the wipers 140, 141, and 142 into engagement with the first set of bank contacts in the level opposite which they were raised. In case the first trunk line is busy, the wipers are rotated in search of an idle trunk line under control of the private wiper 141 and the stepping relay 103. Since this operation has been fully described in the case of selector E it will be unnecessary to describe it again in detail. When the private wiper 141 arrives at the test contact of an idle trunk line, assumed to be the test contact 163, the rotation of the switch will cease, and the switching relay 107, heretofore short-circuited either from ground G^8 or from grounded busy test contacts, will energize with the following results: At its lower armature the circuit of the release magnet 106 is opened in the usual manner; at its upper armature the connection of the private wiper 141 is shifted as described in the case of selector E; and at its two inner armatures, the line conductors 90 and 92 are disconnected from the windings of the line relay 100 and are extended instead by way of the line wipers 140 and 142 and conductors 160 and 162 to the windings of the double-wound line relay 150 of the connector H.

The line relay 150 is therefore energized over the calling subscriber's line and completes an energizing circuit for the slow-acting relay 151. This latter relay, upon energizing, completes a holding circuit for the selector F and the other switches which extend as follows: ground at G^9, working contact of armature 115 and the said armature, conductor 161, bank contact 163, private wiper 141, and armature 112 and its working contact to junction point 116; where the circuit divides, one branch extending by way of the winding of relay 107 and the winding of relay 103 to battery, and the other branch extending by way of normally closed contacts of relay 102 to the conductor 91 where it joins the previously traced holding circuit extending back to the selector E and the line switch C.

The connector H is now operated in response to the calling of the remaining digits in the desired number to complete the connection to the called subscriber's line. These operations are well known having been described in the previously mentioned patents and will not be considered in detail. It will be enough to say that when the connection is completed the called subscriber is signaled in the usual manner, and when he responds, conversation may be held over the connection which has been established. The calling subscriber is supplied with talking current over the heavy line conductors and through the windings of the relay 150 of the connector switch. When the receiver is replaced at the substation A at the end of the conversation, the relays 150 and 151 of the connector H are deënergized and ground G^9 is removed from the holding circuit extending back to the selectors F and E and to the individual line switch C. The switching relays 107 and 57 of these selector switches are accordingly deënergized whereupon the selectors are restored to normal in

the usual manner through the medium of their respective release magnets 106 and 56. Upon the deënergization of the holding winding 17 the plunger of the line switch C is withdrawn from the bank, whereupon all the apparatus involved in the connection will have been restored to normal.

The operation of the selector E will now be further considered for the purpose of explaining its operation in passing over or rejecting open trunks. From the description which has already been given, it will be understood that after the selector switch has "cut in" or, in other words, after its switching relay 57 has operated to extend the connection to the second selector F, the continued energization of the switching relay is dependent upon a holding circuit being established over the third conductor 91 by the relay 101 of the second selector. The failure to close this holding circuit, which were it not for my invention would result in the release of the selector switch and line switch, may be due to a number of causes. For example, either of the conductors 90, 91 or 92 may be actually open, the bank contacts in which these conductors terminate in the selector E may be dirty, resulting in a poor wiper contact, or there may be one or more dirty relay contacts in the selector F. At any rate, prior to my invention, whenever a selector switch in a well known two-wire system was operated, if ground was not immediately fed back from the selector switch ahead, the operated switch would immediately release. This is an undesirable result, for it makes it necessary for the calling subscriber to call his number over again. By my invention, when a selector switch, as the selector E for example, stops on an idle but open trunk line, it does not release but the rotation is started again and continues until the next idle trunk line is reached. If this second selected trunk line should also happen to be open for any reason, the selector switch selects still another idle trunk line, continuing the operation until a trunk is selected which is in working condition.

For the purpose of explaining this feature, it will be assumed that the trunk line comprising conductors 90, 91 and 92 was open at some point when the selector E was operated to establish connection therewith, and the operation of the selector under these circumstances will be explained. When the wipers of the selector are brought to rest in engagements with the bank contacts 83, 84, and 85 and the switching relay 57 is energized, the line conductors incoming to the selector E are disconnected from the line relay 50 as previously explained and are extended through to the conductors 90 and 92. The relay 50, upon deënergizing, closes an energizing circuit for the relay 52 which extends by way of resistance 72, the winding of the said relay 52, and the winding of the vertical magnet 55 to battery. Upon energizing, relay 52 connects ground G^3 to conductor 73 as a substitute for ground G^2 which is momentarily disconnected an instant later, and also prepares a circuit for the stepping relay 53. Relay 51 now deënergizes and breaks the circuit of relay 57. By the deënergization of relay 57, the circuit of the line relay 50 is reëstablished, whereupon the relays 50 and 51 immediately energize again. The slow-acting relay 52 still being in operated position, the energization of relay 51 now results in the short-circuiting of relay 57 and the closure of the circuit of the stepping relay 53. Upon energizing, relay 53 locks itself independent of the slow-acting relay 52 and also prepares the rotary magnet circuit, which is completed an instant later when the relay 52 deënergizes. These operations are the same as those which took place when the connection was first extended to the selector switch, except for the fact that now, since the off-normal springs 59 are closed, the rotary magnet is operated and the wipers of the selector are advanced into engagement with the contacts associated with the next trunk line. Idle trunk selection now takes place as before and if it should happen for any reason that the trunk next selected was open also, the wipers would be again rotated, the trunk selecting operations being brought to a halt only when an idle and working trunk is reached.

The operation of the second selector F in passing over open trunks is practically identical with the operation of selector E under similar conditions. The selector F is wired slightly different from selector E, however, in order to prevent the preliminary operation of the relays when the selector is first connected with; for since in the case of the second selector, there is no occasion for removing the selector from the control of the calling line, such relay operations would serve no useful purpose. The off-normal springs 159 therefore are placed in the circuit of the stepping relay 103 rather than in the circuit of the magnet 104. Also it will be noticed that there is no resistance in the selector F corresponding to the resistance 72 in the selector E. This resistance may be included if desired, but its omission causes no harm. Its purpose is solely to prevent the operation of the vertical magnet during the preliminary relay operations at the selector immediately following the seizure thereof, and since the circuits which cause the preliminary relay operations in the selector E are not present in the selector F, no resistance is needed. It

is understood, of course, that the energization of the vertical magnet after the switch has cut in is of no effect.

Having described my invention what I consider to be new and desire to have protected by Letters Patent will be pointed out in the appended claims.

What I claim as my invention is:

1. In a telephone system, a selector switch having an operating magnet and a line relay, subscriber controlled means for energizing said relay and for subsequently deenergizing the same to close a circuit for said magnet, and means in said switch serving automatically to cause a momentary deënergization of said relay while preventing the energization of said magnet.

2. In a telephone system, subscribers' lines, an automatic selector switch having an operating magnet and controlling relays, means for extending a calling line to said switch, and circuits serving automatically to energize every relay in said switch at least once when connection is extended thereto and for preventing at the same time the energization of said magnet.

3. In a telephone system, subscribers' lines, an automatic switch having an operating magnet and a relay, means for extending a connection from a calling line and for controlling said relay, to operate said magnet, and automatic means for reducing the current flow in said magnet to prevent its operation for a definite interval after the relay has been energized.

4. In a telephone system, an automatic switch, a line relay and an operating magnet therefor, means for seizing said switch and energizing said line relay, means for intermittently deënergizing said line relay to close the circuit of said magnet to operate said switch, and automatic means for preventing the first closure of the circuit of said magnet from operating the switch.

5. In a telephone system, an automatic switch, a line relay and an operating magnet therefor, means for seizing said switch and for controlling said line relay to close a circuit for said operating magnet to in turn operate said switch, and another circuit for said operating magnet closed by the first operation of the line relay which circuit is ineffective to operate said magnet.

6. In a telephone system, calling lines, an automatic switch, means for extending a connection from a calling line to said automatic switch in response to the first closure of a line circuit, a line relay and operating magnet for said switch, said line relay controlled by subsequent interruptions of said line circuit to close a circuit for said operating magnet to operate said switch, and automatic means for rendering said line relay nonresponsive to any interruptions of the line circuit which may occur for a certain time interval after the first closure of the line circuit.

7. In a telephone system, calling lines, an automatic switch, means for extending a connection from one of said lines to said automatic switch in response to the first closure of the line circuit of said line, a line relay and an operating magnet for said switch, said line relay controlled by subsequent interruptions of said line circuit to close a circuit for said operating magnet to operate said switch, and automatic means for including a resistance in the circuit of said operating magnet the first time said circuit is closed by the line relay to prevent the operation of the switch.

8. In a telephone system, calling lines, an automatic switch, a line relay and an operating magnet for said switch, means for extending a connection from one of said lines to said automatic switch to energize said line relay, a calling device on said line for controlling said relay to control the operation of the switch through the medium of said magnet, and automatic means for momentarily opening the circuit of said line relay as soon as the switch is seized and for rendering said magnet inoperative momentarily to prevent a false operation of the switch.

Signed by me at Chicago, Cook county, Illinois, this 21st day of May, 1917.

GEORGE E. SCHOMAKER.