

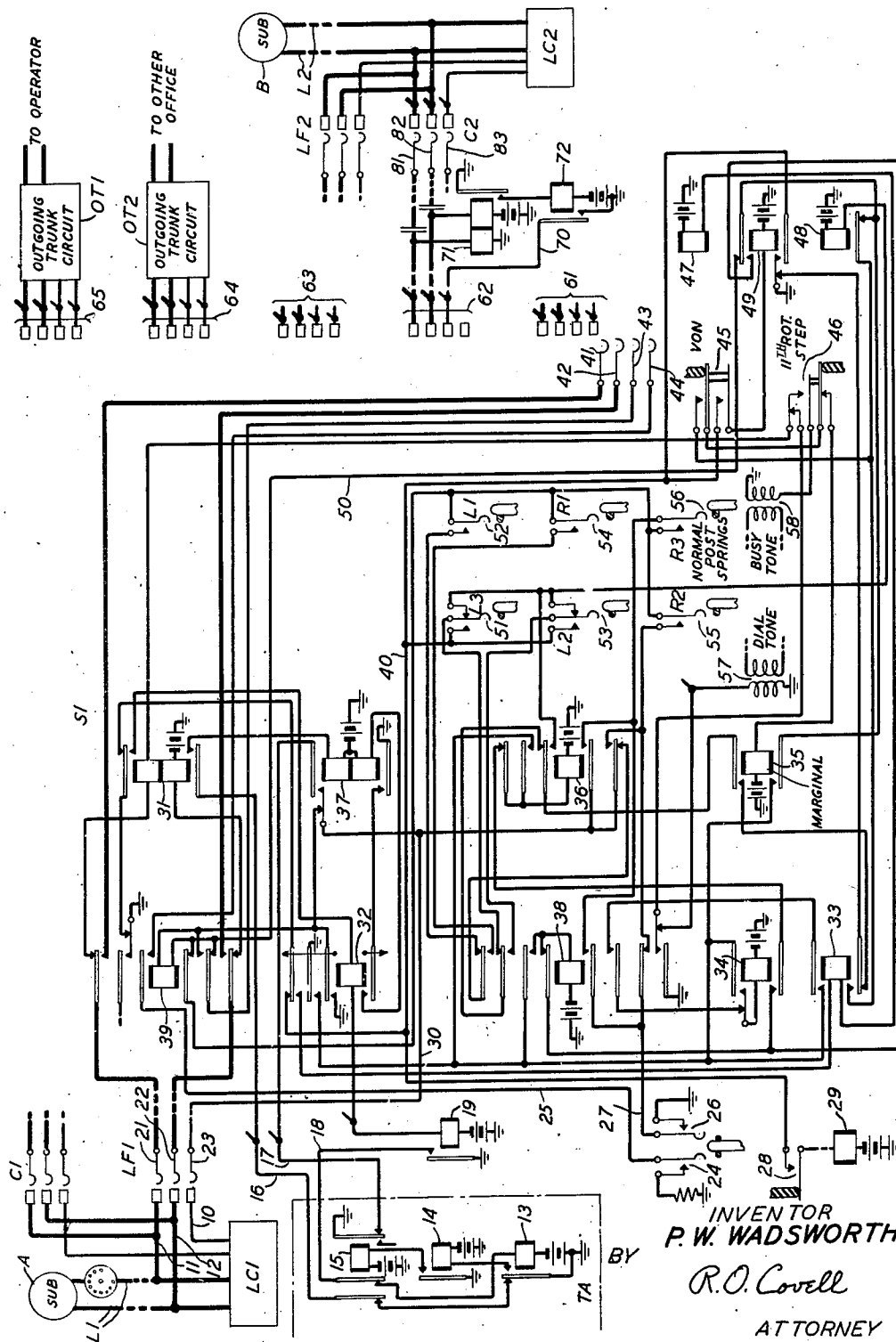
Feb. 3, 1942.

P. W. WADSWORTH

2,271,878

TELEPHONE SYSTEM

Filed Oct. 25, 1940



UNITED STATES PATENT OFFICE

2,271,878

TELEPHONE SYSTEM

Paul W. Wadsworth, Garden City, N. Y., assignor
to Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application October 25, 1940, Serial No. 362,771

23 Claims. (Cl. 179—18)

This invention relates to telephone systems and particularly to systems comprising impulse controlled switching mechanism for establishing connections between calling and called stations.

Objects of the invention are an increase in the flexibility, adaptability and efficiency of group selector switches and the trunking arrangements of telephone systems comprising such switches.

This invention is a selector switch having a primary group selecting movement and a secondary, trunk hunting movement arranged to absorb a first digit of any desired numerical value, arranged to absorb a second digit of any desired numerical value after absorbing a first digit, arranged to transmit a busy tone to a connected calling station if the level selected in response to the first digit is a level which is not used or is one on which service is restricted, and arranged to transmit a busy tone if the level selected in response to a second digit is a level which is not used or is one on which service is restricted. According to a feature of the invention a selector is provided with six sets of shaft operated springs, each set independently operable on any desired level or levels. The actuation of a first set of springs effects the return of the brushes to absorb a first digit, the actuation of a second set of springs effects the return of the brushes to absorb a second digit, the actuation of a third set effects the advance of the brushes to the eleventh rotary position in a selected level to transmit a busy tone if the level is selected in response to a first digit, the actuation of a fourth set effects the advance of the brushes to the eleventh rotary position in a selected level to transmit a busy tone if the level is selected in response to a second digit, the actuation of a fifth set of springs effects the advance of the brushes to the eleventh rotary position and transmission of a busy tone if the call is from a restricted service subscriber's station and the level is selected in response to a first digit, and the actuation of the sixth set of springs effects the advance of the brushes to the eleventh rotary position and transmission of a busy tone if the call is from a restricted service subscriber's station and the level is selected in response to a second digit.

Another feature of the invention is a digit absorbing selector arranged to absorb two digits, each of any numerical value, by a return of the brushes to normal after a primary movement of the shaft and brushes. A further feature of the invention is a two-motion group selector arranged to advance to the eleventh rotary position in an unused level when selected either in re-

sponse to a first or a second digit and to advance to the eleventh rotary position upon selection of a restricted level in response to either a first or a second digit on calls from restricted service subscribers.

A clear and complete understanding of the invention will be facilitated by considering a system and selector in which the invention is embodied, one such system and selector being shown schematically in the drawing which forms a part of this specification. The invention is not limited in its application to the system and selector shown in the drawing but is generally applicable to impulse controlled group selectors.

The drawing, which consists of a single figure, shows subscribers' stations A and B, lines L1 and L2 and line circuits LC1 and LC2, line finders LF1 and LF2, selector S1, connectors C1 and C2, and timing apparatus TA.

While only one selector is shown in a connection between a calling and a called line, it is understood that intermediate selectors may be provided, the total number of switches required for establishing connections between calling and called lines depending upon the trunking arrangement and number of subscribers in the system.

The subscribers' stations A and B may be of known type, each comprising a dial or other impulse sender for controlling the operation of the switches through which connections are established with called lines. Each of 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. Reference may be had to the patent to T. L. Dimond, No. 2,210,068 of August 6, 1940, for a description of the operation of a subscriber's line circuit and the operation of a step-by-step line finder switch in connecting a calling line to a first selector. Each of the line finder and connector switches are represented in the drawing by a set of brushes and a single set of terminals, all operating magnets, relays and other associated apparatus being omitted. The line finder LF1 is further represented by shaft operated level or normal post springs 24 and 26, vertical off-normal springs 28 and release magnet 29.

The selector S1, which is shown in detail, comprises a set of brushes 41, 42, 43 and 44, a bank of terminals consisting of ten levels, each level

consisting of ten sets of four terminals each, a vertical stepping magnet 47, a rotary stepping magnet 48, a release magnet 49, vertical off-normal springs 45, eleventh rotary step springs 46, shaft operated level or normal post springs 51, 52, 53, 54, 55 and 56, a line relay 31, a release relay 32, rotary stepping relay 35, cut-through relay 39, and other control relays 33, 34, 36, 37 and 38. Reference may be had to the patent to H. Sengebusch, No. 1,888,700, November 22, 1932, for a description of the shaft operated level or normal post springs 51 to 56, inclusive, and the manner in which they are adjusted for operation when the brushes are on any desired level or levels. Although the selector S1 is shown as a first selector connected directly to a line finder LF1, the invention is applicable to selectors other than first selectors. The bank of selector S1 is represented by five sets of terminals 61 to 65, inclusive. Terminals 61 represent the first level in which the terminals are connected to auxiliary first selectors; terminals 62 represent a level in which the terminals are connected to second selectors (not shown) or directly to connectors C2; terminals 63 represent a level which is not used; terminals 64 represent a level in which the terminals are connected to outgoing trunk circuits OT2 associated with trunks to another office; and terminals 65 represent the tenth level in which the terminals are connected to outgoing trunk circuits OT1 associated with trunks to an operator. The outgoing trunk circuits OT2 associated with inter-office trunks may be similar to that shown in Fig. 67 and described on pages 70 to 72 of the aforementioned second edition of "Automatic Telephony." The outgoing trunk circuits OT1 associated with trunks to an operator may be similar to that disclosed in Fig. 5 of the patent to R. B. Buchanan et al., No. 2,233,282 granted Feb. 25, 1941.

The timing apparatus TA, which is common to all of the first selectors in the office, comprises slow-to-operate relays 13 and 14 and slow-to-release relay 15. When these relays are normal, ground is connected to conductors 16 and 17. As soon as ground is connected to start conductor 18, relay 13 is operatively energized. Relay 13 disconnects ground from conductor 16 and closes a circuit for energizing relay 14. Relay 14 operates from two to four minutes after its operating circuit is closed, thereby closing a circuit for operating relay 15. Relay 15 disconnects ground from conductor 17 and disconnects relay 13 from start conductor 18 to release relay 13. The release of relay 13 causes the release of relay 14 and the release of relay 14 opens the operating circuit of relay 15. Relay 15 is slow in releasing so that ground is disconnected from conductor 17 for not less than a desired interval; and relay 13 is slow in operating so that ground is connected to conductor 16 for not less than a desired interval. Relays 13, 14 and 15 repeat their cycle of operations, as long as ground is connected to start conductor 18, to control the release of selectors when connected to subscribers' lines on which a permanent signal condition exists, as hereinafter described.

Assume now that a call is initiated at station A and that the line L1 is connected by a line finder LF1 to the selector S1. The line relay 31 is thereupon operated by the current in a circuit from battery through the lower winding of relay 31, outer lower back contact of relay 39, brush 22 of line finder LF1, conductor 12 of line L1,

through station A and the dial thereat, conductor 11 of line L1, brush 21 of line finder LF1, outer upper back contact of relay 39, upper winding of relay 31, upper back contact of eleventh rotary step springs 46, outer lower back contact of relay 38, and through the left winding of dial tone transformer 57 to ground. Dial tone is transmitted in this circuit to the calling subscriber. Relay 31 closes a circuit for operating relay 32 in series with relay 19, relay 19 being common to a plurality of first selectors. Relay 32 connects ground to conductor 30 to hold the line finder LF1 in usual manner. Relay 19 connects ground to start conductor 18 of the common timing apparatus TA, to start its operation if not already in operation. As soon after relay 31 operates as ground is connected to conductor 16, the upper winding of relay 37 is operatively energized. Relay 37 locks through its lower winding under control of relay 32 and connects conductor 30 to timing conductor 17, to enable the automatic release of the selector, as hereinafter described, in case the selector has not completed the connection of the calling line to a succeeding switch or trunk within an interval of from two to four minutes after relay 37 is operated.

When the calling subscriber dials the first digit of the number of a subscriber's station with which connection is desired, relay 31 is alternately released and reoperated as many times as there are units in the digit dialed. The release of relay 31 in response to the first impulse of the train closes a circuit including the outer upper front contact of relay 32 for energizing relay 33 and vertical stepping magnet 47 in series. The operation of magnet 47 steps the brushes 41, 42, 43 and 44 up to the first level of the bank. When the shaft carrying the brushes moves out of normal position, vertical off-normal springs 45 are actuated, thereby closing a circuit including the lower contact of eleventh rotary step springs 46, upper contact of springs 45, and the lower front contact of relay 33 for operating relay 35. Relay 35 locks under control of springs 45 and 46, and under control of the rotary stepping magnet 48, to ground at a front contact of relay 32. The reoperation of relay 31 at the end of the first impulse opens the circuit through the windings of relay 33 and magnet 47. The stepping magnet 47 releases but relay 33 is slow in releasing and remains operated while relay 31 is responding to succeeding impulses in the train. Relay 32 is slow in releasing and is operatively unaffected by the response of relay 31 to dial impulses. Each succeeding release and reoperation of relay 31 in response to the impulses in the train created by the dialing of the first digit effects the operation and release of vertical stepping magnet 47, thereby stepping the brushes up to the level corresponding to the digit dialed.

If the level selected in response to the first digit is a level requiring trunk hunting and if this level is not a restricted level or a vacant level, none of the normal post springs 51, 52 or 55 are operated. Assume the selected level to be the tenth level, to which trunks to an operator are connected, this level being represented by terminals 65 connected to trunk circuit OT1. In this case, the release of relay 33, after all of the impulses in the train created by the dialing of the digit 0 have been received, closes a circuit including the back contact of springs 51, back contacts of relays 38 and 36, and a front contact of relay 35 for operating the rotary stepping

magnet 48. The operation of magnet 48 rotates the brushes into engagement with the first set of terminals in the selected level and opens the locking circuit of relay 35. Relay 35 releases, in turn opening the operating circuit of magnet 48. If the first set of terminals is connected to a busy trunk, the terminal engaged by brush 43 will be connected to ground potential to guard against seizure of this set of terminals. This ground potential is further connected through brush 43 and the middle lower back contact of relay 39 to conductor 50; and when magnet 48 releases, it connects the winding of relay 35, through the upper back contact of release magnet 49 to conductor 50, thereby causing the re-operation of relay 35. Relay 35 again closes the circuit for operating rotary stepping magnet 48; the operation of magnet 48 steps the brushes to the next set of terminals and opens the operating circuit of relay 35; and the release of relay 35 causes the release of magnet 48. Relay 35 and magnet 48 are in this manner effective to advance the brushes step by step until the brushes engage an unguarded set of terminals; whereupon, relay 39 is operated by the current in a circuit from battery through the winding of relay 35, lower back contact of springs 46, upper contact of springs 45, back contact of magnet 48, upper back contact of magnet 49, conductor 50, winding of relay 39, to ground at a front contact of relay 32. Being marginal, relay 35 does not operate in series with relay 39. Relay 39 disconnects the windings of relay 31 from the calling line and connects the calling line, through brushes 41 and 42, to the selected trunk OT1. Relay 39 also temporarily connects ground potential from the inner upper front contact of relay 32, through the inner lower front contact of relay 39, to test brush 43 to guard the selected trunk against seizure by another selector until the trunk circuit has operated in the usual manner to connect a holding and guarding ground potential to the terminal engaged by brush 43. Relay 31 releases and causes the successive release of relays 32 and 37. After relay 32 releases, relay 39 and the line finder LF1 are held through brush 43 to ground potential in the trunk circuit. Relay 39 connects conductor 25 to brush 44 so that the trunk circuit OT1 may receive an indication of the class of the calling line under control of level springs 24 of the line finder, as described in the aforementioned patent to R. B. Buchanan et al. The connection is held under the joint control of the calling subscriber and the answering operator. When holding ground potential is disconnected from the terminal engaged by brush 43, relay 39 releases. The release of relay 39 connects ground to conductor 40 to effect the operation of release magnet 49, so as to restore the brushes to normal. When the shaft reaches normal, springs 45 are restored to normal, opening the circuit for operating magnet 49. The connection of ground to conductor 40 also causes the operation of release magnet 29 of line finder LF1 to restore the brushes of the line finder to normal. When the shaft of the line finder reaches normal, springs 28 are restored to normal, opening the circuit for operating magnet 29.

If, when the brushes of selector S1 are hunting in a level, all of the sets of terminals in the level are guarded against seizure, the brushes are advanced by an eleventh rotary step to an overflow position in which springs 46 are actuated to open the circuit for operating relay 35 and to

connect the right winding of busy tone transformer 58 to the upper winding of relay 31 to transmit a busy tone to the calling subscriber. When the calling subscriber restores the telephone set to normal, relay 31 releases. The release of relay 31 causes the release of relays 32 and 37 and return of the selector and line finder to normal, as above described.

Assume next that the level selected in response to the first digit is one having trunks to another office connected thereto. The terminals 64 represent such a level; and normal post springs 55 are actuated upon selection of this level. If the calling station is not a restricted service station, the brushes are advanced in the manner hereinbefore described to hunt for and seize an idle outgoing trunk circuit connected to a trunk to the called office; the operation of relay 39, upon finding an unguarded set of terminals, disconnects relay 31 and connects the calling line to an outgoing trunk circuit OT2; and the connection is held under the control of the calling subscriber and release is effected as above described. If, however, the calling station is a restricted service station, the level springs 26 of the line finder are operated and ground is connected through springs 26, conductor 27, a back contact of relay 38, springs 55 and a back contact of relay 39 to conductor 50, thereby simulating an all-trunks-busy condition which effects the repeated operation of relay 35 and stepping magnet 48 to advance the brushes to the eleventh rotary position, a busy tone being thereupon transmitted to the calling station. When the connection is released, the selector S1 and line finder LF1 are restored to normal.

Assume next that the level selected in response to the first digit is a vacant level, that is, one which represents numbers not assigned to subscribers' stations or a level restricted to all stations having access to the selector S1, such a level being represented by terminals 63. Level springs 52 are actuated upon selection of this level; and ground is connected from the back contact of timing relay 15 through conductor 17, upper front contact of relay 37, lower back contact of relay 36, outer upper back contact of relay 38, through springs 52, and a back contact of relay 39 to conductor 50 to effect the advance of the brushes to the eleventh rotary position; and a busy tone is transmitted to the calling station until the connection is released thereat.

If the first digit dialed is one which is to be absorbed, the brushes are advanced to the corresponding level to effect the operation of normal post springs 51. When relay 33 releases, after receipt of the last impulse of the train, a circuit for operating release magnet 49 is closed from battery through the winding of magnet 49, lower contact of springs 45, front contact of springs 51, back contacts of relays 38 and 36, upper front contact of relay 35, back contact of relay 33, to ground at the lower back contact of magnet 49. The release magnet locks under control of vertical off-normal springs 43, opens its operating circuit, prevents operation of rotary stepping magnet 48, closes a circuit for operating relay 38, and causes the shaft and brushes to be restored to normal. The circuit for operating relay 38 is traced from battery, through the winding and inner upper back contact of relay 39, upper front contact of magnet 49, lower front contact of relay 35, to ground at a front contact of relay 32. Relay 38 locks under the sole control of relay 32; opens its operating circuit; dis-

connects the dial tone transformer from, and connects ground to, the upper winding of relay 31; and transfers connections from contacts of springs 51, 52, and 55 to contacts of springs 53, 54 and 56 respectively. When the shaft reaches normal, springs 45 are restored to normal, releasing relay 35 and magnet 49.

When a second digit is dialed, switch S1 having been restored to normal to absorb the first digit, the brushes are advanced to the level corresponding to the digit dialed in the same manner that the brushes were advanced responsive to the first digit. When relay 33 operates in series with vertical stepping magnet 47 in response to the first impulse of the train, it closes a circuit including the middle lower front contact of relay 38 for operating relay 34. Relay 34 opens its operating circuit and locks under the sole control of relay 32. If the level selected in response to the second digit is not a restricted level or a vacant level and is a level in which it is desired that the brushes be advanced to select an unguarded set of terminals, none of the normal post springs 53, 54 and 56 are operated; and, when relay 33 releases at the end of the train of impulses, the brushes are advanced in the selected level to hunt for and seize an unguarded set of terminals in the manner hereinbefore described, the circuit for operating magnet 48 including the back contact of springs 53. If the level selected in response to the second digit is a restricted level, level springs 56 are actuated; and, if the call is from a restricted service station, ground is connected through level springs 26 of line finder LF1, conductor 27, front contact of relay 38, springs 56, and a back contact of relay 39 to conductor 50 to effect the advance of the brushes to the eleventh rotary position and transmission of a busy tone to the calling station. If the level selected in response to the second digit is a vacant level or is denied to all subscribers having access to selector S1, springs 54 are actuated to connect ground to conductor 50 and effect the advance of the brushes to the eleventh rotary position.

If, after absorbing the first digit, the second digit dialed is one which is to be absorbed, the level springs 53 are actuated upon selection of the level corresponding to the second digit. When relay 33 releases, at the end of the train of impulses, a circuit for operating release magnet 49 is closed through the lower contact of springs 45, springs 53, a front contact of relay 38, inner upper back contact of relay 36, upper front contact of relay 35, and back contact of relay 33, to ground at a back contact of magnet 49. Magnet 49 locks under control of springs 45, opens its operating circuit, prevents the operation of rotary stepping magnet 48, closes a circuit for operating relay 36, and causes the return of the brushes to normal. The circuit for operating relay 36 includes the lower front contact of relay 34, upper front contact of magnet 49, lower front contact of relay 35, and a front contact of relay 32. Relay 36 locks under the sole control of relay 32, opens its operating circuit, connects ground to contacts of springs 55 and 56, and connects the rotary magnet for operation at the end of any third digit. When the shaft reaches normal, springs 45 are restored to normal opening the operating circuit of magnet 49.

When the third digit is dialed, the brushes of switch S1 having been restored to normal to

absorb the second digit, the brushes are advanced to the corresponding level. The operation of any of normal post springs 51, 52, 53 and 54 does not affect the further operation of the selector. When relay 33 releases at the end of the train of impulses, a circuit is closed for operating the rotary stepping magnet 48 to step the brushes into engagement with the first set of terminals in the selected level. If this level is a restricted level, normal post springs 55 or 56 are operated to connect ground through the inner lower back contact of relay 39 to conductor 50 to effect the advance of the brushes to the eleventh rotary position, thereby preventing selection of a trunk in a restricted level by the dialing of a third digit of the same value as that of a first digit or a second digit which effects selection of a restricted level. If neither of springs 55 or 56 is operated, the brushes are advanced to select an unguarded set of terminals whereupon relay 39 is operated to connect the calling line thereto. Upon selection of a set of terminals, such as 62, leading to another selector or a connector, holding ground potential is connected to the terminal engaged by brush 43 to hold relay 39 and to hold the line finder in usual manner.

Upon connection of the calling line through terminals 62, either directly or through an intermediate selector, to a connector C2, the line relay 71 of the connector is operated. Relay 71 closes a circuit for operating relay 72; and relay 72 connects holding ground potential to conductor 70 to hold the intermediate selectors, if any, and to hold the selector S1 and line finder LF1. Relay 71 responds to the impulses created by the dialing of the last two digits of the called subscriber's number to control the operation of the connector whereby connection is established with the called line L2. The called station B is signaled in the usual manner and the talking connection is under the control of the calling station A. When the telephone set at station A is restored to normal, relays 71 and 72 release in succession. The release of relay 72 disconnects holding ground potential from conductor 70; and all of the selectors and the line finder are restored to normal. When both the calling and called stations have restored their telephone sets to normal, the connector C2 is restored to normal in the usual manner.

If, after connection of a calling line to the selector S1 and after relay 37 has operated in the manner hereinbefore described to connect the ground at the back contact of timing relay 15 to conductor 30 to hold the line finder LF1, the selective operation of the selector S1 is not completed and relay 39 operated before the two to four minute interval measured by timing relays 13, 14 and 15 has elapsed, the disconnection of ground potential from conductor 17, by the operation of relay 15, causes the release of the line finder LF1, and the operation of a line lock-out relay (not shown) if the line circuit LC1 includes such a relay, in the manner described in the aforementioned patent to T. L. Dimond. Upon return of the line finder to normal, relays 31, 32 and 37 release in succession. The release of relay 31 causes the momentary operation of relay 33 and vertical stepping magnet 47, the brushes being thereby stepped up to the first level. When relay 32 releases, it closes the circuit for operating release magnet 49 restoring the brushes to normal, the circuit for operating magnet 49 being opened by springs 45 when the shaft reaches normal.

select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means connecting a calling line to said selector, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising a second one of said sets of contact springs for advancing the brushes in a level with which said second set of contact springs is operatively associated upon selection of the level in response to a first train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, and means comprising means actuated only if the calling line is a restricted service line and comprising a third one of said sets of contact springs for advancing the brushes, in a level with which said third set of contact springs is operatively associated upon selection of the level in response to a first train of impulses incoming to the selector, to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level.

8. In a telephone system, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising a second one of said sets of contact springs for advancing the brushes, in a level with which said second set of contact springs is operatively associated upon selection of the level in response to a first train of impulses incoming to the selector, to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, and means comprising a third one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said third set of contact springs is operatively associated, in response to a second train of impulses incoming to the selector.

9. In a telephone system, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for ad-

vancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising a second one of said sets of contact springs for advancing the brushes, in a level with which said second set of contact springs is operatively associated upon selection of the level in response to a first train of impulses incoming to the selector, to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, and means comprising a third one of said sets of contact springs for advancing the brushes in a level with which said third set of contact springs is operatively associated upon selection of the level in response to a second train of impulses incoming to the selector, to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level.

10. In a telephone system, lines connected to restricted service subscribers' stations, other lines, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means connecting a calling line to said selector, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising a second one of said sets of contact springs for advancing the brushes in a level with which said second set of contact springs is operatively associated upon selection of the level in response to a first train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, and means comprising means actuated only if the calling line is a restricted service line and comprising a third one of said sets of contact springs for advancing the brushes, in a level with which said third set of contact springs is operatively associated upon selection of the level in response to a second train of impulses incoming to the selector, to an all-trunks-busy position irrespec-

tive of whether there is or is not an unguarded set of terminals in the level.

11. In a telephone system, lines connected to restricted service subscribers' stations, other lines, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means connecting a calling line to said selector, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising means actuated only if the calling line is a restricted service line and comprising a second one of said sets of contact springs for advancing the brushes, in a level with which said second set of contact springs is operatively associated upon selection of the level in response to a first train of impulses incoming to the selector, to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, and means comprising a third one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said third set of contact springs is operatively associated in response to a second train of impulses incoming to the selector.

12. In a telephone system, lines connected to restricted service subscribers' stations, other lines, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means connecting a calling line to said selector, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising means actuated only if the calling line is a restricted service line and comprising a second one of said sets of contact springs for advancing the brushes in a level with which said second set of contact springs is operatively associated upon selection of the level in response to a first train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, and means comprising a third one of said sets of

contact springs for advancing the brushes in a level with which said third set of contact springs is operatively associated upon selection of the level in response to a second train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level.

13. In a telephone system, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising a second one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said second set of contact springs is operatively associated in response to a second train of impulses incoming to the selector, and means comprising a third one of said sets of contact springs for advancing the brushes in a level with which said third set of contact springs is operatively associated upon selection of the level in response to a second train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level.

14. In a telephone system, lines connected to restricted service subscribers' stations, other lines, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means connecting a calling line to said selector, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising a second one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said second set of contact springs is operatively associated in response to a second train of impulses incoming to the selector, and means comprising means actuated only if the calling line is a restricted service line and comprising a third one of said sets of contact springs for advancing the brushes, in a level with which said third set of

contact springs is operatively associated upon selection of the level in response to a second train of impulses incoming to the selector, to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level.

15. In a telephone system, lines connected to restricted service subscribers' stations, other lines, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means connecting a calling line to said selector, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising a second one of said sets of contact springs for advancing the brushes in a level with which said second set of contact springs is operatively associated upon selection of the level in response to a second train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, and means comprising means actuated only if the calling line is a restricted service line and comprising a third one of said sets of contact springs for advancing the brushes in a level with which said third set of contact springs is operatively associated upon selection of the level in response to a second train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level.

16. In a telephone system, lines connected to restricted service subscribers' stations, other lines, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means connecting a calling line to said selector, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising a second one of said sets of contact springs for returning the brushes to normal upon selection of a level on which said second set of contact springs is actu-

ated in response to a second train of impulses incoming to the selector, means comprising a third one of said sets of contact springs for advancing the brushes in a level with which said third set of contact springs is operatively associated upon selection of the level in response to a second train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, and means comprising means actuated only if the calling line is a restricted service line and comprising a fourth one of said sets of contact springs for advancing the brushes in a level with which said fourth set of contact springs is operatively associated upon selection of the level in response to a second train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level.

17. In a telephone system, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising a second one of said sets of contact springs for advancing the brushes in a level with which said second set of contact springs is operatively associated upon selection of the level in response to a first train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, means comprising a third one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said third set of contact springs is operatively associated in response to a second train of impulses incoming to the selector, and means comprising a fourth one of said sets of contact springs for advancing the brushes in a level with which said fourth set of contact springs is operatively associated upon selection of the level in response to a second train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level.

18. In a telephone system, lines connected to restricted service subscribers' stations, other lines, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of

springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means connecting a calling line to said selector, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising a second one of said sets of contact springs for advancing the brushes in a level with which said second set of contact springs is operatively associated upon selection of the level in response to a first train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, means comprising means actuated only if the calling line is a restricted service line and comprising a third one of said sets of contact springs for advancing the brushes in a level with which said third set of contact springs is operatively associated upon selection of the level in response to a first train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, means comprising a fourth one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said fourth set of contact springs is operatively associated in response to a second train of impulses incoming to the selector, means comprising a fifth one of said sets of contact springs for advancing the brushes in a level with which said fifth set of contact springs is operatively associated upon selection of the level in response to a second train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, and means comprising means actuated only if the calling line is a restricted service line and comprising a sixth one of said sets of contact springs for advancing the brushes in a level with which said sixth set of contact springs is operatively associated upon selection of the level in response to a second train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level.

19. In a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, and means for advancing the brushes in any level to select an unguarded set of terminals, a set of contact springs actuated upon selection of a particular level, means comprising said set of contact springs for returning the brushes to normal upon selection of the level with which the springs are operatively associated in response to a first train of impulses, another set of contact springs actuated upon selection of a particular level, and means comprising said other set of contact springs for returning the brushes to normal after selection of the level with which said other springs are operatively associated in response to a second train of impulses incoming to said selector, said brushes being advanced responsive to a third train of impulses to select an idle set

of terminals in the level corresponding to said third train of impulses.

20. In a telephone system, lines connected to restricted service subscribers' stations, other lines, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means connecting a calling line to said selector, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising means actuated only if the calling line is a restricted service line and comprising a second one of said sets of contact springs for advancing the brushes in a level with which said second set of contact springs is operatively associated upon selection of the level in response either to a first or to a third train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, and means comprising a third one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said third set of contact springs is operatively associated in response to a second train of impulses incoming to the selector.

21. In a telephone system, lines connected to restricted service subscribers' stations, other lines, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means connecting a calling line to said selector, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising a second one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said second set of contact springs is operatively associated in response to a second train of impulses incoming to the selector, and means comprising means actuated only if the calling line is a restricted service line and comprising a third one of said sets of contact springs for advancing the brushes in a level with which

said third set of contact springs is operatively associated upon selection of the level in response either to a second or to a third train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level.

22. In a telephone system, lines connected to restricted service subscribers' stations, other lines, a two-motion step-by-step selector comprising a set of brushes, a terminal bank divided into levels, means for advancing the brushes to select any level, said means controlled by directive impulses incoming to said selector, means for advancing the brushes in any level to select an unguarded set of terminals, a plurality of sets of contact springs, and individual operating means for each set of springs, each operating means adapted to operate the associated set of springs upon selection of a particular level or any one of a plurality of particular levels, the particular level or levels on which any one of said sets is operable being the same or different from the particular level or levels on which any other of said sets is operable, means connecting a calling line to said selector, means comprising a first one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said first set of springs is operatively associated in response to a first train of impulses incoming to the selector, means comprising means actuated only if the calling line is a restricted service line

and comprising a second one of said sets of contact springs for advancing the brushes in a level with which said second set of contact springs is operatively associated upon selection of the level in response either to a first or to a third train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level, means comprising a third one of said sets of contact springs for returning the brushes to normal upon selection of a level with which said third set of contact springs is operatively associated in response to a second train of impulses incoming to the selector, and means comprising means actuated only if the calling line is a restricted service line and comprising a fourth one of said sets of contact springs for advancing the brushes in a level with which said fourth set of contact springs is operatively associated upon selection of the level in response either to a second or to a third train of impulses incoming to the selector to an all-trunks-busy position irrespective of whether there is or is not an unguarded set of terminals in the level.

23. In a telephone system according to claim 18, means automatically effective if the selection of an unguarded set of terminals in a selected level is not completed within a predetermined interval of time to effect the disconnection of said line and return of said selector to normal.

PAUL W. WADSWORTH.