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J. E. OSTLINE

2,137,507

AUTOMATIC SWITCHING APPARATUS

Filed June 11, 1937

FIG. 3

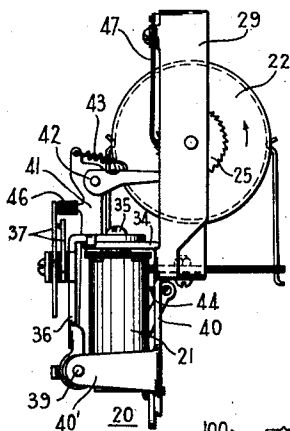


FIG. 1

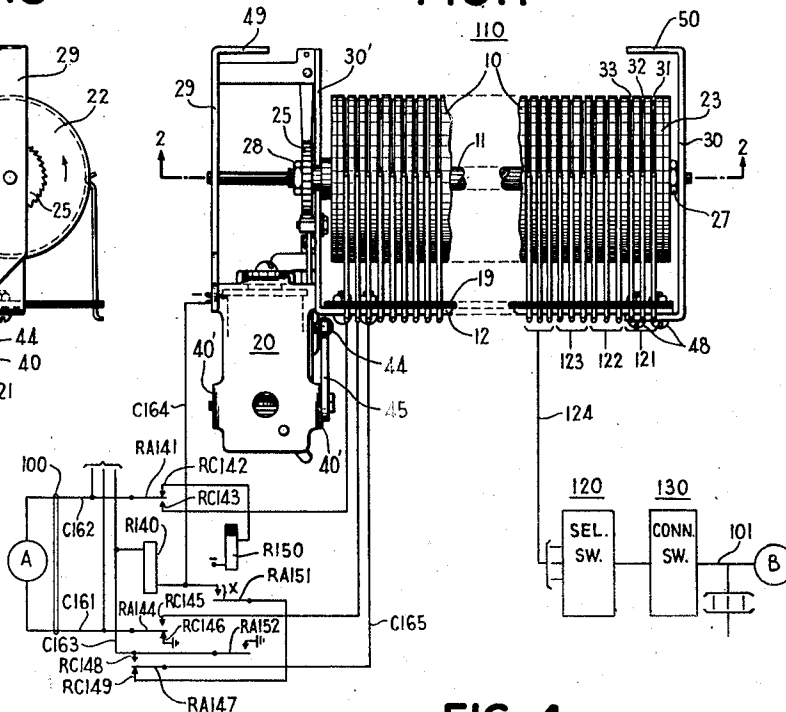


FIG. 5

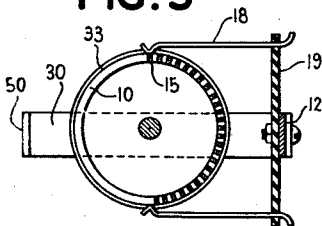


FIG. 4

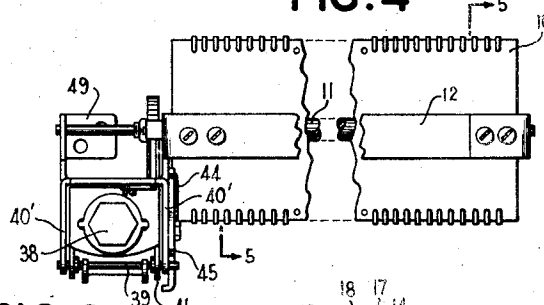
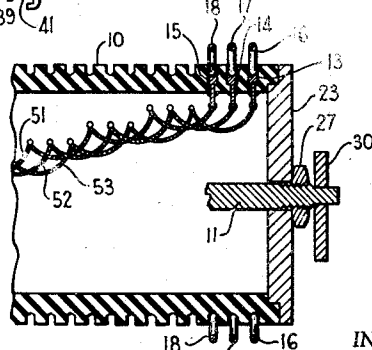
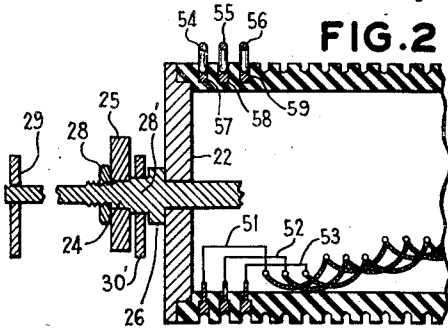


FIG. 2



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ATTORNEYS

UNITED STATES PATENT OFFICE

2,137,507

AUTOMATIC SWITCHING APPARATUS

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14 Claims. (Cl. 179—27.5)

The present invention relates to automatic switching apparatus and more particularly to automatic switches of the type adapted for use in signalling systems.

5 Various forms of the so-called drum type of circuit controller are known in the electrical arts. These controllers almost universally comprise a rotatable drum or cylinder having mounted thereon conducting or commutating segments, and wipers or brushes associated with the res-
10 pective commutating segments and adapted to engage the same at predetermined points in the rotation of the cylinder about its axis of rotation. In each instance the manner in which the commutating segments and the associated
15 brushes are arranged is dependent upon the particular use to be made of the controller. The means provided for rotating the cylinder and the control means therefor also depends upon the use to be made of a particular type of controller. In general, this type of circuit controller has not been extensively used in the signalling arts, for the reason that it is comparatively bulky in construction and is uneconomical in first cost
20 as compared to other forms of rotary switches.

It is an object of the present invention, therefore, to provide an improved automatic switch of the form noted, more particularly suited for use in the control of signalling circuits, which
25 is of simple, economical and compact construction, and which is capable of selectively connecting a line incoming thereto, to any one line of two groups of lines outgoing therefrom by twice utilizing the commutating segments of the switch.

35 In general, the object as set forth above is realized in accordance with the present invention by providing a switch of the form noted, wherein the commutating segments mounted on the cylinder are spirally arranged within a segment of the circumferential surface of the cylinder, and the wipers associated with these segments are arranged in two groups, the wipers of each group being disposed to engage the cylinder along a different line, and the two lines
40 thus formed defining a segment of the surface of the cylinder slightly greater than that within which the conducting segments are confined. By this arrangement, and during a portion of a revolution of the cylinder, the wipers of one group are successively engaged by their respective associated segments, and during another portion of the revolution the wipers of the other group are successively engaged by their respec-
45 tive associated segments. In this manner, the

conducting segments are twice utilized for selecting any line included in either of two groups of lines respectively terminating at the two groups of wipers. Further improvements in the switch structure are described specifically hereinafter
5 which pertain to the particular arrangement of the elements whereby the above operating features are obtained.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention
10 itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the specification taken in
15 connection with the accompanying drawing in which Figure 1 illustrates an automatic telephone system having embodied therein a switch constructed and arranged in accordance with the present invention; Fig. 2 is a view partially in
20 section illustrating the details of certain of the elements of the switch shown in Fig. 1; Figs. 3 and 4 are end and side views, respectively of the switch shown in Fig. 1, and Fig. 5 is a sectional view taken along the lines 5—5 of Fig. 4.
25

Referring now more particularly to Fig. 1 of the drawing, there is illustrated in partially diagrammatic form an automatic telephone system having incorporated therein automatic switches
30 constructed and arranged in accordance with the present invention connected to function as line switches, and numerical switches, preferably of the well-known step-by-step type, for accomplishing the selection of called lines. In general, the system comprises a plurality of sub-
35 scribers' substations, two of which are shown at A and B, adapted to be interconnected by means including their respective associated subscribers' lines 100, 101, etc., and switch trains including the aforementioned line switches, and intermediate and final impulse responsive selector switches.
40 These switch trains, when established, may individually comprise a line switch of the form noted associated with the calling subscriber's line, an intermediate selector switch accessible to the line switch, and a final selector or connector switch accessible to the operated intermediate selector switch and having bank con-
45 tacts in which the conductors of the called subscriber's line terminate. Thus, in the system shown, the line 100 terminates at a line switch indicated generally at 110, which in turn, has access to each of sixteen different intermediate selector switches, such for example, as the switch
50 120, over trunk lines indicated at 121, 122, 123, 55

124, etc. Each of the latter switches, in turn, has access to final selector or connector switches arranged in groups, each switch of each group having its bank contacts connected to subscribers' lines and multiplied to the corresponding bank contacts of each of the remaining switches in the same group.

Thus, the selector switch 120, has access over trunk lines to connector switches, one of which is indicated generally at 130, in the bank contacts of which the subscriber's line 101 terminates. It is well known that by this general arrangement, any subscriber may by a proper manipulation of the impulsing device conventionally projected at his substation, establish a talking connection between his line and any other idle subscriber's line in the system.

Each of the final and intermediate impulse responsive selector switches included in the system, may be of any desired form, although preferably is of the well-known Strowger type, comprising bank contacts arranged in levels, each level corresponding to a particular group of succeeding switches or subscribers' lines, wipers for engaging the bank contacts, ratchet and pawl mechanisms for imparting translatory and rotary movements to the wipers, vertical and rotary magnets cooperating with the respective ratchet and pawl mechanisms, a release magnet and control means whereby the respective selecting functions of the switch are carried out in response to the transmission of impulses thereto. The arrangement of the control means for the switches is different, depending upon whether a particular switch is used in any intermediate or final selecting capacity. In switches adapted to perform the intermediate selecting functions, the control means for each switch is arranged so that the switch is responsive to a single series of impulses transmitted thereto to select a particular level of bank contacts corresponding to a particular group of succeeding numerical switches, following which the switch wipers are automatically rotated until an idle switch in the selected group is found. The control means embodied in those of the selector switches which are used in a final selecting capacity are arranged to be responsive to two series of impulses transmitted thereto, to select not only the group of desired subscribers' lines, but also the particular called line in the selected group of lines.

Neglecting for the present, the details of the line switch 110 and the control means associated therewith, the system as described above is entirely conventional in form, and its operation is well understood in the art. In brief, when a subscriber, such for example, as the subscriber at the telephone A, initiates a call over the line 100 to a second subscriber's telephone, such for example, as the telephone B, by lifting his receiver from its hook, the line switch 110 associated with the calling subscriber's line operates to select an idle intermediate selector switch, and to condition the same to be responsive to impulses transmitted from the impulse device at the telephone A. As noted above, each of the selector switches has access to one or more connector switches at which any subscriber's line of the system terminates. Thus, if the selector switch 120 for example, is seized by the line switch 110, it operates in response to the dialing of the first digit at the substation A, to translate its wipers vertically to a contact level corresponding to the group of connector switches at which the called line 101 terminates, following which it automatically ro-

tates its wipers into engagement with a set of contacts corresponding to the first idle connector switch in this group, such for example, as the connector switch 130. Thereafter, and in response to the dialing of the second digit, the connector switch, through the operation of its vertical magnet and the associated ratchet and pawl mechanism, translates its wipers vertically to a position opposite the level of bank contacts in which the conductors of the line called 101 terminates. With the switch train in this condition, and when the final or third digit is dialed, the rotary magnet of the connector switch in cooperation with its associated ratchet and pawl mechanism, operates to rotate the switch wipers into engagement with the particular bank contacts at which the conductors of the called line 101 terminate.

The system conventionally includes means whereby the called line, upon being seized, is tested to determine its idle or busy condition, ringing current and ring-back tone current are automatically transmitted to the substations of the called and calling parties in case the called line is idle, and busy tone current is transmitted to the receiver at the calling substation in case the called line is found busy. The release of the connection as established in the above-described manner, may be either under the control of the calling party or the last party to hang up, as desired.

Turning now to the construction and arrangement of the line switch 110, forming more particularly the subject matter of the present invention, and considering Figs. 1, 2, 3, 4 and 5 together, the switch there shown comprises a hollow cylinder 10, arranged for rotation about its longitudinal axis on a rotatable shaft 11 carried by a frame 12, and having mounted thereon conducting segments 13, 14 and 15, which are adapted to be engaged by wipers 16, 17 and 18, mounted on an insulating member 19 also supported on the frame 12. The wipers may be mounted on the member 19 in any suitable manner, but preferably are embedded therein during moulding of this member. Means indicated generally at 20 and comprising a stepping magnet 21 and a ratchet and pawl mechanism are provided for imparting step-by-step rotary movement to the cylinder 10.

Preferably the cylinder 10 is constructed of insulating material, such for example, as Bakelite or hard rubber, and is mounted on the shaft 11 by means comprising the two end caps 22 and 23. As best shown in Fig. 2, the shaft 11 is provided at its left end with a squared portion 24, upon which the ratchet wheel 25 of the ratchet and pawl mechanism is mounted, and with a flared portion 26 for engaging the end cap 22 when the elements of the drum are assembled. A clamping nut 27 threaded onto the right end of the shaft 11, as shown, serves to clamp the caps 22 and 23 against the ends of the cylinder 10 to provide a rigid assembly. Similarly a nut 28, screwed onto a threaded portion of the left end of the shaft 11 serves to clamp the ratchet wheel 25 in position. The two extremities of the shaft and an intermediate portion 28' thereof engage bearing surfaces formed by the inner surfaces of drilled openings in side members 29, 30, and 30' of the frame 12. Cut circumferentially around the outer surface of the cylinder 10, are guide grooves 31, 32, 33, etc., having bottoms of V-shaped cross section and within which the conducting segments 13, 14 and 15

are mounted. For the purpose of mounting the segments, each thereof is provided with a threaded shank which extends through an opening of slightly greater diameter drilled through the bottom of the guide groove in which it is mounted, and upon which a nut is screwed. Preferably, the head of each conducting segment is provided with a V-shaped groove, and is countersunk in the bottom of its guide groove, so that the V-shaped outer surface thereof forms a continuation of the V-shaped bottom surface of the groove. In this manner, the engaging return bent portion of each wiper is easily slidable along the bottom surface of its associated groove into engagement with the conducting segment therein, and when engaged with a segment a two-point contact is provided between the segment and the wiper.

Referring now more particularly to Figs. 3 and 4, it will be seen that the magnet 21 included in the motor means 20, is mounted on an extension 34 of the frame side members 30' and 29 by means comprising a screw 35. A combination heel and side piece 36 is also mounted on the extension 34, and supports a spring assembly 37 comprising a pair of contact springs for controlling the energization of the magnet 21. These springs are insulated from each other and from the frame 12 in the manner illustrated. The ratchet and pawl mechanism comprises an armature 38 fixedly mounted in any suitable manner on a shaft 39. This shaft is, in turn, pivotally mounted on legs 40' extending from an extension 40 of the frame and has fixedly mounted thereon an arm 41 carrying at its outer end a pivotally mounted pawl 42 biased into engagement with the ratchet wheel 25 by a spring 43. The arm 41 is normally biased toward the ratchet wheel 25, as shown in Figs. 1 and 3, by a coil spring 44 having one end connected to the frame 12 and the other end connected to an arm 45 carried by the shaft 39. The bias of the spring 44 is adapted to be overcome by the force exerted on the arm 45 through the shaft 39 when the magnet 21 is energized. At the upper end of the arm 41 there is provided an insulating member 46 for making and breaking contact between the pair of contact springs included in the spring assembly 37. It will be apparent from the preceding description that with this form of motor mechanism, the cylinder 10 is rotated on the back-stroke of the arm 41 by the spring 44, i. e., when the magnet 21 is deenergized following its energization. The energization of the magnet 21 only serves to condition the motor to step the cylinder one step in a counterclockwise direction by rotating the shaft 39 to cause the translation of the pawl 42 from engagement with one tooth of the ratchet wheel 25 into engagement with the next succeeding tooth. In order to retain the cylinder 10 in any position to which it is stepped there is provided a spring 47 mounted on the frame 12 and having a finger biased into engagement with the teeth of the ratchet wheel 25.

In assembling the parts of the switch, the parts of the motor mechanism 20 are first mounted on the frame 12, and following this, the elements shown in Fig. 2 comprising the cylinder 10, are mounted within the side frame members 29 and 30 by first inserting the left end of the shaft 11 through the opening in the frame member 30'. The ratchet wheel 25 and nut 28 are then slipped on the left end of the shaft and the extreme left end of the shaft is inserted in the opening in the

side member 29. Thereafter, the assembly of the switch is completed by mounting the frame member 30 on the main portion of the frame 12 by means comprising bolts 48, with the right end of the shaft 11 extending through the opening in this side frame member forming the bearing surfaces for the shaft, and by positioning the ratchet wheel 25 on the portion 24 of the shaft 11. In order conveniently to mount the switch on a supporting structure, the two ends of the side members 29 and 30 are bent over at their upper extremities, as indicated at 49 and 50. These extremities are provided with openings for accommodating mounting screws or bolts.

Referring now more specifically to Figs. 2 and 5, there is illustrated the arrangement of the conducting segments and wipers, whereby the segments are twice utilized during each revolution of the cylinder 10. As shown in these two figures, the conducting segments are spirally arranged within a segment of the circumferential surface of the cylinder 10. This segment for the switch shown is of a width slightly less than one-half of the circumference of the cylinder 10. The conducting segments are, in the arrangement shown, arranged in sets of three segments each and means comprising multiple conductors 51, 52 and 53, are provided for electrically connecting the corresponding segments of each set together. Obviously the number of segments in each set will, in any given application of the switch, depend upon the number of conductors in the lines incoming and the lines outgoing from the switch. Thus, when used in the type of telephone system briefly described above, employing two line conductors and a control or test conductor, three conducting segments are required in each set. For the purpose of connecting a line incoming to the switch to these conducting segments, the three wipers indicated in Fig. 2 at 54, 55 and 56 are provided which engage conducting strips 57, 58 and 59, respectively, extending continuously around the bottom of the three guide grooves at the extreme left end of the cylinder 10. These conducting strips are connected to the multiple conductors 51, 52 and 53, respectively, so that a line incoming to the switch and connected to the wiper set 54, 55, 56 is multiplied to each of the sets of conducting segments. As illustrated in Fig. 1, each set of three wipers with the exception of the set comprising the wipers 54, 55 and 56 is adapted to be connected to a line outgoing from the switch. These wipers are arranged in two groups with the wipers of one group engaging the cylinder 10 along a line diametrically opposite the line of engagement between the wipers of the other group and the cylinder so that the two lines of engagement define a segment of the surface of the cylinder which is of slightly greater width than that of the segment within which the conducting segments are confined. With this arrangement, and when the cylinder is stepped from position to position during operation of the stepping magnet 21 and its associated ratchet and pawl mechanism, the commutating segments successively engage and disengage, at the rate of one segment set for each step, the respective associated wipers of one group for one-half of a revolution of the cylinder 10 and, during the other half of the revolution, they successively engage and disengage, at the same rate, the respective associated wipers in the other wiper group. Thus, the wipers 54, 55 and 56 are successively connected to the wipers in each of the wiper sets comprising the two wiper groups during each revolution of

the cylinder. Obviously, the design of the switch may be varied so that the number of sets of conducting segments embodied in the switch may within limits be adapted to the requirements of a particular installation. This may be accomplished by increasing or decreasing the length of the cylinder 10 and varying the spacing of the segments around the circumference of the cylinder. In the specific application described a fifty point switch is contemplated; that is, a switch having twenty-five sets of grooves and conducting segments and two wiper groups of twenty-five wipers each, in addition to the common wipers 54, 55, and 56 which are adapted to be connected to the conductors of the line incoming to the switch and to engage the conducting strips 57, 58 and 59, respectively.

Referring again to the system as shown in Fig. 1 and more particularly to the use of the switch 110 in the capacity of a non-homing line switch, a cut-off relay R140 and a line relay R150 are required for controlling the operation thereof. These relays are preferably mounted together and are of the form shown and described at page 49 of the book by Kempster B. Miller entitled "Telephone Theory and Practice, Automatic Switching and Auxiliary Equipment", published by McGraw Hill Publishing Company, Inc., in 1933. As disclosed in this book, a mechanical interlock between the two relays is provided which performs the functions described in detail hereinafter. As pointed out above, the operation of this switch to find a trunk line leading to an idle first selector switch is initiated by the subscriber at the telephone A lifting his receiver from its hook to place a direct current bridge across the conductors C161 and C162, comprising the line conductors of the calling subscriber's line 100. When this occurs, a circuit is completed for energizing the slow-to-operate relay 150, this circuit extending from ground at RC146 by way of the elements RA144, C161, the bridge across C161 and C162 at the substation A, C162, RA141, RC142 and the winding of R150 to battery. In response to its energization over the above traced circuit, R150 operates to apply, at RA152, busying ground to the test conductor C163 of the line 100 and to complete at the contacts associated with RA151, a test circuit for testing the condition of the trunk lines 121, 122, 123, 124, etc., outgoing from the line switch 110. In order to prevent a premature or false operation of R140, this relay is constructed so that the armature RA151 operates before RA152 to permit testing of the outgoing trunk connected to the line incoming to the switch 110 and operation of the switch to a position corresponding to a succeeding trunk before the relay R140 operates. With the cylinder 10 in a given position, such that one of the trunk lines, as, for example, the line 121, is connected by way of its terminating wipers 16, 17 and 18, the conducting segments in engagement with the same, the multiple conductors 51, 52 and 53, and the wipers 54, 55 and 56, to the control means for the line switch 110, the condition of this line is determined by the potential which exists on the control conductor thereof, which conductor terminates at the wiper 16 and is connected through to the wiper 56. If the distant selector switch connected to the line is busy, ground is present on this conductor, whereas if the line is idle, the conductor is open circuited. Assuming that the lines 121, 122 and 123 lead to busy selector switches, and the cylinder 10 is in a position such that the conducting segments associated with the

wipers terminating the line 121 are connected to the common wipers 54, 55 and 56, when R150 operates a circuit is completed for energizing the magnet 21 of the line switch 110. This circuit starts from ground on the test conductor of the line 121 by way of the wiper 16, the segment 13, the conductor 53, the conducting strip 59, the wiper 56, C165, RA147, RC149, RA151, C164, the winding of the magnet 21 and the interrupting springs 37 to battery. Thereupon, the magnet operates its armature 38 preparatory to stepping the cylinder 10 one step, or to a position corresponding to the trunk line 122. When the magnet 21 attracts its armature 38, the above traced circuit over which it was energized is interrupted at the contact springs in the spring assembly 37, thereby to cause this magnet to restore its armature and step the cylinder 10 one step. When this occurs, the segments in engagement with the wipers connected to the line 121 become disconnected therefrom, and the segments associated with the wipers terminating the line 122 are rotated into engagement therewith. Since in the case assumed, this line 122 also leads to a busy selector switch ground is again applied to the common test wiper 56, so that the magnet is again energized and deenergized causing the cylinder 10 to be stepped a second step. This operation continues until the cylinder is stepped to a position such that a line leading to an idle selector switch is connected to the wipers 54 to 56, inclusive. In the present assumed case, this occurs following three steps of the cylinder, such that the segments associated with the wipers terminating the line 124 are brought into engagement therewith. Since the selector switch 120 is idle, ground is not applied to the test wiper 56 and the magnet 21 is not sufficiently energized to attract its armature 38. It will be noted that when the operation of the switch 110 is initiated the winding of R140 is maintained short circuited so long as ground is held on the conductor C165 from the control conductors of the trunks 121, 122, 123, etc. This short circuiting path extends from ground on C165 by way of RA147, RC149, RA151, the winding of R140, C163 and back to ground at RA152. Thus, the relay R140 is prevented from operating until an idle trunk outgoing from the switch 110 is found. Further to insure this result the engaging portions of the wipers 16, 17, 18, etc., are constructed so that during the transfer of connections from one set of wipers to the succeeding set, both sets are connected to the common wiper set 54, 55, 56, thereby continuously to maintain ground on C165 until a trunk leading to an idle selector switch is found.

When ground is removed from the test wiper 56, R140 is energized in series with the magnet 21 over a circuit extending from ground at RA152 by way of C163, the winding of R140, C164, the winding of the magnet 21 and the interrupting springs 37 to battery. The magnet does not operate its armature 38 when energized in series with R140 and consequently, the cylinder 10 remains in a position corresponding to the line 124. The relay R140, however, operates when energized over the above traced circuit and extends at its armatures RA141 and RA144, the loop to the selector switch 120, thereby to cause the energization and operation of the line and hold relays conventionally provided in this switch. When the hold relay of the selector switch 120 operates it applies ground to the common test wiper 56, thereby to provide a holding circuit for R140, this holding circuit extending from ground on C165, by way of

of RA147, RC148, C163, the winding of R140, C164, the winding of the magnet 21 and the springs 37 to battery. At RA144 and RA141 and their respective associated contacts, RC146 and RC142, the relay R140 interrupts the original circuit over which R150 was energized causing this relay to restore. The retention of ground on the control conductor C163 maintains the calling line 100 marked as busy in the bank contacts of the connector switches to which this line extends. With the line switch 110 in this condition, the calling line is connected through to the selector switch 120 and R140 is locked up in its operated position. This condition prevails until the switch train including the line switch 110 is released. During the release of the switch train, the control equipment associated therewith is restored to normal by the removal of ground from the control conductor of the trunk line 124, thereby to interrupt the holding circuit for R140. When this relay restores, the line switch is entirely released, the cylinder 10 remaining in the position to which it was operated during the selection of an idle selector switch.

On an incoming call to the line 100, ground is placed on the test conductor C163, which completes the above traced circuit for energizing R140 and the magnet 21 in series. Although R140 partially operates it is prevented from completing its operation by the above noted mechanical interlock between this relay and the line relay R150, this interlock being released to permit R140 fully to operate only when R150 is energized. The partial operation of R140 opens all circuits at its spring contacts, removing all bridges or attachments to the line switch, thereby preventing connection with a selector switch.

Although the switch described above has been shown only in its use as a line switch of the non-homing type, it will be apparent to those skilled in the art that the structure embodied therein is susceptible of many other applications. Thus, by suitably arranging the control equipment and with but slight modification of the structure shown, the switch may be adapted to function in the manner of a rotary switch of the homing type, or one in which the switch is restored to normal during the release of a connection involving the same.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that many modifications may be made in the structure thereof, and it is contemplated in the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

I claim:

1. Automatic switching apparatus comprising a cylinder, conducting segments mounted on said cylinder, two groups of wipers, each of said wipers being insulated from each of the other wipers, and means for causing relative movement between said cylinder and said wipers, each of said segments being adapted to be engaged by only one wiper of each of said groups during relative movement between said cylinder and wipers and said wipers being so arranged relative to said segments that only the wipers of one of said groups successively engage their respective associated segments during a predetermined relative movement between said cylinder and wipers and only the wipers of the other group successively engage their respective associated segments during another predetermined relative movement between said cylinder and wipers.

2. Automatic switching apparatus comprising a cylinder arranged for rotation, means for imparting rotary movement to said cylinder, conducting segments mounted on said cylinder, and two groups of wipers, each of said wipers being insulated from each of the other wipers, each of said segments being adapted to engage only one wiper of each of said groups during a revolution of said cylinder and said wipers being so arranged relative to said segments that only the wipers of one of said groups are successively engaged by their respective associated segments during a portion of said revolution and only the wipers of the other of said groups are successively engaged by their respective associated segments during another portion of said revolution.

3. Automatic switching apparatus comprising a cylinder arranged for rotation, means for imparting rotary movement to said cylinder, conducting segments mounted on said cylinder, means electrically connecting said segments together, means adapted to connect one conductor of a line incoming to said switching apparatus to said segments, and two groups of wipers, each of said wipers being insulated from each of the other wipers and being adapted to be connected to one conductor of a line outgoing from said switching apparatus, each of said segments being adapted to engage only one wiper of each of said groups during a revolution of said cylinder and said wipers being so arranged relative to said segments that only the wipers of one of said groups are successively engaged by their respective associated segments during a portion of said revolution and only the wipers of the other of said groups are successively engaged by their respective associated segments during another portion of said revolution.

4. Automatic switching apparatus comprising a cylinder arranged for rotation, means for imparting rotary movement to said cylinder, conducting segments mounted on said cylinder, means electrically connecting said segments together, means adapted to connect one conductor of a line incoming to said switching apparatus to said segments, said last mentioned means comprising a conducting strip encircling said cylinder and connected to said segments and a wiper for continuously engaging said strip, and two groups of wipers, each of said wipers being insulated from each of the other wipers and being adapted to be connected to one conductor of a line outgoing from said switching apparatus, each of said segments being adapted to engage only one wiper of each of said groups during a revolution of said cylinder and said wipers being so arranged relative to said segments that only the wipers of one of said groups are successively engaged by their respective associated segments during a portion of said revolution and only the wipers of the other of said groups are successively engaged by their respective associated segments during another portion of said revolution.

5. Automatic switching apparatus comprising a cylinder arranged for rotation, means for imparting rotary movement to said cylinder, said cylinder having guide grooves therein, a conducting segment mounted on said cylinder in each of said grooves, means electrically connecting said segments together, means adapted to connect one conductor of a line incoming to said switching apparatus to said segments, and two groups of wipers, each of said wipers being insulated from each of the other wipers and being adapted to be connected to a line outgoing from said

switching apparatus, each of said wipers including a portion riding in one of said grooves for engaging the conducting segment therein, each of said segments being adapted to engage only one wiper of each of said groups during a revolution of said cylinder and said segments being so arranged relative to said wipers that only the wipers of one of said groups are successively engaged by their respective associated segments during a portion of said revolution and only the wipers of the other of said groups are successively engaged by their respective associated segments during another portion of said revolution.

6. Automatic switching apparatus comprising a frame, a cylinder rotatably mounted on said frame, means mounted on said frame for imparting rotary movement to said cylinder, conducting segments mounted on said cylinder, means electrically connecting said segments together, means adapted to connect one conductor of a line incoming to said switching apparatus to said segments, an insulating member mounted on said frame, and two groups of wipers supported by said insulating member, each of said wipers being adapted to be connected to one conductor of a line outgoing from said switching apparatus, each of said segments being adapted to engage only one wiper of each of said groups during a revolution of said cylinder and said wipers being so arranged relative to said segments that during a portion of said revolution only the wipers of one of said groups are successively engaged by their respective associated segments and during another portion of said revolution only the wipers of the other of said groups are successively engaged by their respective associated segments.

7. Automatic switching apparatus comprising a frame, a cylinder rotatably mounted on said frame, means mounted on said frame for imparting rotary movement to said cylinder, said cylinder having guide grooves therein, a conducting segment mounted on said cylinder in each of said grooves, means electrically connecting said segments together, means adapted to connect one conductor of a line incoming to said switching apparatus to said segments, an insulating member mounted on said frame, and two groups of wipers supported by said insulating member, each of said wipers being adapted to be connected to one conductor of a line outgoing from said switching apparatus and including a portion riding in one of said grooves for engaging the conducting segment therein, and said segments being so arranged relative to said wipers that each of said segments engages only one wiper of each of said groups during a revolution of said cylinder, only the wipers of one of said groups are successively engaged by their respective associated segments during a portion of said revolution and only the wipers of the other of said groups are successively engaged by their respective associated segments during another portion of said revolution.

8. Automatic switching apparatus comprising a frame, a cylinder rotatably mounted on said frame, means mounted on said frame for imparting rotary movement to said cylinder, said cylinder having guide grooves therein, a conducting segment mounted on said cylinder in each of said grooves, means electrically connecting said segments together, means adapted to connect one conductor of a line incoming to said switching apparatus to said segments, an insulating member mounted on said frame, and two groups of wipers supported by said insulating member, each of said wipers being adapted to be connected to one

conductor of a line outgoing from said switching apparatus and including a portion riding in one of said grooves for engaging the conducting segment therein, each of said segments being provided with a V-shaped slot therein the sides of which are adapted to make a two point contact with the associated wipers, and said segments being so arranged relative to said wipers that each of said segments engages only one wiper of each of said groups during a revolution of said cylinder, only the wipers of one of said groups are successively engaged by their respective associated segments during a portion of said revolution and only the wipers of the other of said groups are successively engaged by their respective associated segments during another portion of said revolution.

9. Automatic switching apparatus comprising a cylinder arranged for rotation, means for imparting rotary movement to said cylinder, conducting segments mounted on said cylinder, said segments being confined within a segment of the circumferential surface of said cylinder, and two groups of wipers, each of said wipers being insulated from each of the other wipers, each of said conducting segments being adapted to engage a wiper of each of said groups during a revolution of said cylinder, and the wipers of said two groups being disposed to engage said cylinder along two different lines which define a segment of the surface of said cylinder of slightly greater width than that of the segment within which the conducting segments are confined, whereby the wipers of one of said groups are successively engaged by their respective associated conducting segments during a portion of a revolution of said cylinder and the wipers of the other of said groups are successively engaged by their respective associated conducting segments during another portion of said revolution.

10. Automatic switching apparatus comprising a cylinder arranged for rotation, means for imparting rotary movement to said cylinder, conducting segments mounted on said cylinder, said segments being spirally arranged within a segment of the circumferential surface of said cylinder, and two groups of wipers, each of said wipers being insulated from each of the other wipers, each of said conducting segments being adapted to engage a wiper of each of said groups during a revolution of said cylinder, and the wipers of said two groups being disposed to engage said cylinder along two different lines which define a segment of the surface of said cylinder of slightly greater width than that of the segment within which the conducting segments are confined, whereby the wipers of one of said groups are successively engaged by their respective associated conducting segments during a portion of a revolution of said cylinder and the wipers of the other of said groups are successively engaged by their respective associated conducting segments during another portion of said revolution.

11. Automatic switching apparatus comprising a cylinder arranged for rotation, means for imparting rotary movement to said cylinder, conducting segments mounted on said cylinder, said segments being spirally arranged within a segment comprising slightly less than one-half the circumferential surface of said cylinder, and two groups of wipers, each of said wipers being insulated from each of the other wipers, each of said conducting segments being adapted to engage a wiper of each of said groups during a revolution of said cylinder, and the wipers of said two groups

being disposed to engage said cylinder along two diametrically opposite lines, whereby the wipers of one of said groups are successively engaged by their respective associated conducting segments during one-half of said revolution, and the wipers of the other of said groups are successively engaged by their respective associated conducting segments during the other half of said revolution.

12. Automatic switching apparatus comprising a cylinder arranged for rotation, means for imparting rotary movement to said cylinder, conducting segments mounted on said cylinder, means electrically connecting said segments together, means adapted to connect said segments to one conductor of a line incoming to said switching apparatus, said segments being spirally arranged within a segment comprising slightly less than one-half the circumferential surface of said cylinder, and two groups of wipers, each of said wipers being insulated from each of the other wipers and being adapted to be connected to one conductor of a line outgoing from said switching apparatus, each of said conducting segments being adapted to engage a wiper of each of said groups during a revolution of said cylinder, and the wipers of said two groups being disposed to engage said cylinder along two diametrically opposite lines, whereby the wipers of one of said groups are successively engaged by their respective associated conducting segments during one-half of said revolution and the wipers of the other of said groups are successively engaged by their respective associated conducting segments during the other half of said revolution.

13. Automatic switching apparatus comprising a frame, a cylinder rotatably mounted on said frame, means mounted on said frame for imparting rotary movement to said cylinder, said cylinder having guide grooves therein, a conducting segment mounted on said cylinder in each of said grooves, means electrically connecting said segments together, means adapted to connect said segments to one conductor of a line incoming to said switching apparatus, said segments being spirally arranged within a segment comprising slightly less than one-half the circumferential surface of said cylinder, and two groups of wipers supported on said frame, each of said wipers being insulated from each of the other wipers and being adapted to be connected to a line outgoing

from said switching apparatus, each of said wipers including a portion riding in one of said grooves for engaging the conducting segment therein, each of said segments being adapted to engage a wiper of each of said groups during a revolution of said cylinder and the wipers of said two groups being disposed to engage said cylinder along two diametrically opposite lines, whereby the wipers of one of said groups are successively engaged by their respective associated conducting segments during one-half of said revolution and the wipers of the other of said groups are successively engaged by their respective associated conducting segments during the other half of said revolution.

14. Automatic switching apparatus comprising a frame, a cylinder constructed of insulating material and rotatably mounted on said frame, means mounted on said frame for imparting step-by-step rotary movement to said cylinder, said cylinder having guide grooves therein, a conducting segment mounted on said cylinder in each of said grooves, means electrically connecting said segments together, means adapted to connect said segments to one conductor of a line incoming to said switching apparatus, said conducting segments being spirally arranged within a segment comprising slightly less than one-half the circumferential surface of said cylinder, an insulating member mounted on said frame, and two groups of wipers supported by said insulating member, each of said wipers being insulated from each of the other wipers and being adapted to be connected to one conductor of a line outgoing from said switching apparatus, each of said wipers including a portion riding in one of said grooves for engaging the conducting segment therein, each of said conducting segments being adapted to engage a wiper of each of said groups during a revolution of said cylinder, and the wipers of said two groups being disposed to engage said cylinder along two diametrically opposite lines, whereby the wipers of one of said groups are successively engaged by their respective associated conducting segments during one-half of said revolution and the wipers of the other of said groups are successively engaged by their respective associated conducting segments during the other half of said revolution.

JOHN E. OSTLINE.