

Aug. 18, 1953

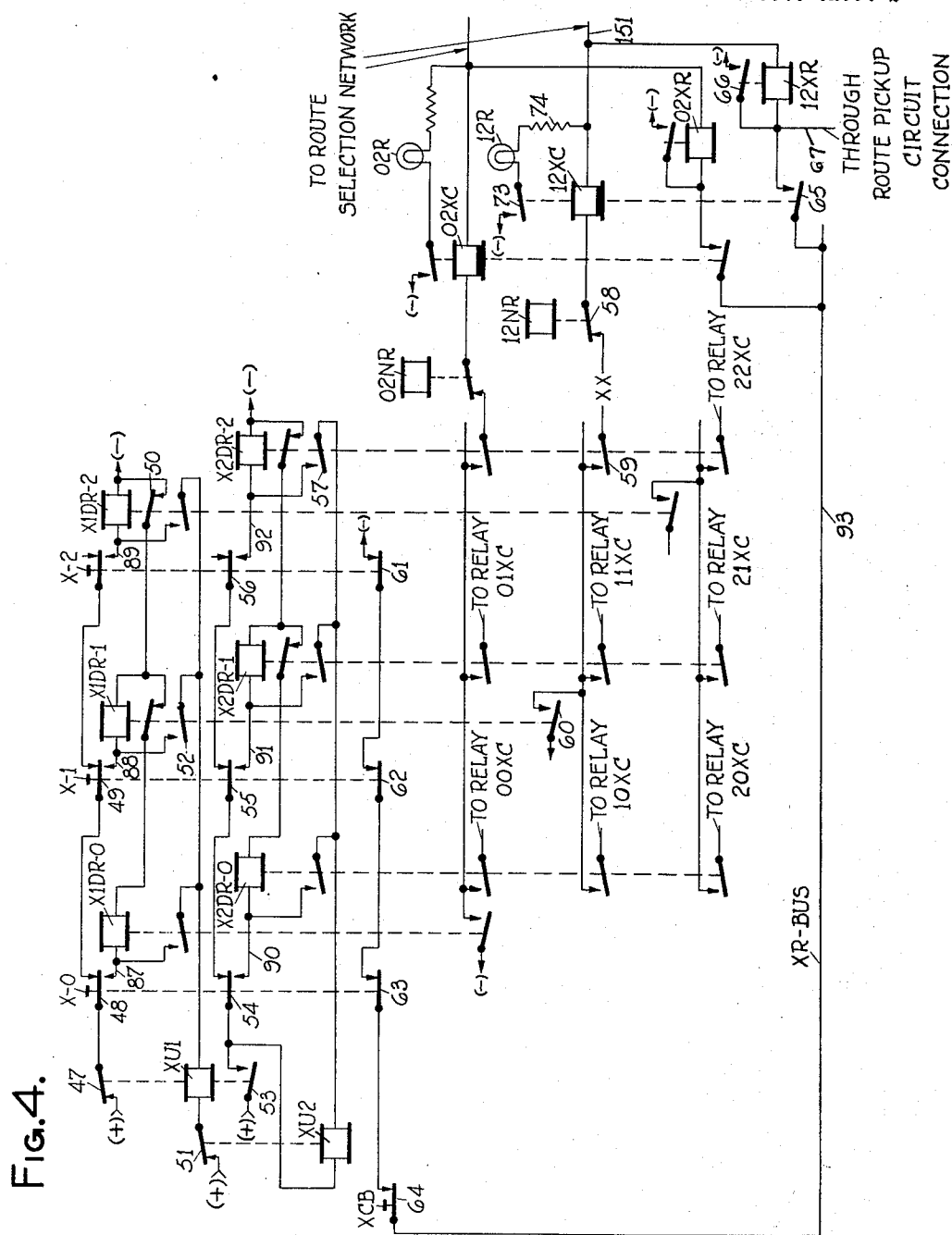
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2,649,536

SWITCH AND SIGNAL CONTROL SYSTEM

Filed Dec. 12, 1947

4 Sheets-Sheet 2



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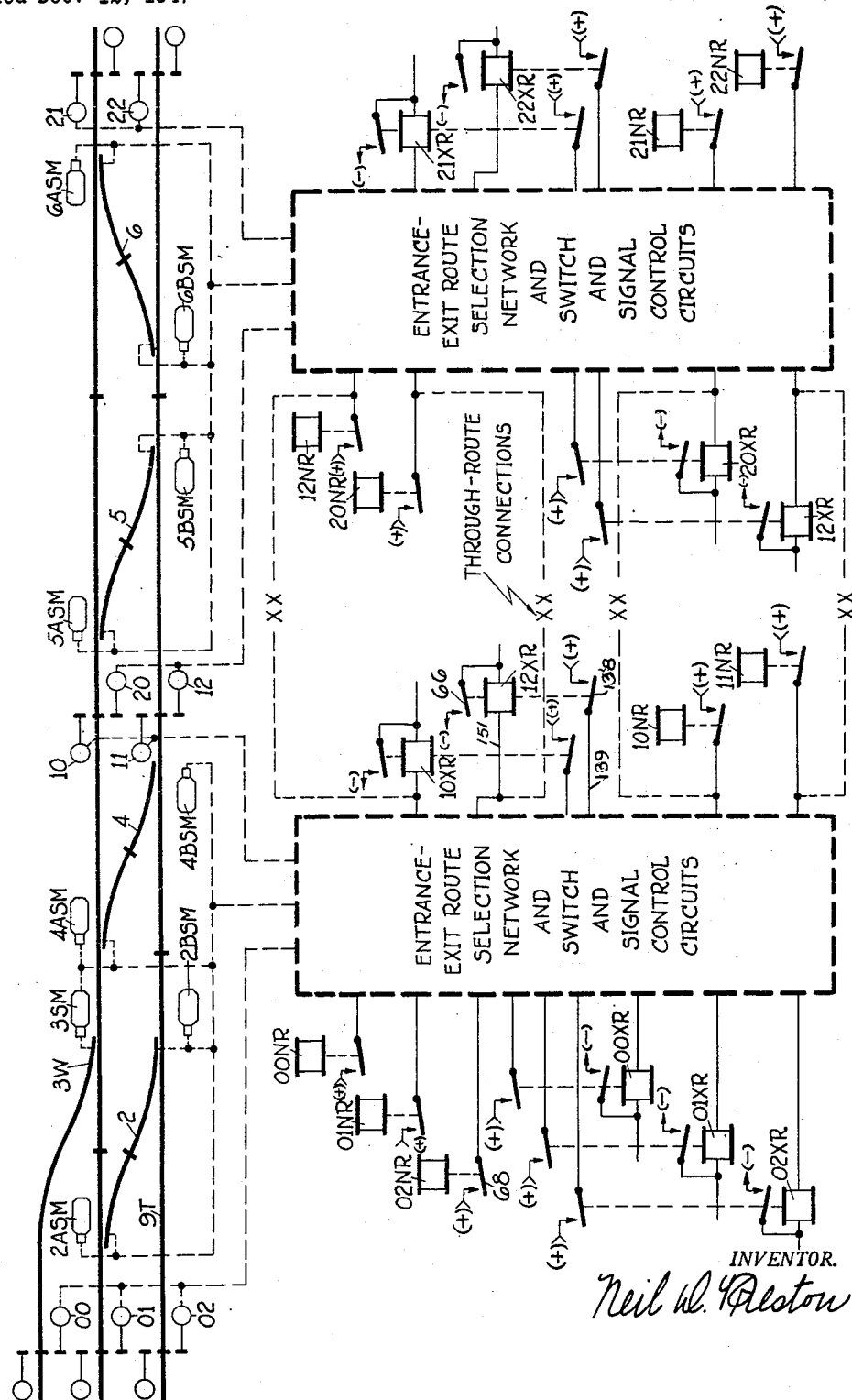
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SWITCH AND SIGNAL CONTROL SYSTEM

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FIG. 5.



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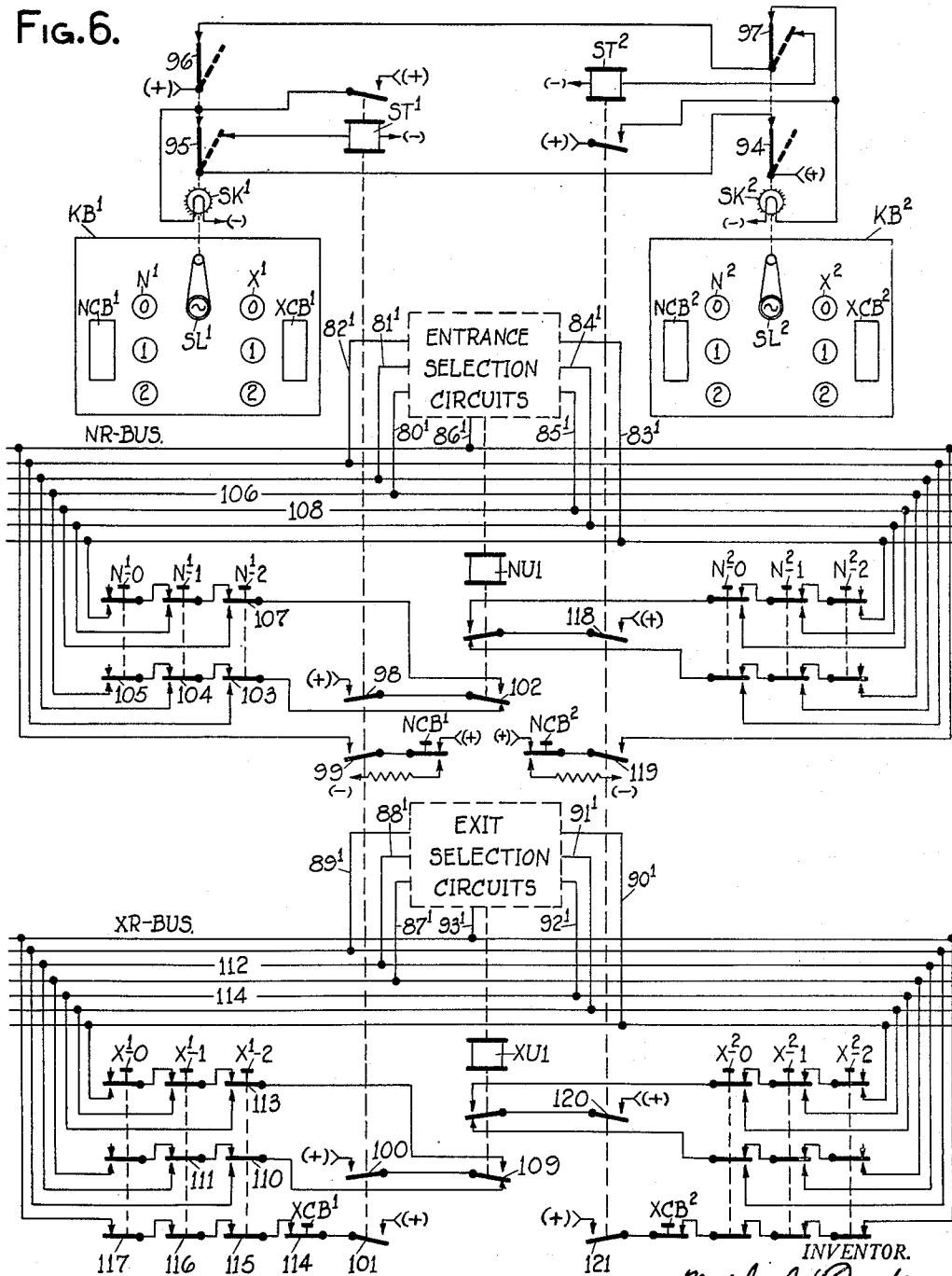
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FIG. 6.



UNITED STATES PATENT OFFICE

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SWITCH AND SIGNAL CONTROL SYSTEM

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17 Claims. (Cl. 246—134)

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This invention relates to switch and signal control systems for railroads and it more particularly pertains to means for designating the respective entrance and exit ends of routes to be established in a switch and signal control system of the entrance-exit type.

An entrance-exit switch and signal control system is characterized by the provision of means effective to select and establish a route, including the power operation of track switches as required, in response to the manual designation of the respective entrance and exit ends of that route. The means conventionally employed for the manual designation of the respective ends of routes to be set-up involves the use of respective entrance and exit push and/or turn buttons disposed on a miniature diagram of the track layout for which the system is provided at positions comparable to the entrance and exit points with which such buttons are associated for designation of the route ends. It is thus desirable that the size of the track diagram be maintained such as that all buttons are within convenient reach of an operator seated at a desk. In systems provided for large track layouts however, the size of the diagram becomes such as to bring many of the buttons out of the convenient reach of an operator seated at a desk, and thus such structure complicates the performance of the operator's duties.

An object of the present invention is to facilitate the designation of the ends of routes to be established by employing a keyboard located within convenient reach of an operator by which the operator can designate the respective ends of routes to be set up by the actuation of keys corresponding to route end numbers which are preferably marked upon the diagram of the track layout at the entrance and exit points in place of the buttons which have heretofore been conventionally employed for designation of these points. By this arrangement, the dimensions of the track diagram are not limited, and the diagram can be constructed of a size to more proportionately illustrate the actual track layout for which the system is provided. As long as an operator is able to read the numerals on the diagram belonging to the respective entrance and exit points from his desk, he is able to designate conveniently the route ends for all routes to be established by actuation of keys on the keyboard he has in front of him.

Another object of the present invention is to simplify the keyboard manipulation by use of the same set of keys for the designation of the tens

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digits of the numbers as for designation of the units digits, the sequence in which the keys are actuated being the determining factor as to whether the single numeral digit designated by actuation of a key is a tens digit number or a units digit number. If a system of numbering of the respective entrance and exit points is employed using a maximum number of distinctive units and tens digit combinations of the smallest number of distinctive single digit numerals, the actual number of keys required upon the keyboard, and the amount of associated control apparatus is maintained at a minimum.

Another object of the present invention is to provide for manual cancellation of a route which has been established by holding down a cancel button at a time when the number belonging to the entrance end of that route is designated by the actuation of the entrance keys to designate that number.

Another object of the present invention is to indicate each designated exit point before the establishment of the route is actually initiated, and to provide means for cancelling such exit designation so as to prevent route establishment in accordance with the will of the operator. It is thus provided that a route actually becomes established in response to entrance and exit designation except when an exit cancel button is actuated prior to the restoration of the keys used for designating the exit number.

Another object of the present invention is to permit the establishment of routes by a plurality of operators, without interference with each other, by the use of a plurality of interlocked keyboards for designation of the respective entrance and exit ends of the routes.

Other objects, purposes and characteristic features of the present invention will be in part obvious from the accompanying drawings and in part pointed out as the description progresses.

In describing the invention in detail reference is made to the accompanying drawings in which like reference characters designate corresponding parts throughout the several illustrations, in which those parts having similar features and functions are designated by like letter reference characters which are generally made distinctive by reason of preceding numerals representative of various route ends or track switches, and in which:

Fig. 1 illustrates a track diagram at the control office of the track layout in the field for which this embodiment of the present invention is assumed to be provided;

Fig. 2 shows in perspective a keyboard provided according to the present invention for designation of the respective entrance and exit route end controls;

Fig. 3 illustrates a circuit network organization conditioned in response to the actuation of the entrance keys of the keyboard;

Fig. 4 illustrates a circuit network organization conditioned in response to the actuation of the exit keys of the keyboard;

Fig. 5 illustrates the track layout for which this embodiment of the present invention is provided together with somewhat of a diagrammatic showing of the route establishing means and switch and signal control apparatus employed for causing the selective power operation of the track switches and the clearing of signals in response to the designation of route ends by actuation of the keys of the keyboard; and,

Fig. 6 illustrates a means for interlocking the controls of a plurality of keyboards used for entrance-exit designation for routes to be established through the same track layout.

The illustrations in general are of a conventional schematic nature so as to more clearly illustrate the mode of operation, and the principles involved, rather than attempting to illustrate the specific construction and arrangement of parts that would be employed in practice. The symbols (+) and (—) have been used to indicate connections to the respective positive and negative terminals of suitable batteries or other sources of direct current, the symbol (F+) being used to indicate connection to the positive terminal of a direct current source of energy through a suitable flasher contact.

For the purpose of simplification of the disclosure of the present invention, this embodiment of the present invention has been particularly adapted to be used with an entrance-exit type of system such as is disclosed, for example, in the patent to T. J. Judge, No. 2,298,946, dated October 13, 1942; but it is to be understood, and it will be readily apparent as the description progresses, that various features of the present invention are applicable to entrance-exit type systems having modified types of route selecting and route establishing means from that specifically disclosed in the above mentioned Judge patent. For the purposes of simplification of the disclosure of this embodiment of the present invention, certain parts which correspond to parts of the disclosure in the Judge patent have been indicated in block form in this disclosure as reference can be made to that Judge patent for a more complete disclosure of such parts.

Although the system provided by the present invention is illustrated as applied to the setting up of routes through a particular track layout, it is to be understood that the system is readily applicable to practically any track layout to be encountered in railway practice because of the particular characteristics of the circuit organization being such as to be readily applied to track layouts involving a greater or a lesser number of track switches and/or route ends. The track layout according to Fig. 5 will be readily identified as corresponding to the track layout more specifically described in the above mentioned patent to T. J. Judge wherein two parallel main tracks are interconnected at various points by crossovers to afford a plurality of conflicting and non-conflicting routes, the crossovers 2, 4, 5 and 6 being provided for connecting the two main tracks. A third track is included

in the track layout and is connected to the upper of the two main tracks by the single track switch 3W.

The entrance ends of the routes are governed by signals which are assumed to be of the searchlight type, such, for example, as the signal disclosed in the patent to O. S. Field, Patent No. 1,835,150, dated December 8, 1931. Although the signals of this embodiment are of the searchlight type, it is to be understood that other types of signals such as signals having individual color lamp units, position light, or semaphore signals can as well be employed in accordance with the requirements of practice. The signals 00, 01, 02, 10, 11, 20, 12, 21, and 22 in Fig. 5 of the present disclosure correspond to the signals 10, 11, 12A, 13, 14, 15, 16A, 17, and 18 respectively as shown in Fig. 4A of the above mentioned patent to T. J. Judge.

For purposes to be more readily apparent as the description progresses, the signals governing entrance to the respective routes through the track layout are identified by different numbers according to the present invention than corresponding signals in the above mentioned Judge patent, but, as far as the signal control circuits are concerned, the signals of this embodiment of the present invention are to be understood as being controlled in the same manner as corresponding signals in the above mentioned Judge patent. Although the number of distinctive indications to be provided by the signals is necessarily governed in accordance with the requirements of practice, it is assumed that the signals employed in this embodiment of the present invention are of the three indication type having red, yellow and green color light aspects for the respective stop, proceed-with-caution, and proceed indications.

The track switches are positioned by power switch machines of a suitable type, such, for example, as by the switch machine shown in the patent to W. K. Howe, Patent No. 1,466,903, dated September 4, 1923. The switch machines generally have control means associated therewith including means for over-load protection and the like such as is disclosed, for example, in the patent to W. H. Hoppe et al., Patent No. 1,877,876, dated September 20, 1932.

At the control office a track diagram of the above described track layout is provided within convenient vision of an operator, who is generally seated at a desk, the structure of the track diagram as illustrated in Fig. 1 and as more fully described in the above mentioned patent to T. J. Judge comprises strips indicative of the trackway which are formed principally by translucent inserts which are selectively illuminated by the selective energization of lamps suitably disposed at the back side of the diagram so as to definitely indicate the routes which are established, and the presence of trains within the track layout. The lamps governing the illumination of the respective inserts are normally dark, and are energized to outline each route when it is established in response to the manual designation of the respective entrance and exit ends thereof. These route indications are generally maintained as long as the electric locking is maintained effective for the routes so as to illuminate the inserts with white light, and as a train progresses through the route, the track portions which are occupied by the train are indicated by changing the color of light used for illumination of the corresponding inserts in the diagram from white to red.

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In the above mentioned patent to T. J. Judge, entrance and exit buttons are disposed on the diagram at positions corresponding to the respective entrance and exit ends of the routes, the entrance buttons contain indication means for indicating the clearing of the signal at that entrance point and means for indicating other conditions relative to the establishment of a route having that end as an entrance point. According to the present invention, however, there are no entrance and exit buttons provided on the track diagram at the control office and in place of such buttons, signal symbols are used to mark the entrance points of routes, and arrows are used to mark the exit points of routes.

The symbols for the signals preferably have translucent inserts provided therein, and indicator lamps on the back of the diagram for the illumination of each signal symbol insert with selected white or green light according to conditions to be hereinafter considered. The arrows along the side of the trackway of the diagram define the respective exit points that can be designated for the respective directions of track through the track layout, and these arrows are preferably formed of translucent material which can be illuminated by suitable lamps secured at the back of the diagram so as to provide an indication as to the exit points that are manually designated by an operator in the establishment of routes. Although the circuits are not all shown for energization of the indicator lamps associated with the above described indications, it is to be understood that the control of the indicator lamps of the track diagram which are not herein specifically considered may be provided according to the above mentioned patent to T. J. Judge, or in any other suitable manner.

The respective entrance and exit locations of the track layout are defined on the track diagram by the particular location of signal symbols corresponding to the signals which mark these entrance and exit points in the track layout, and the respective route ends are definitely identified on the diagram as corresponding to particular signal locations in the track layout by the numbering of the signal symbols on the track diagram to correspond with the actual numbering of the signals in the track layout. It is thus provided that a route may actually be defined upon viewing the track diagram as extending from a signal identified by a particular number to another signal identified by another particular number for governing the same direction of traffic.

With reference to Fig. 2, a keyboard is illustrated for use in designating the signal numbers as viewed on the track diagram as a means for initiating the establishment of routes through the track layout. Because of the small number of keys required on the keyboard, such keyboard can take the general configuration and size of a typewriter, adding machine or the like that is a substantially composite structure which is readily and conveniently operated by an operator seated at a desk. Although it is to be understood that the size and shape of the keyboard is much a matter of choice, the keyboard according to Fig. 2 is a box like organization having an inclined plate or panel 30 above which are suitably disposed a row of entrance keys or push buttons for the numerals 0, 1, and 2 respectively in a row N. Similarly at the right of the row of entrance keys is a row of exit keys or push buttons provided for the numerals 0, 1, and 2 respectively in

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a row X. To the left of the entrance row of numeral keys is an entrance cancel button NCB, and disposed to the right of the exit row of numeral keys is an exit cancel button XCB. These cancel buttons and numeral designation keys are assumed to be normally biased as by biasing springs to an upper position to which they are restored subsequent to their manual actuation.

An entrance selection circuit network is illustrated in Fig. 3 for the selective energization of entrance relays NR in accordance with the manual designation of the respective numbers associated with the entrance points of the routes. The relays NR that are controlled by this network are conveniently called entrance relays in that they govern the application of energy to the route establishing network in response to manual designation of the respective entrance points as fully disclosed in the above mentioned Judge patent. The respective relays NR are readily identified as being associated with the respective signal locations defining the entrance points of routes in the track layout by use of corresponding preceding numerals. Thus the relay 02NR, for example, in Fig. 3 will be identified as being the entrance relay for the entrance point governed by the signal 02 in the track layout of Fig. 5, and also represented by a signal symbol on the track diagram of Fig. 1. Although different numerals are used for designation of the signals in this embodiment of the present invention from the numerals used for designation of the signals in the above mentioned Judge patent, the signal 02 of this application will be readily identified as corresponding to the signal 12A illustrated in Fig. 4A of the Judge patent, and thus the entrance relay 02NR of the present application will be identified as corresponding to the entrance relay 12NR illustrated in Fig. 1A of the above mentioned Judge patent as far as the affect upon the route establishing circuit network is concerned. The circuit for the control of the relay 02NR of the present application differs of course from the circuit for the control of the relay 12NR of the Judge patent because the relay 02NR is governed in accordance with the coding of the signal number by the board number designation keys rather than by the actuation of the particular button belonging to the associated entrance point as in the Judge patent.

According to the circuit network of Fig. 3 the keys or buttons N-0, N-1 and N-2 are illustrated as having contacts which select both normally closed circuits and circuits closed when such keys are depressed. These contacts are readily identified as being associated with the keys 0, 1 and 2 respectively in the entrance row of keys of the keyboard designated by the letter N at the top of the row.

Associated with the entrance keys N-0, N-1 and N-2 are tens digit relays N1DR-0, N1DR-1 and N1DR-2 respectively. These are neutral relays that are selectively energized when their associated key is depressed for the designation of the first, or tens digit, of a two digit number that is used for defining the entrance point for a route to be set up.

Similarly the relays N2DR-0, N2DR-1 and N2DR-2 are associated with the keys N-0, N-1 and N-2 respectively in a manner to be energized in response to the actuation of their associated keys when the second digit (the units digit of the number) for defining an entrance point is designated by the depression of an entrance number key. It is thus provided that one group

of relays N1DR is provided to be responsive to the first digit designated of an entrance number (the tens digit), and another group of relays N2DR is provided to be responsive to the designation of the second digit of the number (the units digit).

Neutral relays NU1 and NU2 are used in the entrance selection circuit network, particularly in connection with the sequencing of the respective tens and units digit designation. These relays are normally deenergized, but the relay NU1 is picked up upon restoration of an entrance key which has been actuated for designation of the first digit of an entrance number, and the picking up of such relay conditions the relays N2DR so that they are controlled by the subsequent actuation of the entrance keys for designation of the second digit of the number. The relay NU2 is picked up upon restoration of the last key used for designation of a complete entrance number only momentarily as a means for clearing out the relays that have been picked up so as to restore such relays to their normal deenergized positions.

An object of the entrance selection circuit network according to Fig. 3 is to provide means for the selective energization of each relay NR in accordance with the complete entrance number designated, and thus a relay NR is selected for energization in accordance with each combination of relays N1DR and N2DR that are picked up in response to the actuation of the entrance keys for designation of both digits of an entrance number. The specific circuit organization provided for the energization of the entrance relays NR will be more specifically considered when considering the mode of operation of the system under specific typical conditions of operation.

With reference to Fig. 4, an exit selection network is illustrated whereby exit relays XR can be selectively energized in response to the designation of exit numbers by the actuation of the number keys in the exit row of keys of the keyboard, and this circuit network will be readily identified as having apparatus somewhat similar to that which has been described for the selective energization of the entrance relays NR.

The keys X-0, X-1 and X-2 will be readily identified as being the keys 0, 1 and 2 respectively in the X row of the keyboard illustrated in Fig. 2, and associated with the contacts of these keys is a group of relays comprising relays X1DR-0, X1DR-1 and X1DR-2 which are selectively energized in response to the first digit designated of a number belonging to the exit end of a route.

Relays X2DR-0, X2DR-1 and X2DR-2 are provided to be responsive to the second digit designated of the exit number (the units digit), and the combined energization of a relay X1DR and a relay X2DR is effective to cause the picking up of an exit control relay XC, provided that a route is available between respective entrance and exit points which have been designated. Each relay XC is picked up by a circuit organization somewhat similar to the circuit organization that is provided according to Fig. 3 for the picking up of an entrance relay NR in response to the designation of the complete entrance number, the control of the relays XC being different in that they are dependent upon selections through a route selection initiating network which is fully disclosed in the above mentioned patent to T. J. Judge. The relays XC are only momentarily energized, however, as they are providing principally for energizing associated exit indicator lamps R which are provided for the illumination

of the respective exit indicator arrows on the track diagram. According to the objects of the present invention as they have been stated in general, the exit indicator lamps on the diagram are provided so that the operator can see on the diagram indications of the route ends that he has designated before he releases the key for the last digit designation of the exit number. If for some reason the operator does not want to cause the establishment of that route he can prevent the energization of an exit relay XR for that exit point (which corresponds to an exit relay XR of the Judge patent) by actuation of a cancel button XCB. According to the normal mode of operation, however, an exit relay XR is picked up upon restoration of the last key which has been depressed for designation of the exit number if the exit control relay XC belonging to that exit point is picked up.

Switch and signal control apparatus is illustrated in Fig. 5 whereby the switches and signals are controlled in response to the picking up of respective entrance and exit relays NR and XR which define the respective entrance and exit ends of routes through the track layout. The circuit networks are not shown completely for operating the switches and signals in response to the picking up of the entrance relays NR and exit relays XR in different combinations because such means is well known in the art and fully disclosed, for example, in the above mentioned patent to T. J. Judge.

Apparatus illustrated in Fig. 6 comprises two keyboards and circuit means for interlocking the two keyboards to permit the designation of routes to be established through a single track layout by either one of two operators. The keyboards are interlocked so that only one of the boards can be effective at a time, and in that way the operator of one keyboard is prevented from inadvertently designating the completion of a route, the entrance point of which has been designated by the operator of the other keyboard. The keyboards in general are provided with keys and cancel buttons corresponding to those illustrated in Fig. 2 and heretofore described, and these keys act to control entrance and exit selection circuit networks corresponding to those that have been described with reference to Figs. 3 and 4, the respective entrance and exit selection circuit networks being common to both keyboards.

Having thus described the apparatus in general employed in this embodiment of the present invention, further detailed description of the circuit organizations will be hereinafter included with reference to the description of the mode of operation of the system under certain typical operating conditions to be encountered in practice.

OPERATION

General

The designation of the respective entrance and exit ends of routes to be established is done by actuation of the respective entrance and exit numeral keys in accordance with the numbers on the track diagram at points corresponding to the respective entrance and exit ends of the routes. Thus, for example, if a route is to be set up having an entrance point at the signal 02, that number is set up on the entrance number keys with the left-hand, or tens, digit being set up first and the right-hand, or units, digit being set up second. Thus the operator actuates first the

key 0 in the N row (see Fig. 2) and allows its restoration, and then actuates the key 2 in the N row and allows its restoration. The entrance end of the route is thus designated and the designation of the exit end of any available route emanating from that point can be effective to cause the establishment of that route.

If it is assumed, for example, that the route is to be established extending to the signal 12, the operator has only to designate the number 12 by actuation of the exit keys. He first actuates the exit key number 1 and permits its restoration and then actuates the exit key number 2. Upon actuation of the exit key number 2 the arrow 75 in the track diagram becomes illuminated to indicate that the exit point at signal 12 has been designated, and that the route extending from the designated entrance point to that exit point is available. Before the operator allows the restoration of the exit key number 2, if for some reason or other he changes his mind and decides not to cause the establishment of that route, he may cause the cancellation of the exit designation by depressing the cancel button XCB at a time when the exit key number 2 is depressed, and holding such cancel button XCB in its actuated position during the restoration of the key number 2. According to the normal mode of operation, however, where no exit cancellation is effected, upon allowing the restoration of the exit key number 2 associated with designation of the second digit of the exit route end number, the lamp which has illuminated the exit arrow 75 is extinguished, and the route becomes established by the entrance-exit self-selecting network, including the illumination with white light of the inserts in the trackway portion of the diagram included within that route. Thus the route which has been designated is clearly indicated to an operator as having been established. If the power operation of certain track switches is required in the setting up of that route, this condition is generally indicated by the flashing of translucent inserts belonging to the track switches which are to be operated in a manner fully described in the above mentioned patent to T. J. Judge.

It is provided in accordance with the general procedure in entrance-exit type of switch and signal control systems of this character that a signal can be put to stop, and thus a route can be restored at the will of an operator as well as automatically upon passage of a train. The particular manipulation required according to the present invention for causing such restoration manually is to depress the entrance cancel button NCB and at the same time designate the entrance number corresponding to the signal that is to be put to stop or the entrance point of the route that is to be canceled. Thus, for example, if it is assumed that a route has been set up emanating from the signal 02, such route can be canceled by the designation of the number 02 by actuation of the entrance keys in a manner corresponding to that employed for normal designation of the entrance end of that route, at a time when the cancel button NCB is depressed.

Although different numbers can be assigned to the signals defining the ends of the routes, such, for example, as the assignment of signal numbers corresponding to those used in the above mentioned Judge patent, it facilitates simplification of the system to use a minimum number of different numeral keys in a maximum number of

different combinations of tens and units digits. Thus the use of the numbers 0, 1 and 2 in all possible different combinations in two digit numbers permits the formation of nine distinctive two digit numbers for designation of the entrance and exit ends of the routes.

It is of course to be understood that as the number of entrance and exit ends of the routes for any particular track layout increases, the number of keys of the keyboard is increased in order to provide the required number of distinctive numbers for designation of the route ends. It will be readily apparent that the number of distinctive two digit numbers available for designation of the route ends is in proportion to the square of the number of keys employed for the designation of the numbers. Thus by the use of three keys for designation of entrance points, nine distinctive numbers can be designated; the use of four entrance keys would provide 16 distinctive two digit numbers; five keys would provide 25 distinctive two digit numbers; etc.

Entrance selection

For a consideration of the circuit means provided for the selective energization of the relays NR belonging to the respective entrance points of the various routes, it will be assumed that an operator desires to set up a route having an entrance point at the signal 02. Thus, upon identifying the entrance point that he wishes to designate by observing the number 02 associated with the signal symbol in the track diagram, he may proceed to designate such number by first actuating the N-0 key for the left-hand or tens digit of the number.

The actuation of the key number N-0, according to Fig. 3, closes a circuit for the energization of the first digit relay N1DR-0 to cause the picking up of that relay. This circuit extends from (+) including back contact 31 of relay NU1, contact 32 of key N-0 in its depressed position, winding of relay N1DR-0, back contact 33 of relay N1DR-1 and back contact 34 of relay N1DR-2, to (-). The picking up of relay N1DR-0 closes a stick circuit for that relay extending from (+) including back contact 35 of relay NU2, winding of relay NU1, front contact 36 of relay N1DR-0, winding of relay N1DR-0, back contact 33 of relay N1DR-1 and back contact 34 of relay N1DR-2, to (-).

It will be noted that the portion of the above described stick circuit including the winding of the relay NU1 is shunted as long as the key N-0 is depressed by a portion of the pick up circuit for the relay N1DR-0, and thus the picking up of the relay NU1 is delayed until the restoration of the key N-0 to open the circuit shunting the winding of the relay NU1 at contact 32 of the key N-0 in its depressed position. Thus when the operator permits the restoration of the key N-0, the relay NU1 is picked up, and the picking up of that relay opens the pick up circuit for all relays N1DR at back contact 31 to prevent the picking up of any other of such relays upon a subsequent actuation of one of the entrance keys.

The picking up of relay NU1 also conditions the relays N2DR so that any one of such relays can be picked up upon the subsequent actuation of a key with which that relay is associated. Thus, to carry out the assumed entrance designation for a route at the signal 02, when the operator depresses the key number 2 in the N row of keys (see Fig. 2), which is identified in Fig. 3 as the key N-2, a circuit is closed to cause the

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picking up of the relay N2DR-2 extending from (+) including front contact 37 of relay NU1, contact 38 of key N-0 in its normal position, contact 39 of key N-1 in its normal position, contact 40 of key N-2 in its depressed position and winding of relay N2DR-2, to (-).

A stick circuit is established upon the picking up of relay N2DR-2 extending from (+) including front contact 37 of the relay NU1, winding of relay NU2, front contact 41 of relay N2DR-2 and winding of relay N2DR-2, to (-). This stick circuit maintains the relay N2DR-2 picked up for a short time subsequent to the restoration of the key N-2 to its normal position. The inclusion of the windings of relay NU2 in the stick circuit provides that the relay NU2 is picked up upon restoration of the key N-2, the winding of relay NU2 being shunted by a portion of the pick up circuit for the relay N2DR-2 only so long as the key N-2 is maintained in its depressed position.

In accordance with the combination of the relays N1DR-0, and N2DR-2 being picked up, a pick up circuit is closed for the entrance relay 02NR through a normally closed contact of the entrance cancel button NCB. This circuit extends from (+) including contact 42 of the cancel button NCB in its normal position, front contact 43 of relay N1DR-0, front contact 44 of relay N2DR-2, and winding of relay 02NR, to (-). The relay 02NR when picked up is maintained picked up by its stick circuit including a contact 45 of a track relay for the track section in advance of the associated signal so as to provide for automatic restoration of the route upon passage of a train. It is thus provided that the relay 02NR is maintained picked up by a stick circuit extending from (+) including front contact 45 of the track relay 9TR, front contact 46 of relay 02NR and winding of relay 02NR, to (-).

Upon the picking up of the relay NU2 in response to the restoration of the second key that has been actuated in the designation of the entrance point at the signal 02, the stick circuit for the relay N1DR-0 which includes the winding of relay NU1 is opened at back contact 35 and thus these relays become dropped away. Inasmuch as the stick circuit for the relay N2DR-2 which includes the winding of the relay NU2 is dependent upon the closure of front contact 37 of relay NU1, the dropping away of the relay NU1 is effective to cause the restoration of the relays N2DR-2 and NU2, and the restoration of these relays completes the restoration of the parts of the entrance selection circuit network to normal to condition such network for a subsequent entrance designation, the network having been effective to complete its purpose of picking up the relay 02NR in response to the designation of the associated entrance signal 02 as the desired entrance point of a route to be established.

Having thus described the circuits and the particular mode of operation involved in the designation of a specific entrance point it is to be understood that a similar mode of operation employing similar circuits is accomplished in the designation of any of the other entrance ends of routes to be set up, each entrance relay NR being energized by a distinctive combination of a first digit relay N1DR and a second digit relay N2DR picked up in response to the actuation of predetermined numeral keys in the entrance row of keys on the keyboard.

The chain circuit organization for the energization of the respective relays N1DR and N2DR

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is provided in order to guard against the possibility of improper operation in case two numeral keys become simultaneously depressed. It is thus provided that energy is fed to each of the relays N1DR or N2DR through the normally closed contact of each lower numeral key from the numeral key with which that relay is associated. This circuit organization means that in case two keys become simultaneously depressed, the key for the lowest numeral will cut energy off from the relay associated with the key for the higher numeral.

It is further provided that the portion of the circuits for the relays N1DR and N2DR to the right of the windings of such relays checks that all relays belonging to those respective groups associated with the designation of higher numerals are checked in their deenergized positions. By this circuit arrangement it is provided that even if two different numeral keys should be operated at particular times to momentarily apply energy to two different relays for a single digit of the entrance number, the picking up of the digit relay for the highest number would cut energy off from the digit relays for lower numbers and thus insure that only one digit relay could be picked up and maintained energized by its stick circuit.

The circuits which have been described in designating the entrance point at the signal 02 will be readily recognized as illustrative of the above described mode of operation. That is, the circuit that has been described for energization of the relay N2DR-2, for example, includes the normally closed contacts 38 and 39 of the keys N-0 and N-1 which are lower numeral keys with respect to the key N-2 that is associated with the picking up of the relay N2DR-2. The chain circuit organization extending to the right of the windings of the relays is illustrated in the circuit for the relay N1DR-0 which has been described wherein the inclusion of back contacts 33 and 34 of the relays N1DR-1 and N1DR-2 respectively in the circuit checks that all higher number relays N1DR are deenergized. It is thus provided that in case two keys become depressed contemporaneously, the key that is depressed first is the one that determines what digit relay shall be picked up, and in case two keys are actuated simultaneously, the lower numeral key is effective to designate the number for that digit.

Exit selection

For a consideration of the circuit means provided for the selective energization of the exit relays XR belonging to the respective exit ends of the various routes, it will be assumed that an operator desires to complete the designation of a route extending from the signal 02 to the signal 12, the entrance end of the route having been designated as above described as being at the signal 02. To designate the exit end of the route to be at the signal 12, the operator must designate the number 12 by actuation of the keys 1 and 2 respectively in the exit row of keys of the keyboard.

With reference to Fig. 4, the depression of the exit key X-1 for designation of the tens digit of the exit number 12 is effective to pick up the relay X1DR-1 by the energization of a circuit extending from (+) including back contact 47 of relay XU1, contact 48 of key X-0 in its normal position, contact 49 of key X-1 in its depressed position, winding of relay X1DR-1 and back contact 50 of relay X1DR-2, to (-). A stick

circuit is established for the relay X1DR-1, upon the picking up of that relay, extending from (+) including back contact 51 of XU2, winding of relay XU1, front contact 52 of relay X1DR-1, winding of relay X1DR-1 and back contact 50 of relay X1DR-2, to (-). The winding of the relay XU1 is shunted by the pick up circuit for the relay X1DR-1 as long as the key X-1 remains depressed, and thus the relay XU1 is picked up only upon the restoration of the key X-1.

Subsequent to the restoration of the key X-1 and the picking up of the relay XU1, the actuation of the key X-2 for designation of the units digit of the exit number 12 is effective to pick up the relay X2DR-2 because of the energization of a circuit extending from (+) including front contact 53 of relay XU1, contact 54 of key X-0 in its normal position, contact 55 of key X-1 in its normal position, contact 56 of key X-2 in its depressed position and winding of relay X2DR-2, to (-). A stick circuit is established for the relay X2DR-2, upon the picking up of that relay, extending from (+) including front contact 53 of relay XU1, winding of relay XU2, front contact 57 of relay X2DR-2 and winding of relay X2DR-2, to (-). The pick up circuit for the relay X2DR-2 shunts the winding of relay XU2 as long as the key X-2 is maintained in its depressed position; but upon restoration of the key X-2, the relay XU2 becomes picked up in series with the stick circuit for the relay X2DR-2.

It is thus provided that a relay is picked up belonging to the particular numeral designated for each digit of the exit number, the relay X1DR-1 having been picked up for the tens digit number 1, and the relay X2DR-2 having been picked up for the units digit number 2. In accordance with the energization of these relays, a circuit is closed by which the relay 12XC can be picked up, provided energy is fed from the positive terminal of a source of energy through the route selection initiating circuit network, the ends of which are illustrated in Figs. 4 and 5, and the detail circuit selections of which are fully disclosed in the above mentioned patent to T. J. Judge. Thus, if the route is available extending between the respective entrance and exit points that have been designated, the relay 12XC (see Fig. 4) is picked up upon the picking up of the relay X2DR-2 in response to the designation of the units digit of the exit number because of the connection of the wire 151 through the winding of the relay 12XC, back contact 58 of relay 12NR, through-route contact selections as shown in the Judge patent and as indicated in Fig. 4 by the letters "XX," front contact 59 of relay X2DR-2, front contact 60 of relay X1DR-1, to (-). It is thus provided that the relay 12XC is picked up immediately in response to the picking up of relay X2DR-2 (with the key X-2 depressed); and upon restoration of the key X-2 so that all keys are in their normal positions, energy is applied to the XR-BUS so that the exit relay 12XR can be picked up as selected by the energized condition of the relay 12XC.

The relay 12XR is connected to the initiating circuit network in a manner fully disclosed in the above mentioned patent to T. J. Judge, and the connection of negative battery to the winding of the relay 12XR through the XR-BUS provides for the picking up of that relay. The connection of negative battery to the winding of the relay 12XR is accomplished through contact 61 of the key X-2 in its normal position, contact 62 of key X-1 in its normal position,

contact 63 of key X-0 in its normal position, contact 64 of the exit cancel button XCB in its normal position, XR-BUS and front contact 65 of relay 12XC to the winding of relay 12XR. Upon the picking up of the relay 12XR, the closure of its front contact 66 establishes a stick circuit to shunt the contact selections just described out of the circuit for that relay. Thus the relay 12XR is maintained picked up until the route is restored either automatically upon passage of a train or manually by the keyboard operator in a manner to be hereinafter considered.

Upon restoration of the key X-2 subsequent to the designation of the units digit of the next number, the relay XU2 is picked up because of the removal of its shunt at contact 56 of the key X-2, and the picking up of that relay by opening back contact 51 causes the dropping away of relay XU1 and also the dropping away of relay X1DR-1 by the opening of its stick circuit which is in series with the winding of relay XU1. When relay XU1 is dropped away, the opening of front contact 53 opens the circuit by which the relays XU2 and X2DR-2 are maintained energized and therefore causes the dropping away of those relays.

The circuit for the relay 12XC is opened by whichever one of the relays X1DR-1 or X2DR-2 is first dropped away, but the relay 12XC is made sufficiently slow in dropping away, as indicated by the shading of the lower portion of the winding of that relay in Fig. 4, so that it is maintained picked up subsequent to the restoration of the keys for a sufficient time to insure the picking up of the relay 12XR, which relay is maintained picked up by its stick circuit as long as the route is maintained established extending between the entrance and exit points which have been designated. The relay 12XR will be readily identified as corresponding to the relay 16XR shown in Fig. 1D of the above mentioned Judge Patent No. 2,298,946, the connection of that relay to the initiating circuit network being accomplished by the wire 151 which corresponds to the wire 151 of the present application. Assuming that through-route connections are desirable whereby end-to-end operation can be accomplished, through-route connections for the relay 12XR are accomplished as indicated by the wire 67 to include suitable through-route contact selections such as is disclosed, for example, in the above mentioned patent to T. J. Judge.

It will be noted from the general mode of operation just described that the relay 12XC was only momentarily picked up during the designation of the exit point, and that the relay 12XR was picked up in response to the relay 12XC, only after the key for the last digit of the exit number was restored to its normal position. This particular mode of operation is accomplished in order to provide a momentary exit indication on the track diagram and also provide a period of time in which the operator may cancel the exit designation if he so desires, all of which will be hereinafter more specifically considered.

The circuits and the mode of operation for the picking up of the relay 12XR in response to the designation of the associated exit point at signal 12 as has been specifically described is to be considered as typical of the circuit organization and mode of operation which is provided for the picking up of the relays XR associated with the other exit points of the track layout,

each relay XR being picked up in accordance with the energization of a distinctive combination of relays X1DR and X2DR.

It is to be understood that the description as has been specifically set forth with respect to the chain circuit connections of the entrance selection network for the control of the relays N1DR and N2DR corresponds to that which is provided for the energization of the relays X1DR and X2DR of Fig. 4. In other words, a chain circuit organization is provided with respect to the designation of exit numbers whereby only a first of a plurality of keys that are inadvertently contemporaneously operated is effective to pick up an associated number relay X1DR, or X2DR.

Route establishment and switch and signal control

Having considered specifically the respective circuit organizations for the selective energization of the entrance and exit relays NR and XR respectively, consideration will now be given as to the manner in which the energization of these relays in different combinations accomplishes the setting up of the routes between the entrance and exit points which have been designated.

Assuming the entrance relay 02NR to be picked up as has been heretofore described for designation of an entrance point at the signal 02, the closure of its front contact 62 (see Fig. 5) applies energy to an initiating circuit network for energizing circuit portions of the network in accordance with the availability of all routes emanating from that point in the manner fully disclosed in the above mentioned patent to T. J. Judge. For a consideration of the details of the circuit organization energized by the relay 02NR, it can be assumed that the front contact 62 of relay 02NR corresponds to the front contact of relay 12NR in Fig. 1A of the Judge Patent No. 2,298,946 which is used for applying energy to an initiating circuit network. Energy applied to the network by the front contact 62 of relay 02NR feeds through the network to the winding of the exit relay 12XR to condition that relay so that it can be picked up in response to the designation of an exit point at signal 12.

In response to the designation of the exit point of the route at signal 12, the relay 12XR is picked up as heretofore described, and the picking up of that relay applies energy to a circuit network for selectively energizing the windings of switch position selecting relays as is shown specifically in the above mentioned patent to T. J. Judge and indicated in block form in the present application. The picking up of relay 12XR applies energy to wire 139 of such circuit network by the closure of front contact 138 which corresponds to the contact 138 of the relay 14XR and wire 139 shown in Fig. 1C of the above mentioned patent to T. J. Judge. Upon application of energy to this wire 139, relays are picked up selecting the normal positions of the track switches of the crossovers 2 and 4, and in accordance with the picking up of such relays, switch control circuits are energized which effect the power operation of the switch machines 2ASM, 2BSM, 4ASM and 4BSM to operate the track switches of the crossovers 2 and 4 to their normal positions. After the track switches have been properly positioned in accordance with their positions called for by the route selection network, a signal control circuit is closed for permitting the clearing of signal 02 for governing

passage of a train into the route which has been assumed to be set up in a manner more specifically disclosed for the clearing of the corresponding signal 12A of the above mentioned patent to T. J. Judge according to a circuit organization shown in Fig. 3 of that patent.

Having thus described how one route can be set up, and the signal governing entrance to that route cleared in response to the designation of the respective entrance and exit ends thereof, it is to be understood that this description can be considered as typical of the mode of operation accomplished in the setting up of other routes which may be designated through the track layout of this embodiment of the present invention, and the signals cleared governing entrance to such routes.

Entrance cancellation

The restoration of the route establishing means and the entrance and exit relays is normally accomplished automatically upon the passage of trains as described in the above mentioned patent to T. J. Judge, and this automatic restoration is initiated by the acceptance of the signal governing entrance to the route by a train so as to cause the dropping away of the track relay for the track section in advance of that signal. Thus the entrance relay 02NR, for example (see Fig. 3), is dropped away by the opening of its stick circuit at front contact 45 of the track relay 9TR upon the entrance of the train into the track section 9T (see Fig. 5). Upon the dropping away of the entrance relay 02NR, the exit relay 12XR for the exit end of that route is dropped away because of the deenergization of the initiating circuit network by the opening of front contact 62 of relay 02NR, and the dropping away of the relay 12XR, in turn, opens the pick up circuits for the switch position selecting relays for the respective track switches included in the route at front contact 138 so that such relays can be dropped away in accordance with the restoration of the route locking as the train progresses through the route.

It is at times desirable for the operator to be able to manually cause restoration of the route establishing means for a route, and it is provided that such restoration can be effected by the actuation of the entrance cancel button NCB at a time when the particular entrance point of the route to be restored has its number designated by the actuation of the entrance keys of the keyboard. Thus, for example, if the route is to be restored extending from the entering signal 02, then cancel button NCB is held down while the respective digits 0 and 2 are designated by the actuation successively of the keys 0 and 2 in the row N of the keyboard, such keys being actuated in the same manner as has been described for designation of the signal 02 as an entrance point. In accordance with such designation the relays N1DR-0 and N2DR-2 (see Fig. 3) are picked up by the energization of circuits which have been described when considering the mode of operation upon entrance designation. Upon the picking up of the relay N2DR-2, with the cancel button NCB in its depressed position, a shunt is applied on the winding of the relay 02NR through a suitable limiting resistor 69 so as to cause that relay to be dropped away. The shunt extends from (+) including front contact 45 of relay 9TR, front contact 46 of relay 02NR, front contact 44 of relay N2DR-2, front contact 43 of relay N1DR-0, contact 42 of the cancel button NCB in its depressed position and the limiting resistor

69, to (—). The resistor is of sufficiently low resistance to reduce the current in the winding of the relay 02NR below the drop away point of that relay, and upon the dropping away of the relay 02NR, the opening of its front contact 46 opens the above described shunt so that such shunt is only momentarily applied irrespective of the length of time the buttons are maintained in their depressed positions.

When an entrance relay is manually restored as above described, it is necessary that the cancel button NCB be held in its depressed position until the restoration of the key for designation of the second digit of the number has become effective, and the entrance selection relays have been dropped away. This is because it is the normal or the depressed position of the cancel button NCB that determines whether an entrance relay designated by the actuation of the number keys is to be respectively picked up or dropped away, and thus if the cancel button NCB is in its normal position when a combination of first and second digit relays are energized, the selected entrance relay NR is picked up, and if the cancel button NCB is depressed at the time when a combination of first and second digit relays are energized, the selected entrance relay is dropped away.

Exit cancellation

According to the mode of operation as it has been described for picking up the exit relays XR, an associate relay XC is picked up in response to the actuation of the exit key for the units digit of the exit number designated, but the relay XR is not picked up until the restoration of the numeral key which has been used for designation for that units digit. In other words there is a period of time during which the key for the units digit is maintained depressed when an exit indication is set up on the track diagram to indicate definitely the exit end of the route that has been designated, but when such indication is displayed, energy is not yet applied to the XR-BUS to cause the picking up of the associated exit relay XR. It is during this interval that an operator has a choice as to whether he wants to permit the establishment of the route between the designated entrance and exit points to become completed, or whether he wishes to cancel the exit designation and set up the route at a different point.

More specifically, the picking up of a relay XC associated with an exit point in response to exit designation is accomplished as has been described whereby the relay 12XC, for example, has been described as being picked up in response to the picking up of the units digit relay X2DR-2, which in turn is picked up in response to the depression of the exit key X-2 subsequent to the depression and restoration of the exit key X-1. It is therefore provided that the combined energization of relays X1DR-1 and X2DR-2 is responsible for the picking up of the relay 12XC in a manner which has been described as soon as the relay X2DR-2 is picked up in response to the designation of the units digit of the number.

No energy is applied to the associated relay 12XR at this time because in order to energize the XR-BUS from which all relays XR are picked up, it is necessary that all exit keys be restored to their normal positions. It will also be noted that the circuit applying energy to the XR-BUS through the normally closed contacts 53, 52, and 61 of the respective keys X-0, X-1 and X-2 also includes a normally closed contact 64 of the exit cancel button XCB. It will also be noted that

the connection of the XR-BUS to the respective exit relays XR is through a front contact of their associated exit control relays XC, such as the connection of the relay 12XR to the XR-BUS through the front contact 65 of the relay 12XC. It is therefore a requisite of the organization in order to pick up a relay XR, that its associated relay XC must be picked up, that the exit cancel button VCB must be in its normal position, and that all of the numeral keys for designation of exit numbers are restored to their normal positions.

Inasmuch as the restoration of the key used for designation of the units digit of an exit number, subsequent to the picking up of an exit relay XC, such as the relay 12XC, is effective through the dropping away of the associated units digit relay X2DR to open the circuit for that relay XC, the relay XC becomes dropped away shortly subsequent to the restoration of the key used for designation of the units digit of the exit number. Thus if the cancel button XCB is actuated when the units digit exit numeral key is depressed and such cancel button is held in its depressed position during and for a short time subsequent to the restoration of the units digit exit numeral key, the relay XC that has been picked up becomes dropped away prior to the time when energy can be applied to the XR-BUS, and thus the associated relay XR does not become picked up.

To consider a specific example of this mode of operation, with respect to the control of the relay 12XR, the holding of the exit cancel button XCB down during and slightly subsequent to the restoration of the exit numeral key X-2 when the exit number 12 is designated, provides that energy is not applied to the XR-BUS until after the relay 12XC has been dropped away to open the front contact 65 and thus prevent the picking up of the relay 12XR when the cancel button XCB is subsequently restored to its normal position. Thus the restoration of the exit cancel button XCB as described above completes the restoration of the parts of the circuit network associated with exit selection to their normal positions without having picked up a relay XR for defining the exit end of the route. Of course under these conditions the entrance relay NR which has been picked up for defining the entrance end of the route is still picked up and the operator has a choice of whether he wishes to designate another exit point, as for example, because of his having mismanipulated a numeral key and designated the wrong exit point first, or whether he wishes to cancel the entrance designation in a manner which has been heretofore described, and not established a route at that time emanating from such entrance point.

Having thus described the mode of operation upon cancellation of an exit designation with specific reference to the cancellation of an exit designation at signal 12, it should be readily apparent that a similar mode of operation is effective in canceling a designation which has been rendered effective for any of the other exit points.

Entrance—exit indications

With reference to the view of the miniature track diagram shown in Fig. 1, the circular part of each signal symbol is preferably constructed of translucent material extending through the panel upon which the diagram is constructed, and a suitable lamp receptacle and light box unit (not shown) is preferably provided on the back

of the diagram panel for illumination of each of these translucent inserts. Such lamp receptacle and light box unit can be of the general character of the lamp unit disclosed, for example, in the patent to J. F. Merkel, Patent No. 2,317,472, dated April 27, 1943. Such a lamp unit organization provides for the mounting of two different color lamps behind each translucent insert, and the colors preferably employed according to the present invention are respectively white and green lamps.

These lamps are both normally dark, and the white lamp becomes energized, preferably with flashing energy, for the indicator light unit associated with each entrance point when that entrance point has its entrance relay NR picked up in response to the designation of the associated entrance number. More specifically, the picking up of the entrance relay 02NR, for example, in a manner which has been described when considering the mode of operation of the entrance selection circuit network, closes a circuit to energize the lamp 02W (see Figs. 1 and 3) which is provided for illumination of the translucent insert in the signal symbol for the signal 02. The lamp 02W is flashed under such conditions because of the energization of a circuit with flashing energy extending from F+ including back contact 70 of the relay 2BN, front contact 71 of relay 02NR, front contact 72 of the signal stop repeater relay 02RGP, and lamp 02W to (-). The relay 2BN which has its contact 70 included in the circuit just described, is the switch position selection relay for the track switch nearest the signal 02 in advance thereof. The relay 2BN corresponds to the relay 2BN which has its circuit specifically disclosed in the above mentioned patent to T. J. Judge. It is therefore provided by the circuit selection of contact 70 of the relay 2BN that flashing energy is applied to the white lamp 02W, in response to the designation of the signal 02 as an entrance point, until the selection of the route by the route selecting, or route establishing, circuit network is accomplished. This is generally accomplished by picking up switch position selection relays in a cascade manner from a point in the completion circuit network corresponding to the exit end of the route which is designated. Thus the picking up of the relay 2BN defines the complete selection of all track switches required to establish a route emanating from the signal 02. The steady energization of the white lamp 02W thus indicates that the route is selected, but the signal 02 is not yet cleared.

The relay 02RGP, which has its contact 72 included in the circuit described for the white lamp 02W, is a normally energized relay which repeats the stop indication normally displayed by the signal 02 according to the usual practice. A circuit for the control of a corresponding relay RGP is specifically shown, for example, in the above mentioned patent to T. J. Judge. When the signal 02 is cleared, the relay 02RGP is dropped away, and the dropping away of that relay, by the shifting of contact 72, opens the circuit for the white lamp 02W and closes a circuit for the steady energization of the green lamp 02G.

According to the usual mode of operation therefore the lamp 02W is flashed in response to the designation of an entrance point at signal 02; the lamp 02W is changed to steady energization upon the completion of the selection of the route by the shifting of contact 70 of relay

2BN; and the subsequent clearing of the signal 02 governing entrance to the route, by dropping the relay 02RGP, causes the extinguishing of the white lamp 02W and the energization of the green lamp 02G to clearly indicate to an operator that the signal 02 governing entrance to the route has been cleared.

For exit indication the arrows shown in Fig. 1 along the side of the trackway in the track diagram for defining the exit points are preferably constructed of translucent material and illuminated by a suitable lamp and receptacle organization secured to the back of the panel in a manner similar to that which has been specifically described for the illumination of the translucent inserts used for entrance indication. Only a single lamp is found necessary for the exit indication, and it is preferable that such exit indicator lamp be of a distinctive color such as the color red.

According to the mode of operation in response to the designation of the exit ends of routes as has been described, it is desirable that the exit indicator lamp be energized for each designated exit point upon actuation of the last numeral key required for designation of the exit number in order to clearly indicate on the track diagram the route ends which he has designated. It is therefore provided that the energization of each exit indicator lamp is rendered effective in response to the picking up of its associated exit control relay XC (see Fig. 4). For example, if the exit control relay 12XC is picked up in response to the designation of an exit point at signal 12 as has been heretofore described, the closure of the front contact 73 of that relay establishes a circuit by which the exit indicator lamp 12R becomes energized through the circuit network including wire 151 which corresponds to a wire at the corresponding end of a suitable initiating circuit network disclosed in the patent to T. J. Judge. Inasmuch as the relay 12XC must be picked up by energy feeding through to the same network wire 151, the lamp circuit for the lamp 12R must have sufficiently high resistance to permit holding current to pass through the relay 12XC when such relay is picked up to close the lamp circuit. If the resistance of the lamp 12R is not such as to provide this mode of operation, a resistor such as the resistor 74 shown in the lamp circuit is included in order that sufficient current may flow through the relay 12XC, subsequent to the picking up of that relay, to maintain the relay 12XC picked up as long as its pick up circuit is maintained closed, irrespective of the contemporaneous energization of the lamp 12R.

Because of the primary purpose of the exit indication being to clearly point out on the track diagram the exit point that is being designated, only one exit lamp on the diagram is energized at a time in accordance with the mode of operation of the indicator control relays XC, only one relay XC being picked up at a time. Such exit indicator lamp is extinguished when its associated relay XC is dropped away in response to the restoration of the units digits exit number key for designation of the associated exit point. Thus the dropping away of the relay 12XC, for example, causes the extinguishing of the red lamp 12R which is used in illumination of the arrow 75 (see Fig. 1) of the track diagram by the opening of front contact 73 of relay 12XC (see Fig. 4).

Multiple keyboards

Assuming that there are conditions to be encountered in practice where the amount of traffic through a track layout provided with an entrance-exit type of system is so great that more than one operator is required for designating the establishment of routes for the trains, a plurality of keyboards can be provided as is illustrated in the embodiment shown in Fig. 6 so that a plurality of operators can designate route ends for routes to be set up at their respective desks, each operator having a keyboard for such designation. It will be readily apparent that the manner in which the work of the plurality of operators can be most advantageously divided will vary in accordance with the requirements of practice, and in accordance with the traffic conditions involved. Where there are different classes of trains to be routed through the track layout it may be entirely possible that an operator will govern routes of one class of trains while the other operator will govern the routes for another class of trains. On the other hand, the division of the work of the operators may be such that one operator may generally control the establishment of routes through one portion of the track layout, and another operator may control the establishment of routes through another portion of the track layout.

The embodiment shown in Fig. 6 for the designation of routes to be established through a track layout by a plurality of operators is particularly adapted to fulfill either or all of the above described conditions under which the work of a plurality of operators may be divided in that each operator has a keyboard which is adapted to designate route ends for any route within the track layout for which the system is provided. It is thus provided that the operators of both keyboards according to Fig. 6 can designate the same route ends and thus cause the establishment of the same routes. It is therefore desirable that interlocking means be provided whereby the operator of one keyboard cannot inadvertently designate a route end which will combine with another route end which has been designated by the operator of the other keyboard. In other words, it is desirable to organize the system so that the operator of one keyboard in designating an exit and of a route will not cause the establishment of a route which has had its entrance end designated by the operator of the other keyboard. It is therefore provided that in order for one operator to use his keyboard he must operate a selector lever SL which will render his keyboard effective in the designation of route ends and the other keyboard ineffective. Thus the levers SL¹ and SL² are provided on the keyboards KB¹ and KB². As a means for indicating to each operator when his keyboard can be rendered effective for the designation of route ends by the actuation of his lever SL, an indicator lamp is provided on each keyboard, and is preferably provided within the selector lever SL of that keyboard, as illustrated in Fig. 6. Thus the lamp SK¹ is associated with the lever SL¹ on the keyboard KB¹, and the lamp SK² is associated with the lever SL² on the keyboard KB². These lamps are normally illuminated, and the extinguishing of a lamp is an indication to the operator of that keyboard that his keyboard is locked out because of the other key-

board being used for designating route ends of routes to be established.

Associated with interlocking between the keyboards KB¹ and KB² are the respective station relays ST¹ and ST² which are normally deenergized, but are picked up in response to the actuation of their associated respective station levers SL. A station relay ST must be picked up before the actuation of the keys of its associated keyboard can be effective to cause the establishment of routes through the track layout.

The general organization of the system according to Fig. 6 of entrance and exit selection in response to the actuation of the respective keys is that an entrance selection circuit network and an exit selection circuit network are common to both keyboards, and include entrance selection circuits and exit selection circuits as shown respectively in Figs. 3 and 4 except that the relays of the networks will pick up in response to key operation of their keyboard, rather than being subject to actuation of only keys of one keyboard. Thus for the purpose of simplifying the disclosure of the organization for using multiple keyboards, entrance selection circuits have been merely indicated in block form in Fig. 6, and similarly exit selection circuits have been indicated in block form, as these circuits can be provided according to entrance and exit selection circuit organizations that have been fully disclosed in Figs. 3 and 4 respectively and have been heretofore described.

The wires 80¹, 81¹, 82¹, 83¹, 84¹, 85¹ and 86¹ extending to the dotted rectangle representing the entrance selection circuits of Fig. 6 from buses associated with the keys of both keyboards KB¹ and KB², have been identified by reference characters distinctive only by exponents from reference characters 80, 81, 82, 83, 84, 85, and 86 used for identification of similar wires connecting the contacts of the keys of Fig. 3 to the respective relays N1DR-0, N1DR-1, N1DR-2, N2DR-0, N2DR-1, and N2DR-2. Thus by these similar reference characters it is clearly illustrated as to the circuit portions of Fig. 3 that are assumed to be included in the dotted rectangle of Fig. 6 designated as "Entrance selection circuits."

In a similar manner the wires 87¹, 88¹, 89¹, 90¹, 91¹, 92¹ and 93¹ extending to the dotted rectangle representing the exit selection circuits of Fig. 6 from buses associated with the keys of both keyboards have been identified by reference characters distinctive only by exponents from reference characters 87, 88, 89, 90, 91, 92 and 93 used for identification of similar wires connecting the contacts of the exit keys of Fig. 4 to the respective relays X1DR-0, X1DR-1, X1DR-2, X2OR-0, X2DR-1 and X2DR-2. In this manner the apparatus represented by the dotted rectangle bearing the legend "Exit selection circuits" will be readily identified as to the particular apparatus that it includes with reference to Fig. 4.

Having thus considered the general organization of the apparatus according to Fig. 6, consideration will now be given as to the mode of operation upon the designation of the route ends of a typical route for establishment. Assuming that the system according to Fig. 6 is provided for the track layout illustrated in Fig. 5, and has included as a part thereof the track diagram according to Fig. 1, it will be assumed, for example, that it is desired to cause the estab-

lishment of a route from signal 02 to signal 12, and it will be first assumed that the operator of the keyboard KB¹ desires to cause the establishment of that route.

Under such assumed conditions, the operator of the keyboard KB¹ first checks that his indicator lamp SK¹ is illuminated to indicate that the system is at rest as far as designation of entrance and exit points by the keyboard KB² is concerned. The indicator lamp SK¹ is energized under such conditions by a circuit extending from (+) including contact 94 of lever SL² in its upright position contact 95 of lever SL¹ in its upright position and lamp SK¹ to (-). The lamp SK² associated with the keyboard KB² is also energized at this time by a circuit extending from (+), including contact 95 of lever SL¹ in its upright position, contact 97 of lever SL² in its upright position and lamp SK², to (-).

The operator of the keyboard KB¹ first actuates his lever SL¹ to its right hand position, and thereby causes the lamp SK² in the lever SL² of the keyboard KB² to be extinguished by the opening of the circuit for such lamp at contact 96 of the lever SL¹. The extinguisher of the lamp SK² indicates to the operator of keyboard KB² that he should not actuate his lever SL² until the operator of keyboard KB¹ releases the control which he has established for his keyboard KB¹ by the restoration of the lever SL¹ to its normal upright position.

In accordance with the actuation of the lever SL¹ to its right hand position, the station relay ST¹, which is associated with the keyboard KB¹, is picked up by the energization of a circuit extending from (+) including contact 94 of lever SL² in its upright position, contact 95 of lever SL¹ in its right-hand position and winding of relay ST¹, to (-). The picking up of relay ST¹ under such conditions closes front contacts 98, 99, 100 and 101 whereby energy is applied to the respective keys of keyboards KB¹ so that their actuation can be effective in designating route ends.

Assuming an operator of the keyboard KB¹ to designate the entrance point 02, he first depresses the key 0, and in response to such actuation, energy is applied to the wire 80 feeding a first digit relay (not shown) corresponding to the relay N1DR-0 of Fig. 3. Energy is applied to the wire 80¹ from (+), including front contact 98 of relay ST¹, back contact 102 of relay NU¹, contact 103 of button N¹-2 in its normal position, contact 104 of button N¹-1 in its normal position, contact 105 of button N¹-0 in its depressed position, and bus wire 106, to wire 80. Upon the restoration of the key N¹-0, the relay NU¹ (corresponds to the relay NU¹ of Fig. 3) is picked up, and the picking up of that relay conditions the entrance keys so that the subsequent designation of the second digit of the entrance number is effective to apply energy to the wire 85¹ and thus cause the picking up of a second digit relay (not shown) corresponding to the relay N2DR-2 of Fig. 3.

Thus assuming that the key N¹-2 is depressed for designation of the second digit of the entrance number, the wire 85¹ is connected to (+), through front contact 98 of relay ST¹, front contact 102 of relay NU¹, contact 107 of button N¹-2 in its depressed position, and bus wire 108, to wire 85¹. Positive battery is connected to the NR-BUS whenever the relay ST¹ is picked up and the entrance cancel button NCB is in its normal position through front contact 99 of relay ST¹,

and in accordance with the energization of the NR-BUS, the joint energization of the first and second digit entrance number relays in the entrance selection circuits is effective to pick up the particular entrance relay NR selected by that distinctive combination of relays, thus completing the designation of the entrance point for a route to be established so as to apply energy to the initiating circuit network of the route establishing means.

If it is now assumed that the operator of keyboard KB¹ defines the exit end of the typical route under consideration, the exit key X¹-1 is first actuated in the designation of the exit number 12, and the depression of this key, with the relay ST¹ picked up, applies energy to the wire 88¹ for the picking up of a first digit exit number relay (not shown) corresponding to the relay X1DR-1 of Fig. 4. Energy is applied to the wire 88¹ from (+), including front contact 100 of relay ST¹, back contact 109 of XU¹, normally closed contact 110 of key X¹-2, contact 111 of the key X¹-1 in its depressed position, and bus wire 112, to wire 88¹.

The relay XU¹ (which corresponds to the relay XU¹ of Fig. 4) is picked up in response to the restoration of the key X¹-1, and the picking up of that relay conditions a circuit whereby the designation of the second digit of the exit number can be effective to pick up a second digit relay. Assuming the depression of the key X¹-2 for defining the second digit of the exit number, energy is applied to the wire 92¹ for the picking up of a second digit exit number relay (not shown) corresponding to this relay X2DR-2 of Fig. 4. Energy is applied to the wire 92¹ under such conditions from (+) including front contact 100 of relay ST¹, front contact 109 of relay XU¹, contact 113 of key X²-2 in its depressed position and wire 114, to wire 92¹.

It is to be understood that the mode of operation for picking up the respective exit relays XR in response to the designation of the respective exit numbers can be accomplished as is shown in Fig. 4 wherein an exit control relay XC is first picked up to establish a momentary exit indication whereby the operator can see an indication of the exit point that he has designated on the track diagram; and according to such mode of operation the exit relay XR, which actually applies energy to completion circuit network relays, is picked up upon the restoration of the last key actuated for defining the exit number in accordance with the application of energy to the XR-BUS through front contact 101 of relay ST¹, contact 114 of the cancel button XCB¹ in its normal position, contact 115 of key X¹-2 in its normal position, contact 116 of key X¹-1 in its normal position, and contact 117 of key X¹-0 in its normal position. The relays XR are selectively energized from this XR-BUS through front contacts of their associated relays XC as disclosed in Fig. 4.

After the manipulation of the entrance and exit number keys as above described, the entrance selection circuits and the exit selection circuits are restored to their normally deenergized conditions as has been heretofore described with reference to Figs. 3 and 4 respectively, thus conditioning the organization for the designation of the route ends of another route to be established by the actuation of the keys of either keyboard operator as selected by the selector levers SL¹ and SL².

It is believed to be a desired mode of operation that the lever SL associated with a keyboard

KB be restored to its upright position when the operator of that keyboard has completed the designation of route ends for routes he desires to be established, and thus with the restoration of that lever SL the indicator lamp SK in both boards become energized as an indication that either operator may take control for designating the next route to be established. More specifically, assuming that the operator of keyboard KB¹ has completed his designation of route ends as has been heretofore described, his next procedure is to restore the lever SL¹ to its upright position, and the restoration of that lever causes the dropping away of the station relay ST¹ by the opening of its circuit at contact 95, and the lamps SK¹ and SK² become energized by circuits that have been heretofore described.

It will be noted that the circuits for the station relays ST¹ and ST² are so interlocked that only one of such relays can be picked up at a time, and that the actuation of the keys of a keyboard having its relay ST dropped away is ineffective, that is, for example, energy is removed from the keys of keyboard KB² by contacts 118, 119, 120 and 121 whenever the keyboard KB¹ is in use.

It is believed that it should be readily apparent that the mode of operation and the circuit organization for the restoration of a route that has been established, and for the restoration of a designated exit route end, is accomplished in a manner corresponding to that which has been specifically described with reference to the description of the circuit organization of Figs. 3 and 4. The circuits of Fig. 6 are modified from those which have been described principally in the addition of a contact of the station relay associated with each of the keyboards KB to govern the effectiveness of the respective cancel buttons. Thus, for example, the picking up or the restoration of entrance relays NR in accordance with the actuation of keys on the keyboard KB¹ is dependent upon the closure of the front contact 99 of station relay ST¹, which is closed only when the station lever SL¹ is actuated to its right-hand position to render the key board KB¹ effective to govern the energization of the entrance relays NR. At the time when the station relay ST¹ is picked up, the station relay ST² associated with the keyboard KB² must necessarily be dropped away, and thus the inadvertent actuation of the cancel button NCB² cannot be effective at such time to act upon the circuits of the entrance relays NR because of the front contact 119 of relay ST² being open.

Similarly, the control of restoration relative to the designation of exit points by the cancel buttons XCB¹ and XCB² of the keyboards KB¹ and KB² respectively is interlocked through contacts 101 and 121 of relays ST¹ and ST² respectively so that only the actuation of the cancel button XCB for a particular keyboard having its station lever SL actuated to its operating position can be effective to cause the restoration of the parts of the circuit organization associated with the designation of an exit point in manner that has been heretofore specifically described with reference to the circuits illustrated in Fig. 4.

The circuit organization and the mode of operation that has been specifically described as being associated with the designation of route ends by the operator of keyboard KB¹ is to be considered as typical of the circuit organization and mode of operation that is accomplished in the designation of route ends by the operator of

the keyboard KB². It is thus provided that the operator of either keyboard KB¹ or KB² can cause the establishment of any route through the track layout for which the system is provided, although it is to be understood that limiting means may be provided if it is required in practice that only certain routes of the track layout may be under the control of the operator of one keyboard or the other. One means by which such limitations may be imposed in a simple manner is that different numbers be assigned to the keys of the respective keyboards so that one keyboard can designate only certain assigned route ends, and the other keyboard can designate only certain other assigned route ends. This is only one of many different ways in which the system shown in Fig. 6 may be required to be modified in accordance with the requirements of practice.

Having shown and described specific systems for designating the ends of routes to be established in a switch and signal control system of the entrance-exit type, it is to be understood that these forms have been described principally to illustrate typical circuit organizations that may be employed, and the principles of operation involved, rather than to define the scope of the present invention, and it is to be understood that various modifications, adaptations, and alterations may be applied to the specific forms shown to meet the requirements of practice without in any manner departing from the spirit or scope of the present invention except as limited by the appending claims.

What I claim is:

1. A switch and signal control system for a track layout having switches and signals providing a plurality of routes extending between the signals comprising in combination, a miniature diagram of the track layout having distinctive multiple digit signal identifying characters disposed thereon at points comparable to the location of associated signals in the track layout, a keyboard having a set of keys for designation of entrance point characters and another set of keys for designation of exit point characters, each of said sets of keys having a plurality of manually operable keys respectively relating to the different characters of the respective digits of said distinctive multiple digit signal identification characters, route selecting means responsive to the manual actuation of said keys corresponding to the respective digits of the multiple digit characters of the respective entrance and exit points of each route for selecting the positions of the track switches required to set up the route extending between those entrance and exit points, and route establishing means responsive to said route selecting means for positioning the respective track switches for each route that is selected and for clearing the signal governing entrance to that route.

2. In a switch and signal control system for a track layout having several signals identified by distinctive multiple digit characters defining respective entrance and exit route ends and having power switches for setting up any selected one of a plurality of routes, a keyboard having a key for each different character in any digit of any of the multiple digit characters, entrance and exit relays belonging to the respective entrance and exit ends of each route to be established, a digit relay for each of the digits of one of said multiple digit characters, electro-responsive means including said digit relays responsive to the designation of the digits successively belonging to any se-

lected entrance point by actuation of corresponding keys of said keyboard for energizing said entrance relay belonging to that entrance point, electro-responsive means effective subsequent to the designation of an entrance point and in response to the designation of the digits successively belonging to any selected exit point by actuation of corresponding keys of said keyboard for energizing said exit relay belonging to the exit point having its digits designated, and means responsive to the joint energization of said entrance and exit relays for the respective entrance and exit ends of a route for selectively governing said power switches to set up that route.

3. In a switch and signal control system of the character described for a track layout having signals defining respective route ends, a miniature diagram of the track layout having distinctive multiple digit route end characters disposed thereon at points comparable to the route ends of a plurality of routes throughout the track layout, route establishing means for setting up each route when designation of the respective ends of that route is rendered effective, means for designating respective route ends for rendering said route establishing means effective comprising a keyboard having a plurality of manually operable keys respectively relating to the different characters of the respective digits of each of said distinctive multiple digit characters on said miniature track diagram, a bank of first digit relays having a relay for each different first digit character on said diagram, a bank of second digit relays having a relay for each different second digit character on said diagram, circuit means responsive to the initial actuation of one of said keys for energizing a selected one of said first digit relays associated with the same character on said diagram, circuit means responsive to the actuation of any one of said keys after designation of a first digit character for energizing a selected one of said second digit relays associated with the same character on said diagram, and means effective only after both one of said first digit relays and one of said second digit relays have been energized corresponding to the respective digits of a particular character on said diagram for acting upon said route establishing means to render it effective with respect to the designation of a particular route end.

4. In a switch and signal control system for a track layout affording a plurality of routes extending between route ends defined by the location of wayside signals, the signals being identified distinctive multiple digit numbers, a keyboard having a key for each distinctive numeral of any digit of said multiple digit numbers, an entrance relay for each of said route ends which serves as an entrance point, and circuit control means governing the energization of each of said entrance relays, said circuit control means being effective to provide for the energization of an entrance relay only in response to the designation by actuation of the keys on said keyboard of each of a plurality of respective digits successively belonging to the particular route end with which that entrance relay is associated.

5. In a switch and signal control system for a track layout having a plurality of routes extending between a plurality of route ends defined by signal locations, each location being identified by a distinctive multiple digit number, a keyboard having a set of keys, there being a separate key for each distinctive numeral that is used as any digit of said multiple digit number, an en-

trance relay for each of said route ends serving as an entrance point, circuit control means governing the energization of each of said entrance relays, said circuit control means being effective to provide for the energization of an entrance relay only in response to the designation of the respective digits successively of a multiple digit number belonging to the particular signal location with which that entrance relay is associated, and stick circuit means for maintaining each of said entrance relays energized until the passage of a train past that entrance point.

6. In a switch and signal control system of the character described for a track layout having routes extended between route ends defined by signal locations, said locations being identified by respective distinctive multiple digit numbers, a keyboard having a key for each distinctive numeral of any digit of said multiple digit numbers, an entrance relay for each of the signal locations serving as an entrance point, means for energizing said entrance relay in response to the designation of the respective digits successively of the particular signal location with which that relay is associated, stick circuit means for maintaining each of said entrance relays energized until passage of a train, an entrance cancel button, and means responsive to the actuation of said keys for the respective digits belonging to the number for any route end while said cancel button is actuated for effecting the deenergization of said entrance relay belonging to that route end, irrespective of said stick circuit means.

7. In a switch and signal control system for a track layout having a plurality of routes extending between route ends defined by signal locations and distinctively identified by respective distinctive multiple digit numbers, an exit relay for each of the route ends to be used as an exit point for an established route, a keyboard having a key for each distinctive numeral of the respective digits of said multiple digit numbers, and circuit means responsive to the actuation of said keys for energizing said exit relay provided that a route is available extending from a designated entrance point to that exit point, said circuit means being rendered effective only provided that said keys have been actuated successively for the respective digit numerals of the exit number belonging to the route end with which that exit relay is associated.

8. In a switch and signal control system of the character described for a track layout having a plurality of routes extended to a plurality of exit points defined by signal locations and distinctively identified by different multiple digit numbers, an exit relay for each of the exit points, an exit control relay for each of the exit points, a keyboard having a key for each distinctive numeral digit found in all of said multiple digit numbers, circuit means for energizing said exit control relay only during the actuation of said key for the last digit of the number belonging to that exit point subsequent to the actuation and restoration of a key for the preceding digit of that number, circuit means for energizing said exit relay only upon restoration of the key for the last digit of the exit number for the associated exit point and only provided that said exit control relay for that exit point is energized.

9. In a switch and a signal control system for a track layout having routes extending to exit points defined by signal locations and distinctively identified by different multiple digit numbers, an exit relay for each of the exit points,

an exit control relay for each of the exit points, a keyboard having a key for each distinctive numeral of any digit of said numbers and having an exit cancel button, circuit means for energizing said exit control relay in response to the actuation of the key for the last digit of the number for that exit point, provided a key for the preceding digit has been actuated and restored, and circuit means for energizing said exit relay only upon restoration of the key for the last digit of the exit number for that exit point, and only provided that said exit control relay for that exit point is in its energized position, said circuit means for energizing said exit relay including a contact of said cancel button whereby the actuation of said cancel button during the restoration of the key for the last digit of the number belonging to that exit point prevents the energization of said exit relay even though said exit control relay for that exit point may be in its energized position.

10. In a switch and signal control system for a track layout having a plurality of routes extending between signal locations, self-restoring manually operable means for designating the respective entrance and exit ends of each of the routes, an exit cancel button, an exit control relay and an exit stick relay for each exit point, means for energizing said exit control relay for each of the exit points when and only when said manually operable means is held in its actuated position for designation of that exit point, said means being effective only if there is an available route extending from a designated entrance point to that exit point, and circuit means for energizing said exit stick relay only upon restoration of said manually operable means used for designation of that exit point, and only provided that said exit control relay for that exit point is in its energized position, said circuit means including a contact of said cancel button whereby the actuation of said cancel button during the restoration of said manually operable means for that exit point prevents the energization of said exit stick relay even though said exit control relay for that exit point may be in its energized position.

11. In a switch and signal control system of the character described for a track layout having a plurality of routes extending between entrance and exit points defined by signal locations, manually operable means for designating the respective entrance and exit ends of each of the routes to be set up, an exit indicator lamp for each of the exit points, an exit control relay for each of the exit points, means for energizing said exit control relay for each of the exit points when said manually operable means is actuated for designation of that exit point subsequent to the actuation of said manually operable means for designation of an entrance point, said means being effective only if there is an available route extending from a designated entrance point to that exit point, and said means being effective only while said manually operable means for that exit point is in its actuated position, and means for energizing said indicator lamp in accordance with the energized position of said exit control relay.

12. In a switch and signal control system of the character described for a track layout having a plurality of routes extending through track switches between entrance and exit points, the combination with normally inactive switch position selecting means which is rendered active in

response to the manual designation of the respective entrance and exit ends of each route desired to be established through the track layout, of two normally deenergized entrance indicator lamps of distinctive colors for each entrance point, circuit means for energizing one of said indicator lamps in response to the designation of that entrance point for a route to be established, said circuit means being effective to distinctively energize said one indicator lamp in response to said route establishing means being rendered effective, and circuit means for energizing the other of said indicator lamps and rendering the energization of said one indicator lamp ineffective upon the clearing of a signal governing entrance to an established route emanating from that entrance point.

13. In a switch and signal control system for governing the setting up of routes through a track layout in accordance with the designation of distinctive numbers assigned to signal locations defining the respective entrance and exit ends of the routes, a plurality of keyboards, each keyboard having keys for designation of the respective entrance and exit route end numbers, a station lever on each of the keyboards having normal and operated positions, route establishing means responsive to the designation of the respective entrance and exit ends of each of the routes extending through said track layout by the actuation of the keys of either of said keyboards for defining the respective entrance and exit ends of each route, and means for rendering said route establishing means responsive to the actuation of the keys of each keyboard only provided said station lever for that keyboard is in said operated position and the station lever for each other keyboard is in its normal position.

14. In a switch and signal control system of the character described for governing the setting up of routes through a track layout in accordance with the designation of the respective entrance and exit route ends which are defined by distinctive numbers assigned to signal locations defining the respective entrance and exit ends of the routes, a plurality of keyboards, each keyboard having keys for designating the respective entrance and exit route end numbers, a station lever on each of the keyboards having normal and operated positions, an indicator lamp for each of the keyboards, circuit means for energizing said indicator lamp only provided that said station lever for each other keyboard is in its normal position, route establishing means responsive to the designation by the actuation of said keys of either keyboard of the numbers belonging to the respective entrance and exit ends of each route for selecting the positions of track switches required to set up that route, and means for rendering said route establishing means responsive to the actuation of the keys of each keyboard only provided that said station lever for that keyboard is in said operated position and the station lever for each other keyboard is in its normal position.

15. In a switch and signal control system for railroads, the combination with a track diagram having indications as to the conditions of the switches and signals of a corresponding track layout for which it is provided and having disposed thereon distinctive multiple digit numerals identifying the ends of the routes, of a keyboard having numeral keys for designation of the respective digits of said distinctive numbers assigned to the respective ends of routes extending

through the track layout, and route establishing means for selecting the positions of the track switches to set up each route in response to the designation of the respective ends of that route, said route establishing means being rendered effective only by the actuation sequentially of numeral keys of said keyboard for the respective digits belonging to each end of each route to be established.

16. A switch and signal control system of the entrance-exit type for a track layout having several signals marking the respective entrance and exit ends of a plurality of routes provided by track switches through a track layout comprising in combination, a miniature diagram of the track layout having disposed thereon distinctive multiple digit characters belonging to the respective signals at points comparable to the locations of the signals in the track layout, entrance and exit relays belonging to the respective entrance and exit ends of each route to be established, a keyboard having a set of keys for designation of entrance point characters and another set of keys for designation of exit point characters, each of said sets of keys having a plurality of manually operable keys respectively relating to the different characters of the respective digits of said distinctive multiple digit characters on said miniature diagram, normally inactive entrance decoding means rendered active in response to the manual actuation of said set of keys for designating entrance point characters in any combination or sequence for energizing said entrance relay belonging to the entrance end of a route identified by the distinctive multiple digit characters designated by the actuation of the keys, normally inactive exit decoding means rendered active in response to the manual actuation of said set of keys for designation of exit point characters in any combination or sequence corresponding to the respective digits of any exit end desired to be designated as the exit end of a route for energizing said exit relay belonging to the corresponding exit point, and route establishing means responsive to the joint energization of said entrance and exit relays for the respective entrance and exit ends of any route for causing the power operation of the track switches of the track layout as required to establish that route.

17. A switch and signal control system of the entrance-exit type for a track layout having several signals disposed at respective entrance and exit ends of a plurality of routes extending through a track layout comprising in combination, a miniature diagram of the track layout having disposed thereon distinctive multiple digit

characters belonging to the respective entrance and exit points of the track layout, entrance and exit relays belonging to the respective entrance and exit ends of each route to be established, a keyboard having a set of keys for designation of entrance point characters and another set of keys for designation of exit point characters, each of said sets of keys having a plurality of manually operable keys respectively relating to the different characters of the respective digits of said distinctive multiple digit characters on said miniature diagram, normally inactive entrance decoding means rendered active in response to the actuation of said entrance set of keys in any combination or sequence corresponding to the digits belonging to any selected entrance point, said entrance decoding means when rendered active being effective to energize said entrance relay belonging to the corresponding entrance point, normally inactive exit decoding means rendered active by the manual actuation of said exit designation keys in any combination or sequence corresponding to the digits belonging to an exit end of a route, said exit decoding means being effective when rendered active to energize said exit relay belonging to the exit point identified by the digits designated by said set of keys for designation of exit point characters, provided that said entrance relay is energized for the entrance end of an available route extending to that exit point, said entrance and exit decoding means for energization of both entrance and exit relays being restored to its normally inactive condition immediately upon the restoration of the keys of said keyboard subsequent to designation of all digits of the respective entrance and exit characters, and route establishing means rendered effective to establish a route between the entrance and the exit route ends corresponding to said entrance and exit relays that are energized.

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