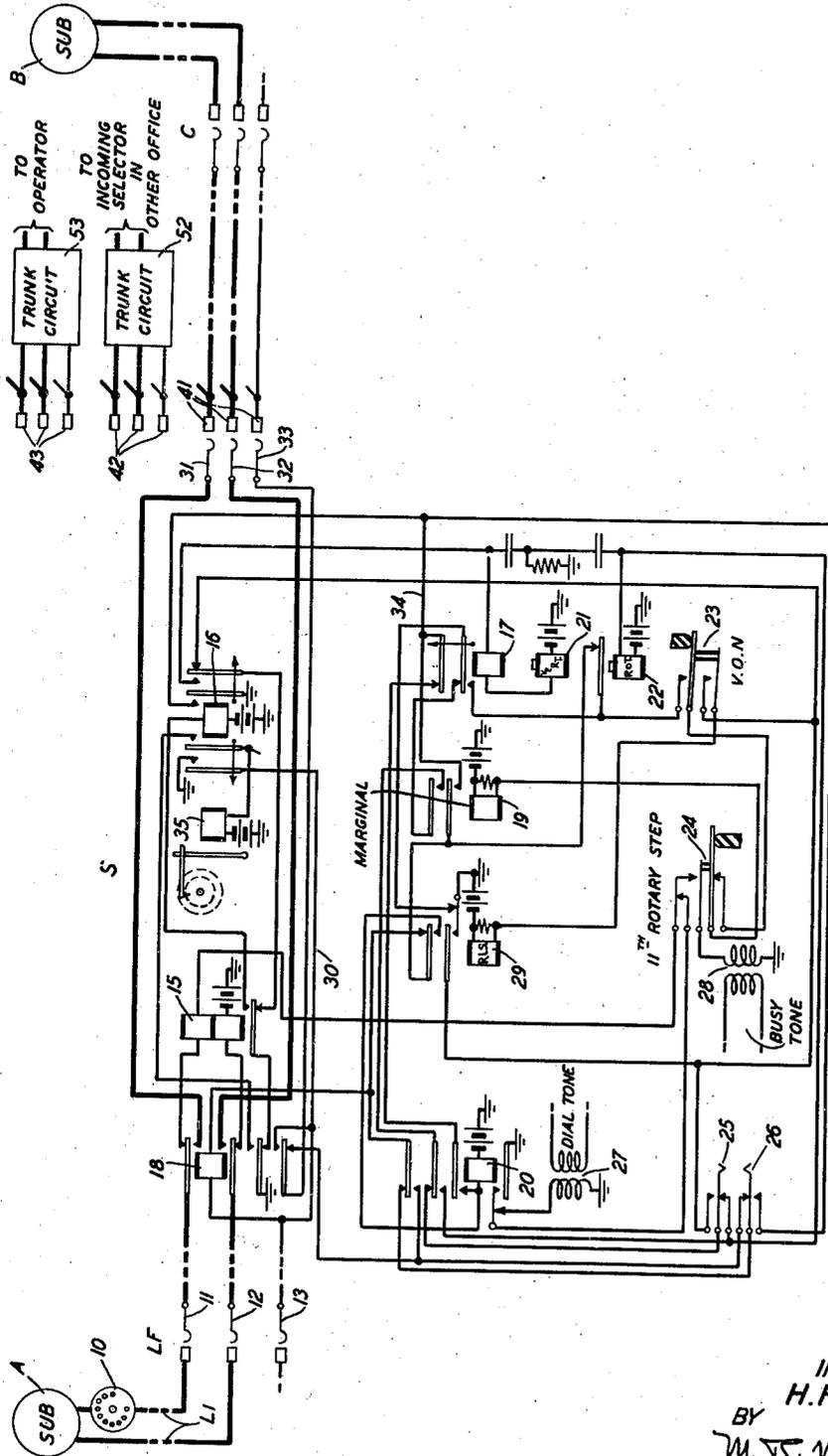


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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems and particularly to systems comprising impulse controlled selector switches for use in establishing connections between calling and called lines.

Objects of the invention are the simplification of the switching means employed in establishing telephone connections and the prevention of, and improvement in, arrangements for limiting the service and preventing the completion of calls to which a subscriber is not entitled.

One feature of this invention is a two-motion selector switch arranged to transmit a busy tone to the calling subscriber upon selection of a restricted level and to automatically advance the brushes to the eleventh rotary step position, the test circuit through the test brush being opened during advance over the terminals of a restricted level so as to prevent the connection of a busy-indicating and guarding potential to the test terminals in this level.

A second feature of this invention is a two-motion digit absorbing selector having a control relay for effecting the secondary motion after one or more digits have been absorbed and so arranged as to prevent false operation of the control relay in case the selector is seized on a second call during its return to normal at the end of a first call.

The invention will be more clearly understood by considering a switch in which the invention is embodied, one such switch being shown in the drawing which forms a part of this specification. The invention is not limited in its application to the switch shown in the drawing but is generally applicable to all two-motion selector switches.

The drawing shows schematically a subscriber's station A and line L1, a line-finder switch LF, a selector S, trunk circuits 52 and 53, a connector C, and a called subscriber's station B. The line-finder, selector and connector switches are of the well-known two-motion step-by-step type. Reference may be had to pages 53 to 65, inclusive, of the second edition of "Automatic Telephony," by Smith and Campbell, for a description of the structure of such switches and their operation when used as selectors and connectors. The line-finder LF is similar to that disclosed in the patent to R. L. Stokely 1,799,654, issued April 7, 1931. The line-finder and connector switches are represented in the drawing by a set of brushes and a single set of terminals, the stepping magnets and control relays associated therewith being omitted.

Although the selector S is shown in the drawing as being permanently associated with the line-finder LF, it is understood that there may be one or more intermediate selectors between the line-finder LF and selector S and that the selector S may be used as an incoming selector in which case it is connected to an interoffice trunk.

The selector S, which is shown in detail, comprises a set of brushes 31, 32 and 33, a vertical stepping magnet 21, a rotary stepping magnet 22, a release magnet 23, vertical off-normal springs 23, "11th rotary step" springs 24, level springs 25 and 26, and control relays 15, 16, 17, 18, 19 and 20. The brushes may be advanced by operation of the vertical stepping magnet to select any one of ten levels of terminals, each level comprising ten terminals. After selection of a level, the brushes may be advanced by operation of the rotary stepping magnet into engagement with an unguarded set of terminals in that level or in case all of the ten sets of terminals test busy to an 11th rotary position. Only three sets of terminals are shown in the drawing, the set 41 representing a level in which the brushes have access to succeeding switches in the same office, the set 42 representing a level in which the brushes have access to interoffice trunks, and the set 43 representing the 10th or "O" level in which the brushes have access to trunks to an operator. The selector S is arranged to absorb one or more digits and for this purpose is provided with a set of springs 25 which are actuated on the level or levels corresponding to digits of the particular numerical value or values which are to be absorbed. The selector S is also provided with a set of springs 26 which are actuated on one or more restricted levels, that is, levels corresponding to the first digits of the numbers of subscribers to which calls from subscribers served by the selector S may be completed only by calling an operator. If a restricted surface level is selected, the brushes are advanced to the 11th rotary step position and an all-trunks-busy tone is transmitted to the calling subscriber. Since the terminals of the bank of selector S may be multiplied to selectors serving subscribers entitled to complete calls to a group of trunks connected to the restricted level or levels of selector S, the actuation of springs 26 is effective to prevent the connection of a busy-indicating potential to the test brush during the advance to the 11th rotary step position.

Assuming a call to have been originated at station A and the line L1 to have been connected through the brushes of line-finder switch LF (and

through intermediate selectors, if any), to the selector S, a circuit is closed from battery through the lower winding of relay 15, inner lower back contact of relay 18, brush 12 of the line-finder switch LF, one conductor of line L1, through the subscriber's instrument at station A, back over the other conductor of line L1, through brush 11 of switch LF, upper back contact of relay 18, upper winding of relay 15, upper normally closed contact of the 11th rotary step spring 24, a lower back contact of relay 20, and through the left winding of the dial tone source 27 to ground. Relay 15 is operated by the current in this circuit and closes a circuit for operating relay 16. Relay 16 connects ground to conductor 30 to hold the line-finder LF in usual manner. Dial tone is transmitted to the calling subscriber if the selector S is being used as a first selector, as shown in the drawing. When the subscriber at station A dials the first digit of the number of the subscriber's line with which connection is desired, relay 15 is alternately released and reoperated as many times as there are units in the digit dialed. The release of relay 15 in response to the first impulse closes a circuit from ground at a back contact of relay 16, through a back contact of relay 15, a front contact of the relay 16, winding of relay 17 and through the winding of magnet 21 to battery. The vertical stepping magnet 21 and relay 17 are operated by the current in this circuit. The operation of magnet 21 steps the brushes 31, 32 and 33 up to the first level of the bank. The vertical off-normal springs 23 are actuated when the shaft and brushes move out of normal position, thereby closing a circuit for operating relay 19, from battery through the winding of this relay, the lower back contact of springs 24, the upper contact of springs 22, front contact of relay 17 to ground at a back contact of release magnet 29. Relay 19 closes a locking circuit which includes the lower back contact of springs 24, the upper contact of springs 22, the back contact of the rotary stepping magnet 22, inner front contact of relay 19, conductor 34 and the inner right front contact of relay 16. When relay 15 releases at the end of the first impulse, the stepping magnet 21 releases; but relay 17 is a slow-to-release relay and remains operated until all of the impulses in the train have been received. Relay 16 is also slow to release and remains operated during the response of relay 15 to dial impulses. Each succeeding release and reoperation of relay 15 effects a corresponding operation and release of stepping magnet 21, thereby raising the brushes, step by step, to the level corresponding to the digit dialed.

Assume first that the called subscriber is in another office and that the selected level is not a restricted level and is represented by the set of terminals 42 connected to the outgoing trunk circuit 52. In this case the level springs 25 and 26 are not actuated on the selected level and the release of relay 17, upon reoperation of relay 15 after the last dial impulse of the train, closes a circuit for operating the rotary stepping magnet 22. This circuit is from battery through the winding of magnet 22, normally closed contact of springs 25, inner upper back contact of relay 20, outer front contact of relay 19, inner back contact of relay 17, to ground at a back contact of the release magnet 29. The operation of magnet 22 advances the brushes into engagement with the first set of terminals in the selected level and opens the circuit through

the winding of relay 19. Relay 19 releases causing the release of magnet 22. If the trunk circuit connected to this set of terminals is busy, the test brush 33 encounters ground potential which is extended through the lowermost back contact of relay 18, normally closed contact of springs 26, uppermost back contact of relay 20, outer back contact of release magnet 29, back contact of magnet 22, upper contact of springs 23, lower back contact of springs 24 and through the winding of relay 19 to battery. Relay 19 is thereby reoperated to again close the circuit for operating rotary stepping magnet 22, and the reoperation of magnet 22 steps the switches into engagement with the next set of terminals in the level. The magnet 22 and relay 19 are in this manner effective to continue the stepping of the brushes until the terminals of an idle trunk are encountered. There being no ground potential on the terminal engaged by test brush 33 if the associated trunk is idle, the release of magnet 22 closes a circuit for operating relay 18. This circuit is from battery through the winding of relay 19, the lower back contact of springs 24, upper contact of springs 23, back contact of magnet 22, back contact of release magnet 29, winding of relay 18, conductor 30 to ground at a front contact of relay 16. Being marginal, relay 19 is not operated by the current in this circuit. Relay 18 extends the connection from line L1 through its front contacts and through brushes 31 and 32 to the trunk or other circuit connected to the seized terminals. The operation of relay 18 also causes the release of relays 15 and 16. Since relay 16 is slow in releasing, ground is connected through its outer left front contact, conductor 30, outer lower front contact of relay 18 and brush 33 to mark the test terminals of the seized trunk circuit busy until this circuit connects ground thereto responsive to its seizure. After relay 16 releases, the line-finder LF and relay 18 of selector S are held through brush 33 to ground in the outgoing trunk or repeater circuit 52. Reference may be had to Fig. 67 and pages 70 to 72, inclusive, of the aforementioned second edition of "Automatic Telephony" for a complete disclosure of such an outgoing trunk circuit.

The impulses created by the dialing of the remaining digits of the called subscriber's number are repeated by the outgoing trunk circuit 52 to effect the operation of an incoming selector, intermediate selectors, if any, and a connector in the called office in usual manner to extend the connection to the called subscriber's line. If the line is idle, the subscriber's station is signaled; and, when the call is answered, the desired conversational connection is complete.

When the calling subscriber releases the connection by restoring the receiver to normal, the outgoing trunk circuit disconnects the holding ground from the terminal engaged by brush 33, thereby causing the release of relay 18 and the release of the line-finder LF. The release of relay 18 closes a circuit from ground at its middle lower back contact, through back contacts of relays 15 and 16, the lower front contact of springs 23, and through the winding of release magnet 29 to battery. The release magnet 29 operates and it locks under control of springs 23. The operation of magnet 29 causes the return of the shaft and brushes of selector S to normal. When the shaft reaches normal position the springs 23 are restored to normal posi-

tion, opening the circuit through the winding of magnet 29.

If all of the trunks connected to the terminals of a selected level are busy, the step-by-step advance of the brushes in this level continues in the manner above described until the brushes reach the 11th rotary position in which position the "11th rotary step" springs 24 are actuated to prevent the further reoperation of relay 19 and rotary stepping magnet 22. The actuation of springs 24 connects the right winding of busy tone source 28 to the upper winding of relay 15 so as to transmit an all-trunks-busy tone to the calling subscriber. When the calling subscriber releases the connection by replacing the receiver, relays 15 and 16 release; and, since relay 18 is not operated, the release magnet 29 is operated and the selector S is restored to normal as above described.

Assume next that the subscriber at station A is calling another subscriber in the same office in which case the first digit dialed is to be absorbed. In this case, the springs 25 are actuated when the brushes are raised to the selected level. The release of relay 17 at the end of the impulse train closes a circuit for operating the release magnet 29. This circuit is traced from battery through the winding of magnet 29, lower contact of springs 23, front contact of springs 25, a back contact of relay 20, front contact of relay 19, back contact of relay 17, to ground at a back contact of magnet 29. Before this operating circuit is opened at the back contact of magnet 29, a holding circuit is closed through the inner front contact of magnet 29 and the lower contact of springs 23. The operation of magnet 29 effects the return of the shaft and brushes to normal position. The springs 25 return to normal when the brushes leave the selected level; and the springs 23 are restored when the shaft and brushes reach normal, thereby causing the release of magnet 29 and relay 19. While magnet 29 is actuated to restore the shaft and brushes to normal, a circuit is closed for operating relay 20. This circuit includes the outer front contact of magnet 29, the inner front contact of relay 19, conductor 34, and front contact of relay 16. Relay 20 locks through its inner upper front contact, the outer back contact of relay 17, and conductor 34, to ground at the front contact of relay 16. Relay 20 disconnects the dial tone source and connects ground directly to the upper winding of relay 15. When the calling subscriber dials the second digit of the called subscriber's number, the alternate release and reoperation of relay 15 causes the operation of vertical magnet 21 and relay 17, as above described, the brushes 31, 32 and 33 being stepped up to the level corresponding to this digit. The operation of relay 17 and actuation of springs 23 cause the reoperation of relay 19 and relay 19 locks as above described. Relay 17 opens the locking circuit of relay 20 and relay 20 releases. If the level selected in response to the second digit dialed is one on which the springs 25 are again operated, the second digit is also absorbed by returning the brushes to normal in the same manner as that in which the first digit was absorbed, relay 20 being reoperated and again locked as above described. If the level selected in response to the second digit, or a succeeding digit, does not effect return of the brushes to normal, the release of relay 17 after the last impulse of the train has been received closes the circuit for operating the rotary stepping magnet 22 and

the brushes are stepped into engagement with an idle set of terminals as above described. The operation of relay 18, when an idle circuit is encountered, effects the release of relays 15 and 16 and extends the connection from the calling line through brushes 31 and 32 to an intermediate selector circuit (not shown) or directly to a connector circuit C. Relay 18 is held operated, after relays 15 and 16 release, by the connection of ground (in the seized circuit) to the terminal engaged by brush 33. The release of relay 16 causes the release of relay 20. The dialing of the remaining digits of the called subscriber's number effects the operation of intermediate selectors (if any) and the connector C to complete the desired connection. When the calling subscriber releases the connection, the holding ground is disconnected from the terminal engaged by brush 33 and relay 18 releases, causing the return of selector S to normal.

If the calling subscriber is a restricted service subscriber and dials the first digit of a number outside of the local area, springs 26 are actuated when the brushes are raised to the corresponding level. The actuation of spring 26 connects ground through the uppermost back contact of relay 20 and outer back contact of magnet 29 to the back contact of the rotary stepping magnet 22, thereby causing the repeated reoperation of relay 19 and magnet 22 to advance the brushes to the 11th rotary position in the manner hereinbefore described. The opening of the back contact of springs 26 prevents the connection of ground potential to the terminals engaged by test brush 33 during advance of the brushes to the 11th rotary position so that these terminals will not be falsely marked busy. Busy tone is transmitted to the calling station as hereinbefore described.

Each time that a connection is completed through the selector S, the operation of relay 18 closes a circuit for operating the message register 35. As soon as relay 16 releases, this circuit is opened and the register releases. The register 35, therefore, gives an indication of the number of calls completed through the selector S.

It is to be particularly noted that the circuit for operating relay 20 includes a front contact of relay 19. This is to prevent the false operation of relay 20 in case the selector S is seized, or otherwise connected to a second calling line, while the release magnet 29 is energized responsive to release of the connection from a first calling line. While such a seizure and false operation may in some cases be prevented by connecting a guarding potential to the release conductor 30 while the release magnet 29 is operated, such an arrangement would not be effective to prevent re seizure and a possible false operation of relay 20 if the selector S is used as an incoming selector. Since relay 19 is not energizing until a first series of impulses has been received, a false operation of relay 20 is prevented in the case of both local and incoming selectors without connecting a guarding potential to the release conductor 30 during the release operation.

What is claimed is:

1. In a selector switch, a bank of terminals, a set of wipers adapted to connect with any set of terminals in said bank, the terminals being divided into a plurality of groups, groups of trunks connected to the groups of terminals, an all-trunks-busy position for said wipers, means for directly advancing the wipers to select any desired one of said groups, means for auto-

matically advancing said wipers to the first set of terminals in the selected group, means including the test wiper for testing each set of terminals engaged by the wipers and for continuing the advance of the wipers from one set of terminals to the next until the wipers engage the terminals of an idle trunk, said last-mentioned means being effective to advance the wipers to the all-trunks-busy position if all of the trunks in the selected group are busy, and means comprising contacts actuated when a particular one of said groups is selected for causing the advance of said wipers to the all-trunks-busy position irrespective of whether there is or is not an idle trunk in the selected group and for disconnecting the test wiper during said advance.

2. In a telephone system comprising subscribers' lines and a selector switch for use in completing calls between calling and called lines, groups of trunks connected to the bank of said switch, an over-flow position for each of said groups of trunks, means for directing operation of said switch to select a desired group of trunks, means for automatically operating said switch to select an idle trunk in a selected group or to advance the wipers to the over-flow position in case all of the trunks in the group are busy, said last-mentioned means comprising a test circuit including the test wiper of the switch, and a set of contact springs actuated upon selection of a certain one of said groups for causing the advance of the wipers to the over-flow position and for opening the connection to the test wiper during said advance.

3. In a telephone system, a selector switch comprising a set of brushes and a bank of terminals, said terminals being divided into groups, trunks connected to said terminals, means for seizing said switch, means for directing advancement of the brushes to select any one of said groups, means for automatically advancing the brushes in a selected group, means effective when the brushes engage a set of terminals connected to an idle one of said trunks for stopping the advance of said brushes to seize said set of terminals, means comprising a release magnet for restoring said brushes to normal position, means comprising contact springs actuated upon selection of a particular group for preventing the automatic advance of the brushes in said group and for operating said release magnet to restore the brushes to normal, a relay, a circuit for operating said relay, said circuit closed by the operation of said release magnet, and relay means for preventing the closure of said circuit in case the operation of said release magnet is subsequent to the seizure of a set of terminals in a selected group.

4. In a two-motion digit absorbing selector comprising a set of brushes, a terminal bank divided into levels, means for directing operation of the selector in a primary movement to select a level, means comprising a test relay for automatically operating said selector to select a set of terminals in a selected level, a release magnet for restoring the brushes to normal, a set of contact springs adapted to be actuated upon selection of a particular level of the terminal bank, and a relay controlling the initiation of the secondary operation, a circuit for operating said release magnet to absorb a digit, said circuit comprising a front contact of said set of contact springs, a circuit for operating said control relay comprising a

front contact of said release magnet, a second circuit for operating said release magnet, and means comprising contacts of said test relay for preventing the operation of said control relay upon operation of said release magnet by the closure of said second operating circuit.

5. In a selector switch, a shaft carrying a set of brushes, a bank of terminals divided into levels, a primary magnet for advancing said brushes to select a desired one of said levels, a secondary magnet for advancing the brushes in any selected level, an impulse receiving relay for controlling said primary magnet, a stepping relay for controlling the operation of said secondary magnet, a circuit for operating said stepping relay comprising a set of vertical off-normal contact springs actuated upon advance of said shaft from normal position, a circuit comprising a back contact of said secondary magnet for holding said stepping relay until the secondary magnet is operated to advance the brushes into engagement with the first set of terminals in a selected level, a circuit comprising a back contact of said secondary magnet and one of said brushes for testing the busy or idle condition of each set of terminals and for reoperating said stepping relay if the engaged set of terminals tests busy, a switching relay for effecting seizure of the first idle set of terminals encountered, a control relay, a second set of shaft operated contact springs, said second set of contact springs adapted to be actuated upon selection of a particular level, a first circuit for operating said secondary magnet comprising a normally closed contact of said second set of contact springs, a back contact of said control relay and a front contact of said stepping relay, a second circuit for operating said secondary magnet comprising a front contact of said control relay and said front contact of said stepping relay, a release magnet for restoring said brushes to normal position, a first circuit for operating said release magnet comprising a front contact of said second set of contact springs, a back contact of said control relay and a front contact of said stepping relay, a circuit for operating said control relay comprising a front contact of said release magnet and a front contact of said stepping relay, and a second circuit for operating said release magnet comprising back contacts of said impulse receiving and switching relays.

6. In a two-motion group selector switch comprising a set of brushes and a bank of terminals divided into levels, means for directing advancement of said brushes to select any one of said levels and means including a test relay for automatically advancing the brushes to select an idle set of terminals in the selected level, a set of contact springs adapted to be actuated when the brushes are advanced to a particular level, and means including said test relay effective upon actuation of said springs for advancing the brushes over all of the terminals in said particular level irrespective of their busy or idle condition to a position beyond the last set of terminals in the level, said springs also being effective when actuated to open the connection between said test relay and the test brush to prevent the connection of a busy indicating potential to the test terminal of the sets of terminals passed over during the advance to said position.

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