

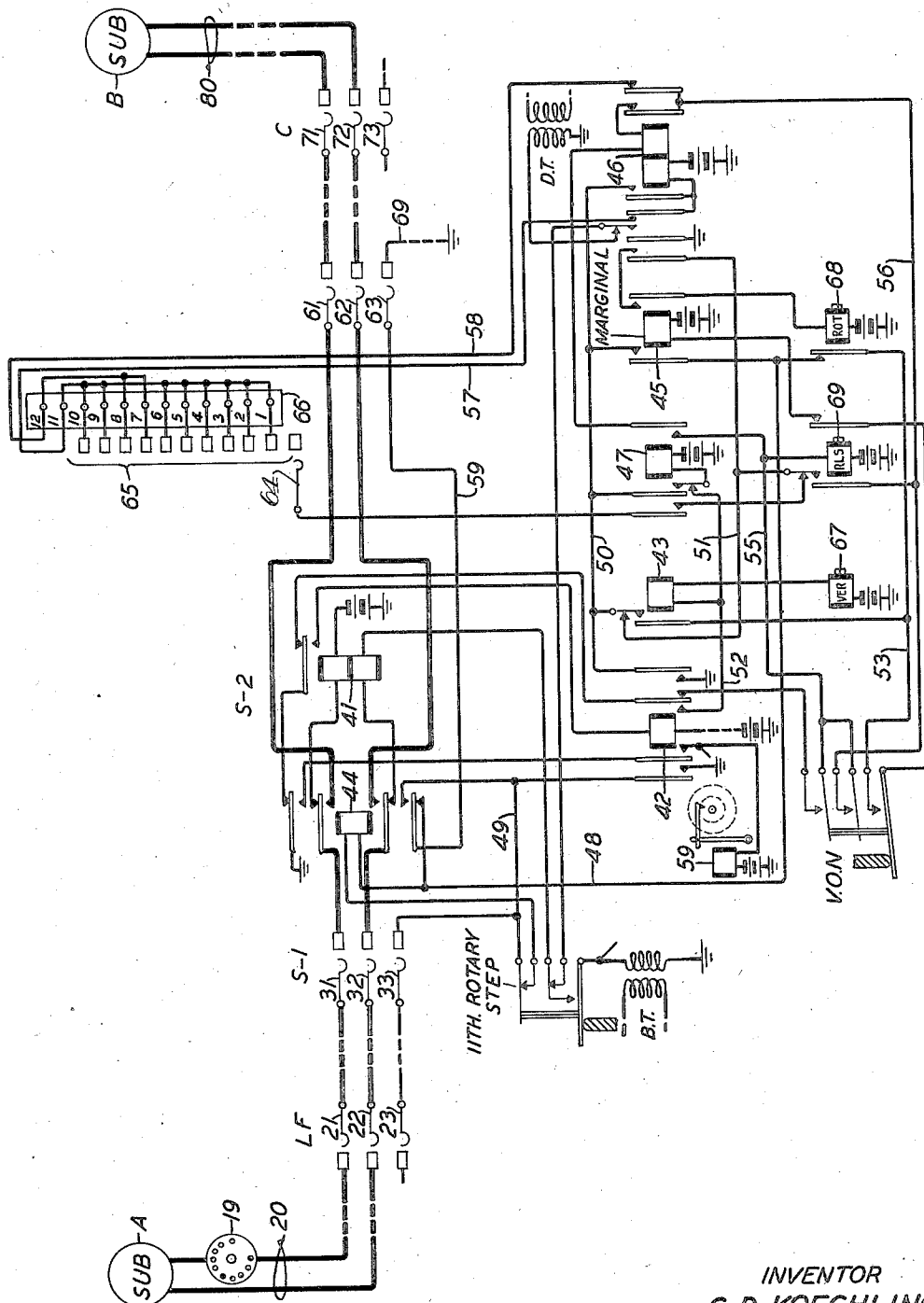
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems and more particularly to systems employing automatic switching equipment for establishing connections.

5 The object of the invention is to provide automatic switching equipment which is adapted to operate under a wider range of varying traffic conditions than has heretofore been possible and which is more reliable in operation.

10 To enable efficient and economical trunking in automatic telephone systems and under certain traffic conditions, it has been found desirable to provide digit-absorbing selectors arranged to absorb one or more digits of some of the called
15 numbers. Such selectors of the two-motion step-by-step type have been variously arranged to absorb one or more certain digits either once or a plurality of times by releasing the shaft and brushes to their normal position after their operation in response to a digit to be absorbed. A
20 switch of this nature is disclosed in the patent to Martin No. 1,640,551, granted August 30, 1927.

A feature of this invention is the provision of a new and improved circuit arrangement in a
25 digit-absorbing selector of the two-motion drop-back type required to absorb one or more digits, the selector being provided with a vertical commutator and means for connecting the segments so as to release the switch from any desired one
30 or more levels. According to this feature, the circuit arrangements are such as to eliminate the possibility of false operation of the switch after its release to absorb a digit, in case the shaft and brushes rebound sufficiently to close the vertical
35 off-normal springs.

According to another feature of the invention, circuit arrangements are provided for eliminating the possibility of false operation of the switch, after it is finally released from a connection, in
40 case the selector is again seized on another call before it has completely returned to normal.

The drawing which forms a part of this specification represents in schematic form a telephone system which includes selector switches arranged
45 in accordance with this invention.

Referring to the drawing, A is a calling subscriber's station connected by line 20 to terminals in the bank of line finder switch LF, S—1 is a first selector permanently associated with the line finder LF, S—2 is a second selector arranged according to this invention, C is a connector switch, and B is a called station connected by line 30 to terminals in the bank of connector switch C. The line finder LF, selector S—1 and connector C are
50 represented by brushes 21, 22 and 23, 31, 32 and

33, and 71, 72 and 73; the terminal banks to which the brushes of these switches have access are each represented by a single set of terminals. The selector S—2 and associated apparatus are shown in detail together with all of the circuit
5 connections. All of the switches are of the two-motion step-by-step type; for a complete description of selector and connector switches of this type reference may be had to pages 53 to 65 inclusive of the second edition of "Automatic
10 Telephony" by Smith and Campbell published in 1921. For a complete description of a line finder of this type reference may be had to the patent to H. Hovland, 1,711,682, May 7, 1929; the brushes 21, 22, and 23 may be one of the two sets of
15 brushes shown in the Hovland patent.

The selector S—2 comprises the brushes 61, 62, and 63 and a bank of terminals to which these brushes have access, a commutator brush 64 and vertical commutator segments 65, a vertical
20 stepping magnet 67, a rotary stepping magnet 68, a release magnet 69, vertical off-normal springs VON and "11th rotary step" springs. Associated with the switch for controlling its operation are the line relay 41, release relay 42, change-over
25 relay 43, switching relay 44, rotary stepping relay 45, and control relays 46 and 47. The terminal strip 66 is provided for facilitating the connection of conductor 57 to the commutator segments of all levels corresponding to digits which are not
30 to be absorbed and the connection of conductor 58 to the commutator segments of all levels corresponding to digits which are to be absorbed. The selector S—2 is shown with circuit connections whereby the first digit to which the switch
35 responds is absorbed if it is either 7 or 8, the absorbing of a digit being effected by operating the release magnet 69 to cause the shaft and brushes to be restored to normal position. Were it desired to have the digits 7 and 8 absorbed repeatedly, the left inner front contact of relay
40 46 should be connected to conductor 51 instead of being connected to conductor 50; no other change is necessary.

Assume that a call has been originated at station A, that line 20 has been extended through brushes 21 and 22 of line finder LF to selector S—1, and that the selector S—1, in response to the dialing of the first digit of the number of the station which is being called, has selected the
50 corresponding group and seized an idle trunk therein, which trunk extends the calling line to the digit-absorbing selector S—2, all in well known manner. The line relay 41 is thereupon energized in a circuit from battery through its upper wind-
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ing, inner upper back contact of relay 44, through brush 31 of selector S—2, brush 21 of line finder LF, over line 20 and through the telephone instrument and dial 19 at station A, back over line 20 through brush 22 of line finder LF, brush 32 of selector S—1, inner lower back contact of relay 44, lower winding of relay 41, lower normally closed contacts of the "11th rotary step" springs, through the back contact of the continuity spring of relay 46 and the left winding of the dial tone source DT, to ground. The operation of relay 41 closes an obvious circuit for operating release relay 42. Relay 42 connects a holding and guarding ground potential to sleeve conductor 49, thence through brush 33 of selector S—1 to prevent the release of selector S—1 and line finder LF and through brush 23 to hold the cut-off relay (not shown) of line 20 in well known manner. No further action occurs until the calling subscriber dials the second digit of the number of the station which is being called, relay 41 being thereby successively released and reoperated as many times as there are units in the digit dialed. Relay 42 being slow in releasing remains operated during the receipt of dial impulses. The first release of relay 41 closes a circuit from ground at the uppermost back contact of relay 44, through the back contact of relay 41, inner right front contact of relay 42, conductor 52, thence through the windings of relay 43 and the vertical stepping magnet 67 in series to battery and through the back contact of the continuity spring and winding of relay 47 to battery. Relays 43 and 47 and magnet 67 operate. Relay 47 locks through the front contact of its continuity spring over conductor 50 to ground at the outer right front contact of relay 42. The operation of magnet 67 raises the shaft and brushes of switch S—2 one step, the vertical off-normal springs VON being actuated as soon as the shaft moves out of normal position. Relay 45 operates due to the closure of a circuit from battery through its winding, right back contact of release magnet 69, lower front contact of the VON springs, conductor 53, front contact of relay 43, over conductor 50 to ground at relay 42. Relay 45 closes a locking path, which is independent of relay 43, from conductor 53 through the back contact of rotary stepping magnet 68 and the left front contact of relay 45 to conductor 50. The reoperation of line relay 41 at the end of the first impulse causes the release of magnet 67. Relay 43 is slow in releasing so as to remain operated until all of the impulses in the series have been received. Each succeeding release and reoperation of relay 41 causes a corresponding operation and release of magnet 67 whereby the brushes 61, 62, 63 and 64 are advanced step-by-step to the level corresponding to the digit dialed. The release of relay 43, after all of this series of impulses have been received, connects ground from the right front contact of relay 42 over conductor 50, through the back contact of relay 43, conductor 51, left back contact of release magnet 69, outer left front contact of relay 47, to commutator brush 64.

If the first digit to which selector S—2 responds is any other than 7 or 8, the ground connected to commutator brush 64 is extended through the corresponding segment of commutator 65 and terminal of terminal strip 66, terminal 11 of terminal strip 66, conductor 57, inner left back contact and winding of relay 46 to battery. Relay 46 operates and a holding circuit is closed through its inner left front contact

over conductor 50 before the operating circuit is opened. The operation of relay 46 transfers the lower winding of line relay 41 from the left winding of dial tone source DT to ground at the front contact of the continuity spring of relay 46. Relay 46 also closes a circuit for operating the rotary stepping magnet 68 from battery through the winding of this magnet, right front contact of relay 45, outer left front contact of relay 46, conductor 51, back contact of relay 43, conductor 50 to ground at relay 42. The operation of magnet 68 advances the brushes 61, 62, and 63 into contact with the first set of terminals in the selected level. When magnet 68 operates stepping relay 45 releases and when relay 45 releases magnet 68 releases. If the first set of terminals is associated with a connector switch which is already in use, the test brush 63 encounters a ground potential on the terminal with which it is in contact, thereby causing the reoperation of stepping relay 45; the circuit for reoperating relay 45 is traced from battery through its winding, right back contact of release magnet 69, lower contacts of the VON springs, conductor 53, back contact of magnet 68, conductor 48, lowermost back contact of relay 44, conductor 59 and through brush 63 to the guarding potential on the terminal with which brush 63 is in contact. The reoperation of relay 45 causes the reoperation of magnet 68 to advance the brushes 61, 62, and 63 to the next set of terminals. Relay 45 and magnet 68 repeat their cycle of operations to cause the advance of the brushes step by step until an idle set of terminals is encountered, whereupon there being no ground potential on the terminal with which brush 63 is in contact, relay 44 is operated by the energization of its winding in a circuit from battery through the winding of relay 45, right back contact of magnet 69, lower contacts of the VON springs, conductor 53, back contact of magnet 68, conductor 48, winding of relay 44, upper back contact of the "11th rotary step" springs, over conductor 49 to ground at the outer left front contact of relay 42. Relay 45 being marginal does not operate in series with relay 44. Should all of the connector switches accessible through the selected level of the bank of switch S—2 be busy, the brushes 61, 62 and 63 are advanced beyond the 10th and last set of terminals thereby causing the actuation of the "11th rotary step" springs, whereby the connection of the right winding of the busy tone source BT through the front contact of these springs to the lower winding of line relay 41 causes the transmission of an all-trunks busy tone to the calling station.

Assuming an idle set of terminals to have been encountered and that the associated connector switch is the switch C, the operation of the switching relay 44 extends the connection from the calling line through its inner front contacts and through brushes 61 and 62 to the line conductors of switch C. A temporary guarding ground potential is connected to the test terminal of switch C from the outer left front contact of relay 42, over conductor 49, through the lowermost front contact of relay 44 and over conductor 59 to brush 63. The operation of the line and release relay (not shown) in the connector C furnishes a permanent holding ground over its test conductor 69 through brush 63 to conductor 59. Relay 41 releases when relay 44 operates, in turn causing the release of relay 42. With relay 44 operated and before relay 42 releases, ground is connected from the uppermost front contact of relay 44

through the inner left front contact of relay 42 to the traffic register 59 to cause the registration of the use of selector S—2 in extending a call. The release of relay 42 causes the release of relays 46 and 47. After relay 42 releases the ground from the test conductor of connector C, through brush 63 over conductor 59 holds relay 44 and also holds the selector S—1 and line finder LF and the cut-off relay of line 20 in the usual and well known manner. In response to the last two digits dialed the connector C is selectively operated to advance its brushes 71, 72 and 73 into engagement with the terminals of the called line which is represented by line 80. The line is tested in the usual manner and, if idle, ringing current is transmitted over line 80 to signal the subscriber at station B. When the calling subscriber replaces the receiver on the receiver hook, the line relay (not shown) of connector C releases, the holding ground is disconnected from conductor 69 to cause the release of relay 44 and to cause the return of the selector S—1 and line finder LF to normal in the usual manner. The release of relay 44 closes a circuit from battery through the winding of release magnet 69, uppermost contact of the VON springs, right back contact of relay 42 and through back contacts of relays 41 and 44 to ground. The operation of release magnet 69 causes the return of brushes 61, 62, 63, and 64 to normal position. The restoration of the VON springs to normal when the shaft of switch S—2 reaches normal position opens the circuit through magnet 69.

If the digit to which selector S—2 responds is either 7 or 8, the connection of ground, by the release of relay 43 after all of the impulses have been received, to commutator brush 64, as hereinbefore described is extended through commutator segment 7 (or 8), the correspondingly numbered terminal and terminal 12 of the terminal strip 66, over conductor 58, outer right back contact of relay 46, conductor 56, middle contacts of the VON springs, conductor 55 and through the winding of release magnet 69 to battery. The operation of magnet 69 causes the shaft and brushes of switch S—2 to restore to normal. When the vertical off-normal springs VON are restored to normal, relay 46 operates due to the energization of its right winding in a circuit from ground through the outer right front contact of relay 42, conductor 50, back contact of relay 43, conductor 51, front contact of release magnet 69, conductor 56, inner right back contact and right winding of relay 46, right front contact of relay 47 and through the winding of release magnet 69 to battery. Relay 46 first closes its inner left front contact so as to hold due to the energization of its left winding over conductor 50 to ground at relay 42. The opening of the right back contacts of relay 46 releases magnet 69. Should the shaft rebound sufficiently to cause a temporary actuation of the VON springs, the possibility of a false pulse being created by a temporary operation of switching relay 44 is prevented due to the inclusion of a back contact of release magnet 69 in the circuit for operating relay 44, magnet 69 being slow in releasing on account of the energization of its winding in series with the right winding of relay 46. When the next digit is dialed by the subscriber at station A, relay 41 and vertical stepping magnet 67 again respond to advance brushes 61, 62, and 63 to the level corresponding to the digit dialed. Relay 43 operates as hereinbefore described and the release of relay 43 after the last impulse of the series has been received causes the

operation of rotary stepping magnet 68 to advance the brushes in the selected level and to seize the first idle connector thus encountered. The switching relay 44 is operated as hereinbefore described and the desired connection is completed by the connector switch in the well known manner.

In order that relay 46 cannot be falsely reoperated during release of switch S—2 in case relays 41 and 42 of this selector reoperate due to seizure on another call before the shaft has reached normal position and release magnet 69 has released, the right contacts of relay 47 are included in the circuit path from the winding of magnet 69, through the right winding and back contact of relay 46, the front contact of magnet 69 and back contact of relay 43 to ground at the outer right front contact of relay 42. The outer left front contact of relay 47 is included in the circuit for energizing the left winding of relay 46 to prevent the false operation of relay 46 while the switch S—2 is returning to normal after release of the connection by the calling subscriber in case the reoperation of relay 41 due to seizure of the switch for use on another call causes the release of release magnet 69. Since relay 47 cannot again operate until impulses are received by relay 41, there is no possibility of relay 46 being prematurely operated and locked.

Should the selector S—2 be arranged to absorb the digits 7 and 8 repeatedly, that is with the inner left front contact of relay 46 connected to conductor 51 instead of to conductor 50, the reoperation of relay 43 in response to the second series of impulses (the brushes having been advanced to level 7 or 8 by the first series of impulses and restored to normal as described in the preceding paragraph) causes the release of relay 46. If the second digit is either 7 or 8, magnet 69 and relay 46 repeat their cycle of operation to again restore the shaft and brushes to normal. This cycle of operation is thus repeated for each digit until some digit other than 7 or 8 is dialed whereupon the brushes are advanced by rotary stepping magnet 68 and the call completed as hereinbefore described.

What is claimed is:

1. In a telephone system, a selector switch comprising a shaft and a set of brushes mounted thereon, a magnet for advancing the shaft and brushes of said switch, off-normal springs actuated by the movement of said switch from its normal position, impulse receiving means for controlling the operation of said magnet, a release magnet the operation of which permits the shaft to restore to normal position, said release magnet being slow in releasing, a circuit for operating said release magnet upon advance of the brushes in response to a series of impulses corresponding to a particular digit to absorb said digit, a relay, a circuit including normally open contacts of said off-normal springs for operating said relay, and contacts in said circuit opened by the operation of said release magnet for preventing the operation of said relay in case the rebound of said shaft, upon its release to absorb a digit, is sufficient to actuate said off-normal springs.

2. In a telephone system, a selector switch comprising a shaft and a set of brushes mounted thereon, a vertical stepping magnet for advancing the shaft and brushes of said switch, off-normal contacts closed by the movement of said shaft from its normal position, impulse receiving

ing means for controlling the operation of said magnet, a release magnet the operation of which permits the shaft to restore to normal, a vertical commutator and a commutator brush mounted on said shaft for successively engaging the segments of said commutator, a circuit including said commutator brush for operating said release magnet upon advance of the switch in response to a series of impulses corresponding to a particular digit to absorb said digit, and means for preventing the false operation of the switch upon its release to absorb a digit in case the rebound of said shaft is sufficient to close said off-normal contacts.

3. In a telephone system, a selector switch comprising a shaft and a set of brushes mounted thereon, a primary magnet for advancing the shaft and brushes of said switch in a primary movement, impulse receiving means for controlling the operation of said primary magnet, a release magnet the operation of which permits the shaft to restore to normal, a circuit for operating said release magnet upon advance of the switch in response to a series of impulses corresponding to a particular digit to absorb said digit, a control relay the operation of which prevents the closing of said circuit, means including a secondary magnet for advancing said shaft and brushes in a secondary movement, means for operating said release magnet subsequent to said secondary movement to cause said switch to be restored to normal, and means for preventing the false operation of said control relay in case said switch is again seized after the last mentioned operation of said release magnet but prior to the complete restoration of said switch to normal.

4. In a telephone system, subscribers' lines, a two-motion selector switch comprising a shaft and a set of brushes mounted thereon, a primary magnet for advancing said brushes in a primary movement, and a secondary magnet for advancing said switch in a secondary movement, means for extending a calling line to said switch, means responsive to impulses received over said calling line for controlling the operation of said primary magnet, a release magnet the operation of which permits the shaft to restore to normal, a circuit for operating said release magnet upon release of the connection by the calling subscriber, a circuit for operating said release magnet after advance of the switch in response to a series of impulses corresponding to a particular digit to absorb said digit, a control relay operated when the shaft reaches its normal position after operation of the release magnet to absorb a digit, and means for preventing the operation of said control relay during the return of the shaft to its normal position in case the operation of said release magnet is due to the release of the connection by the calling subscriber.

5. In an automatic telephone system, a selector switch comprising a shaft, a set of brushes mounted on the shaft, and a vertical stepping magnet, impulse receiving means for controlling the operation of said magnet to advance said brushes to a level corresponding to the number of impulses received, a calling subscriber's line, means for extending said line to said impulse receiving means, a release magnet the operation of which permits the shaft to restore to normal, off-normal, contact springs, a circuit including nor-

mally open off-normal contacts for operating said release magnet upon advance of the switch in response to a series of impulses corresponding to a particular digit to absorb said digit, a relay for preventing the operation of said release magnet in case said switch is again advanced by a series of impulses corresponding to said particular digit, a circuit for operating said relay when said shaft reaches normal position, said circuit including the winding of said release magnet whereby said release magnet is rendered slow in releasing, a switching relay for extending the calling line to said brushes, and for disconnecting said impulse receiving means from said line, and a circuit including a back contact of said release magnet for operating said switching relay.

6. In a telephone system, subscribers' lines, a two-motion selector switch comprising a shaft and a set of brushes mounted thereon, a primary magnet for advancing said brushes in a primary movement, and a secondary magnet for advancing said switch in a secondary movement, means for extending a calling line to said switch, means responsive to impulses received over said calling line for controlling the operation of said primary magnet, a release magnet the operation of which permits the shaft to restore to normal, a circuit for operating said release magnet upon release of the connection by the calling subscriber, a circuit for operating said release magnet after advance of the switch in response to a series of impulses corresponding to any one of certain digits, a control relay operated when the shaft reaches its normal position after operation of the release magnet to absorb a digit, and means for preventing the operation of said control relay during the return of the shaft to its normal position in case the operation of said release magnet is due to the release of the connection by the calling subscriber.

7. In an automatic telephone system, subscribers' lines, a two-motion selector switch comprising a shaft, a set of brushes, a bank of terminals accessible to said brushes, a set of off-normal contact springs, a vertical stepping magnet, a rotary stepping magnet and a release magnet, means for extending a calling line to said switch, a dial for use by the calling subscriber in directing the establishment of a connection with any other of said lines, means for receiving dial impulses over said line and for controlling the operation of said vertical stepping magnet to advance the brushes to a level of the terminal bank which corresponds to the number of impulses received, a circuit including normally open contacts of said off-normal contact springs for operating said release magnet upon advance of the switch in response to a series of impulses corresponding to any one of certain digits, a relay for preventing the operation of said release magnet in case said switch is again advanced by a series of impulses corresponding to the same or a different one of said certain digits, a circuit for operating said relay including the winding of said release magnet whereby said release magnet is rendered slow in releasing, a switching relay for extending the calling line to said brushes and for disconnecting said impulse receiving means from said line, and a circuit including a back contact of said release magnet for operating said switching relay.

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