Nov. 10, 1942.

L. V. LEWIS

2,301,297

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Jan. 25, 1939

10 Sheets-Sheet 1

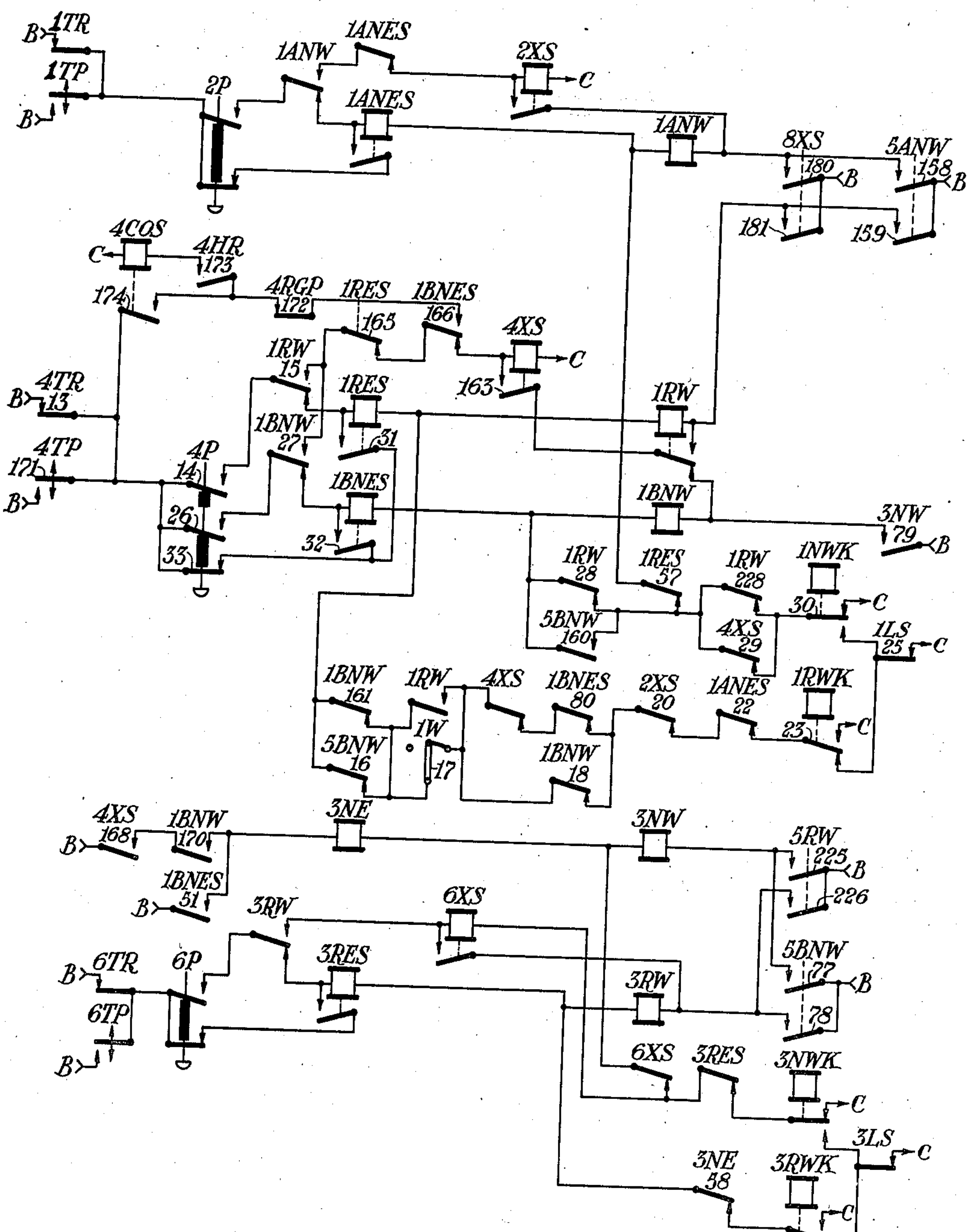

Fig. 1A.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Jan. 25, 1939 10 Sheets-Sheet 2

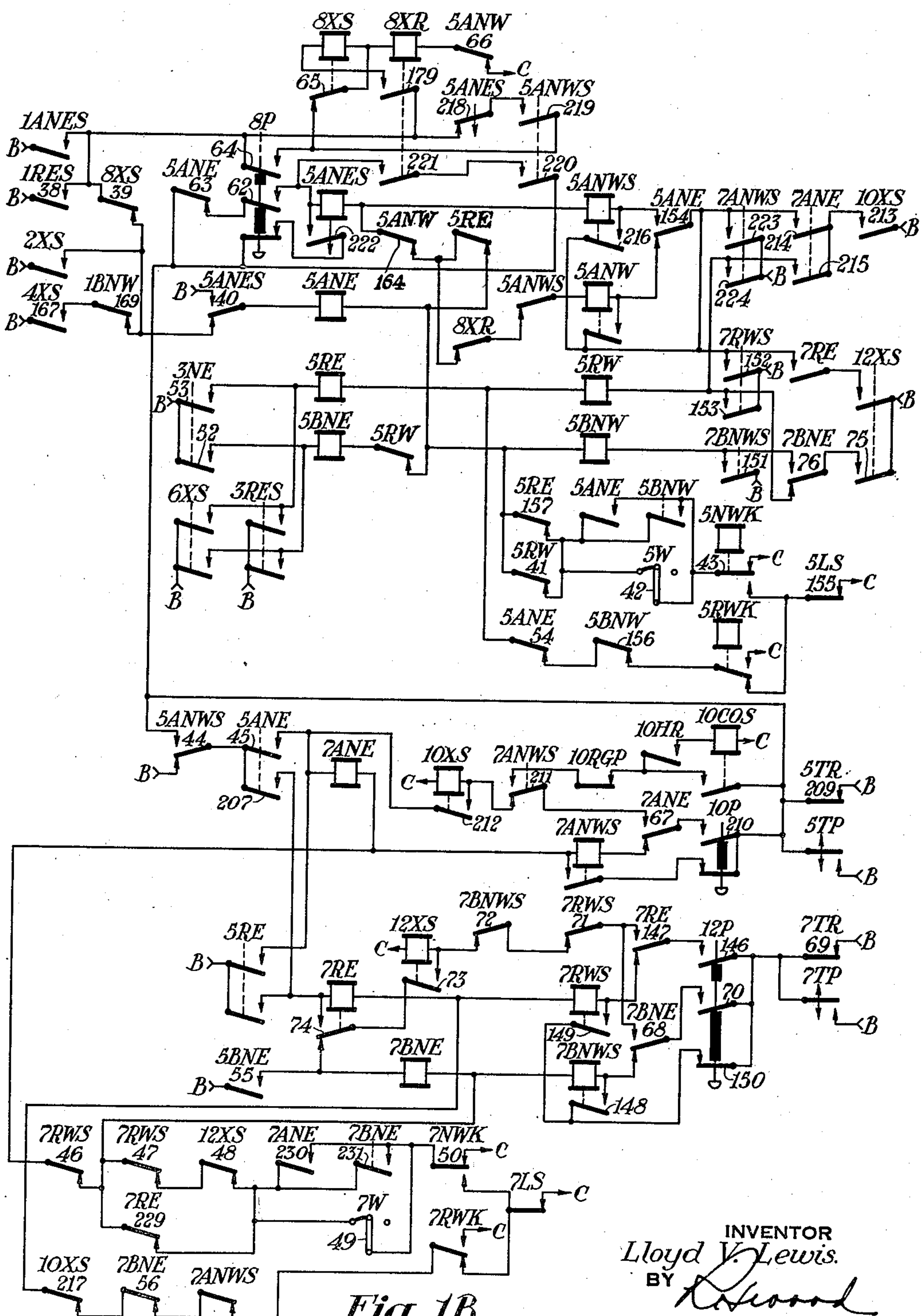

Fig. 1B.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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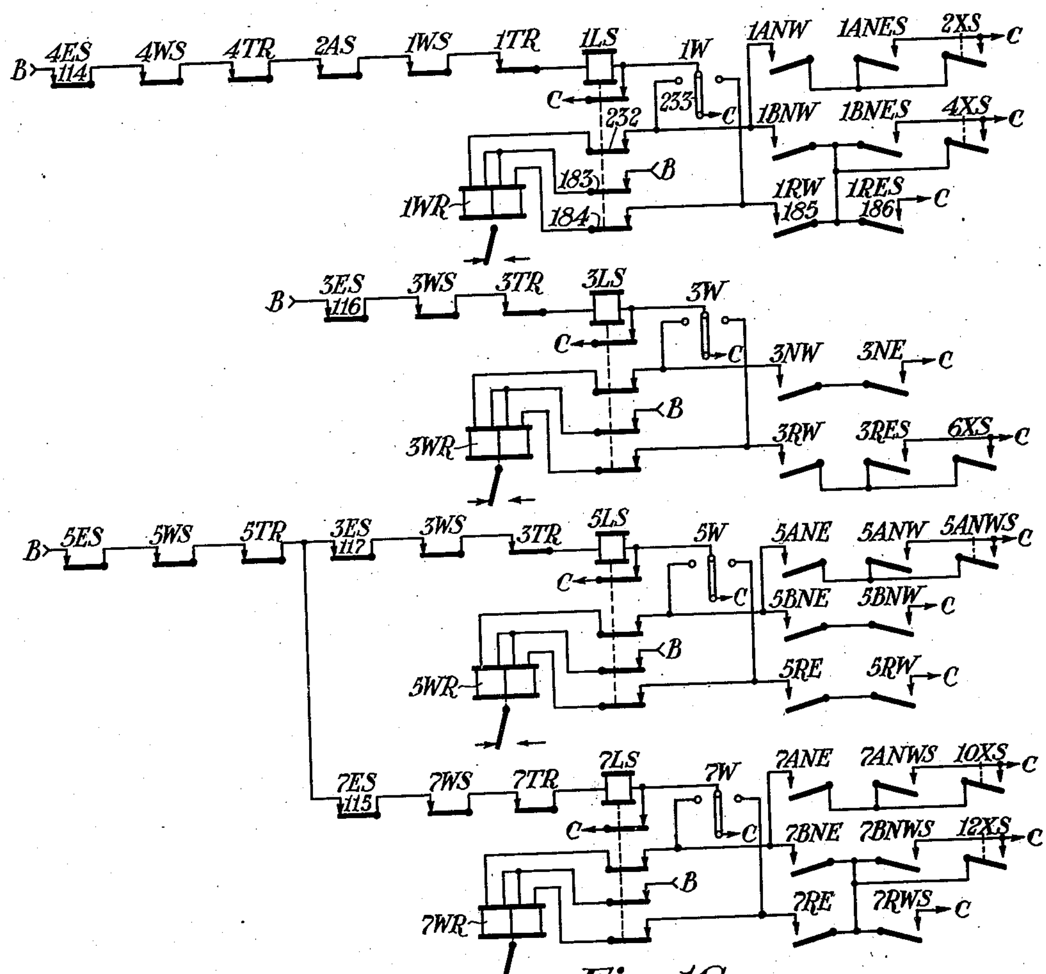

Fig. 1C.

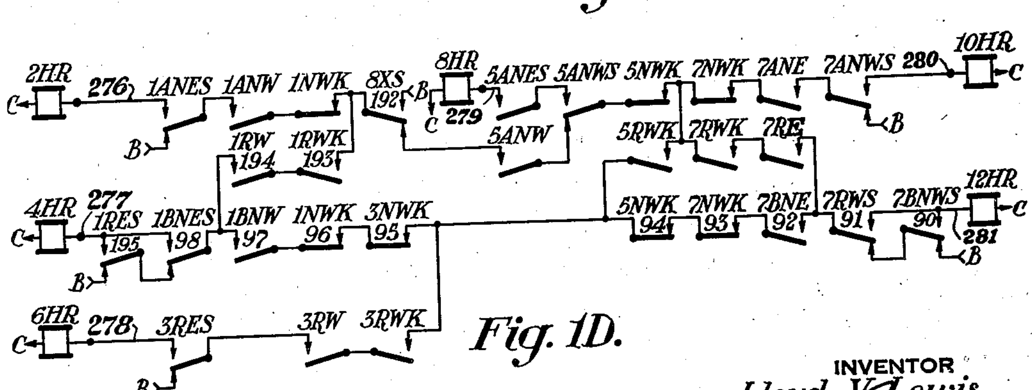

Fig. 1D.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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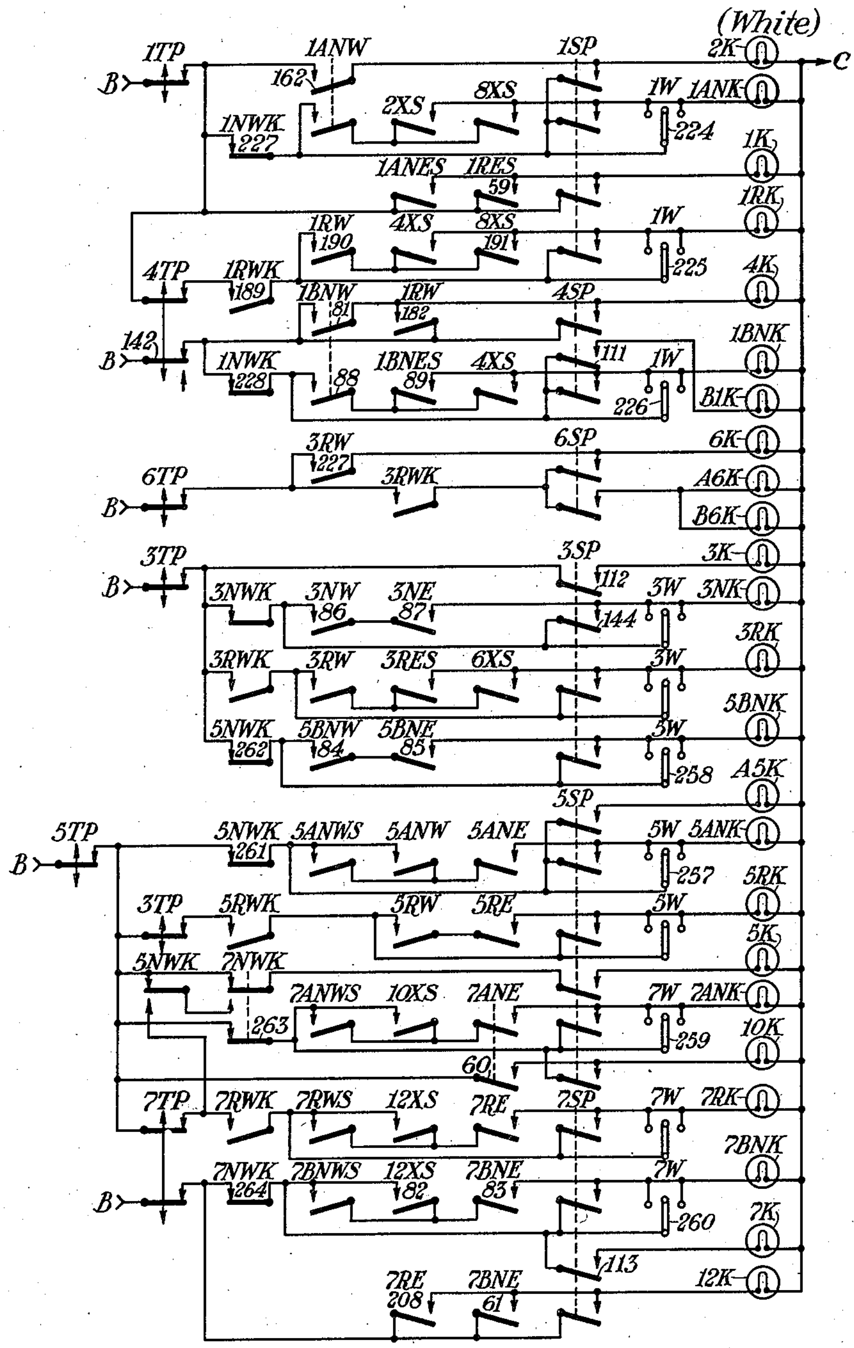

Fig. 1E.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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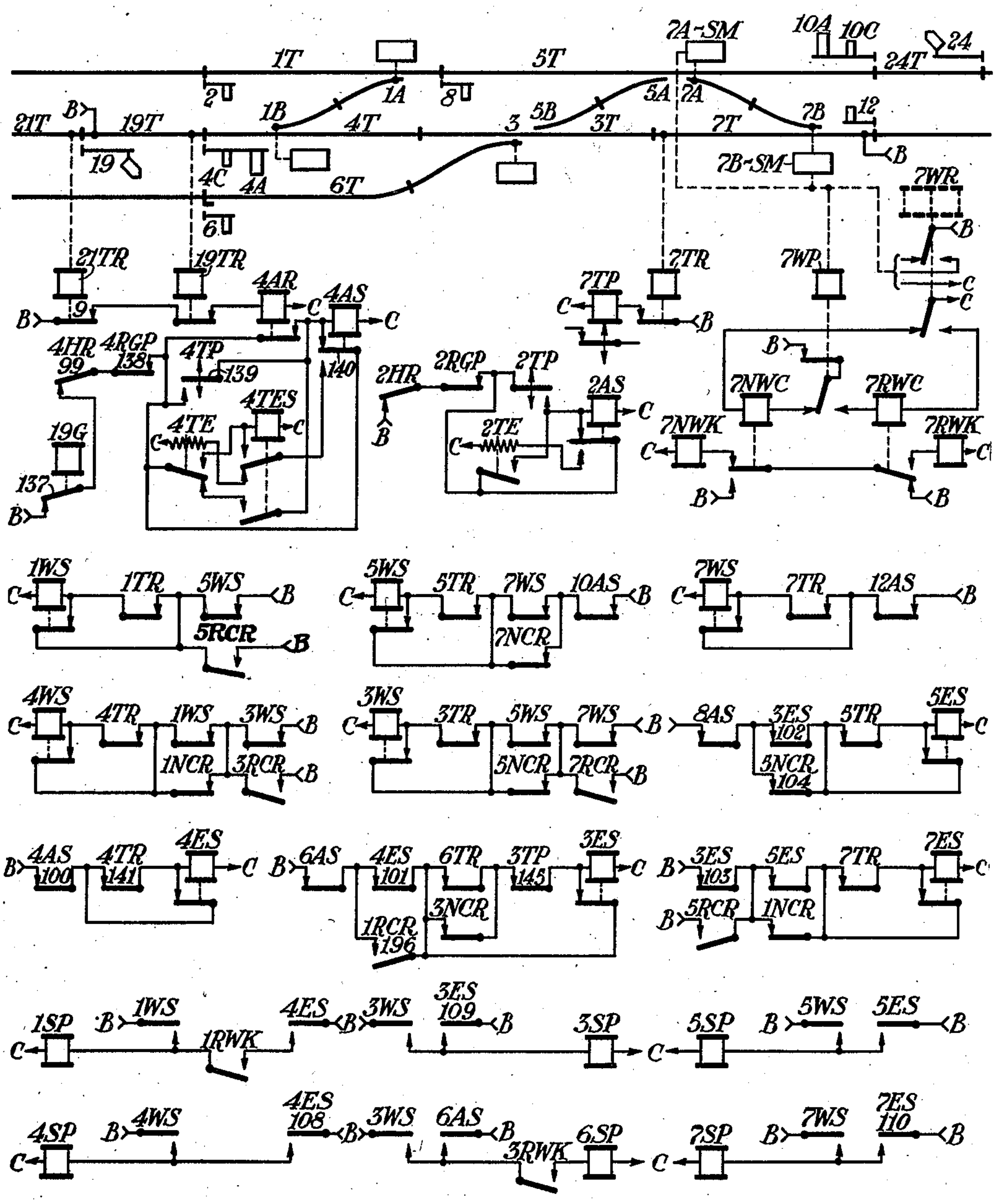

Fig. 1F.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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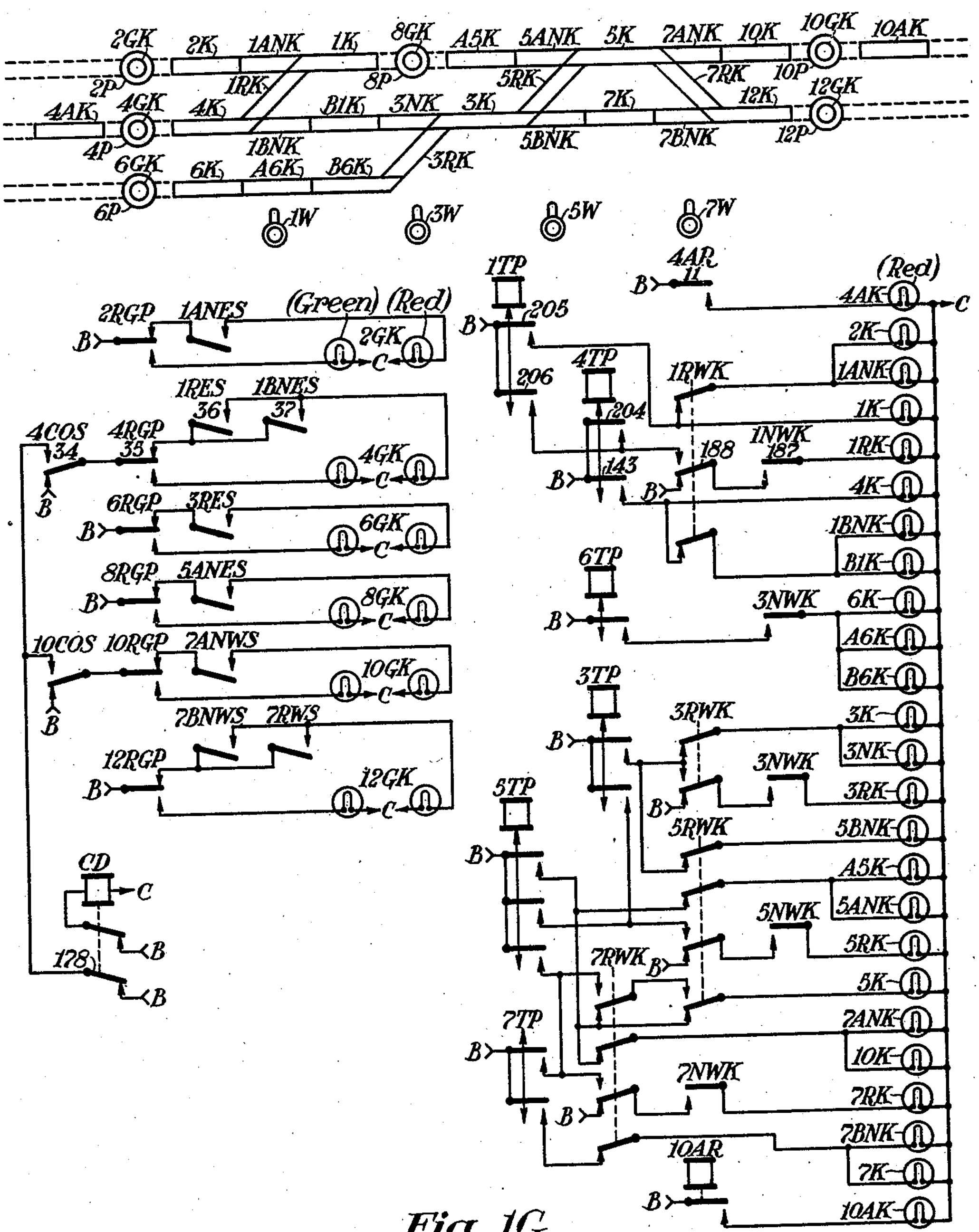

Fig. 1G.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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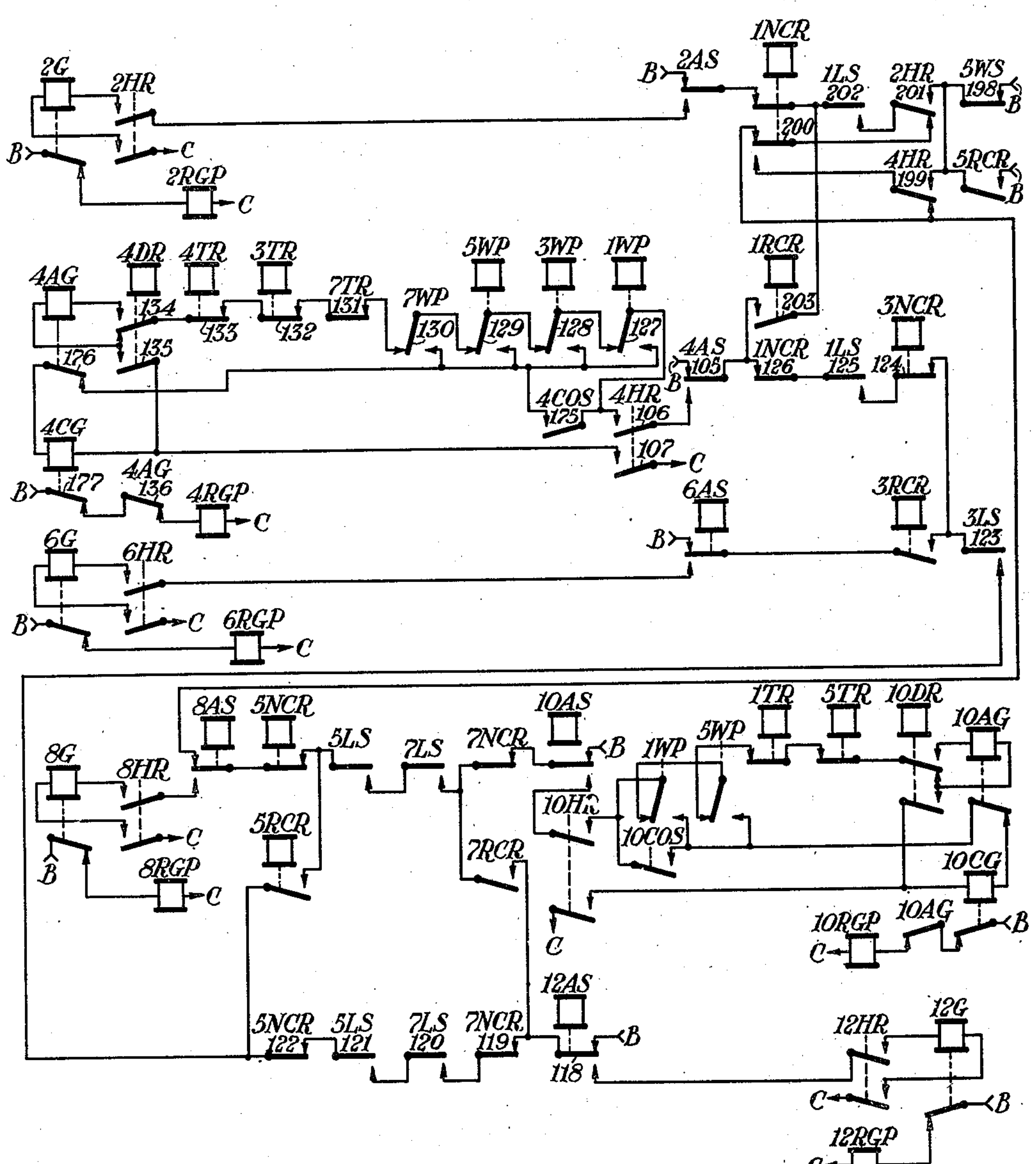

Fig. 1H.

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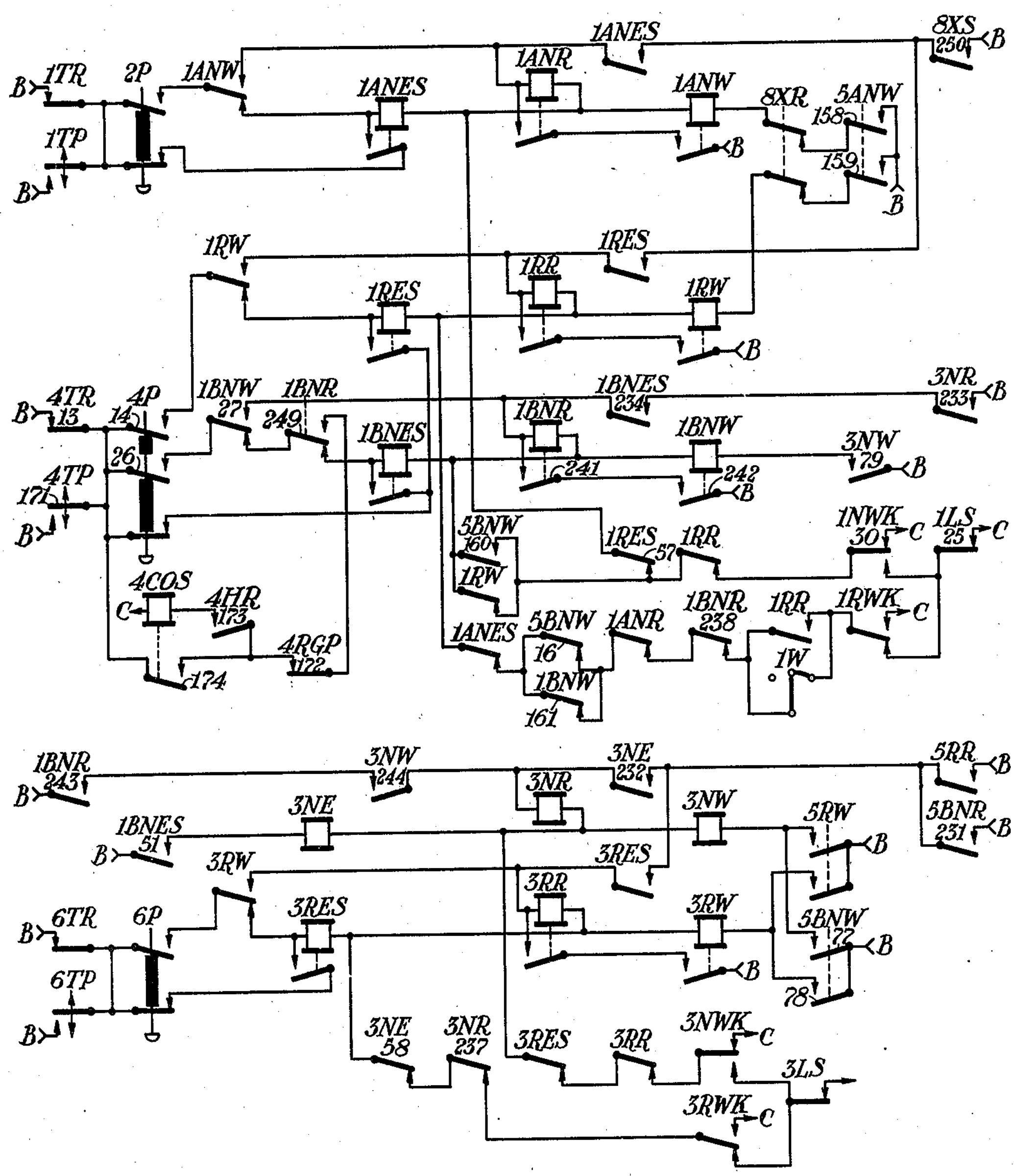

Fig. 2A.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Jan. 25, 1939 10 Sheets-Sheet 9

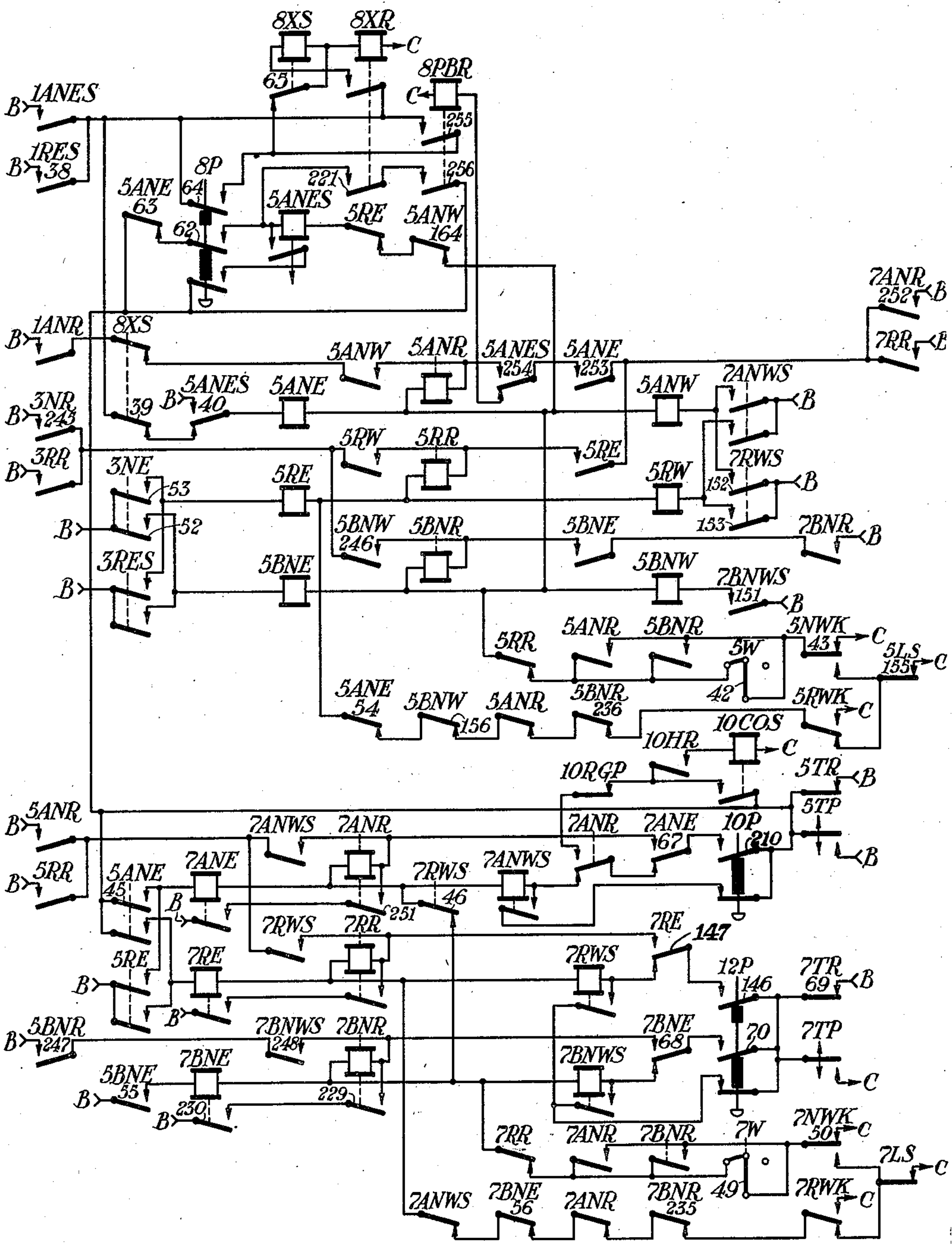

Fig. 2B.

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Nov. 10, 1942. L. V. LEWIS **2,301,297**

RAILWAY TRAFFIC CONTROLLING APPARATUS

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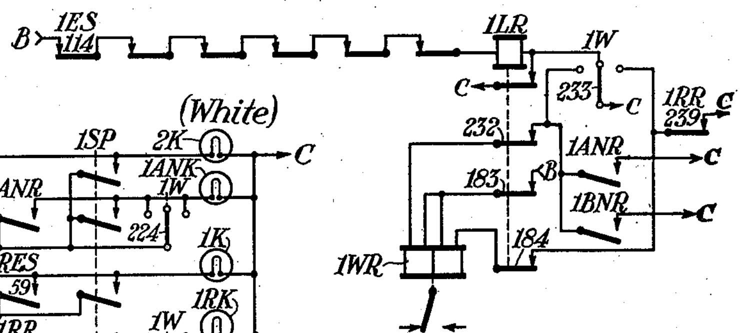

Fig. 2C.

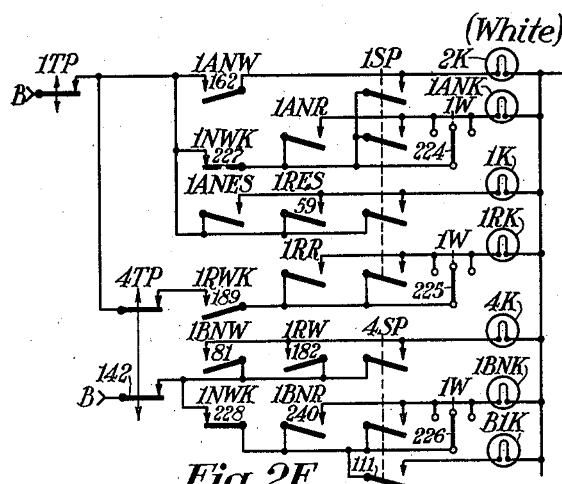

Fig. 2E.

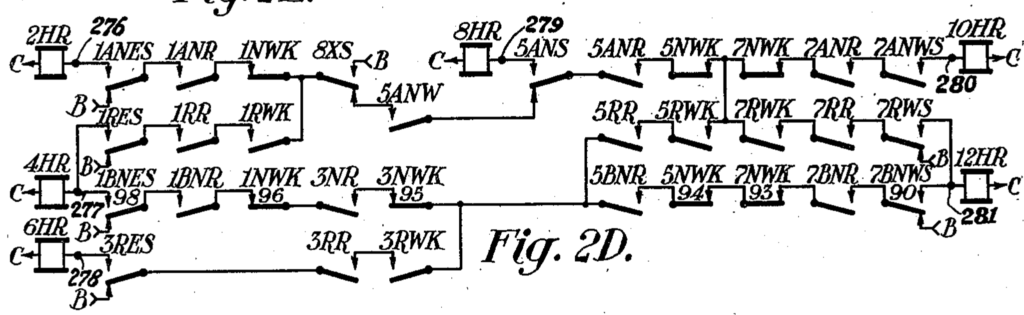

Fig. 2D.

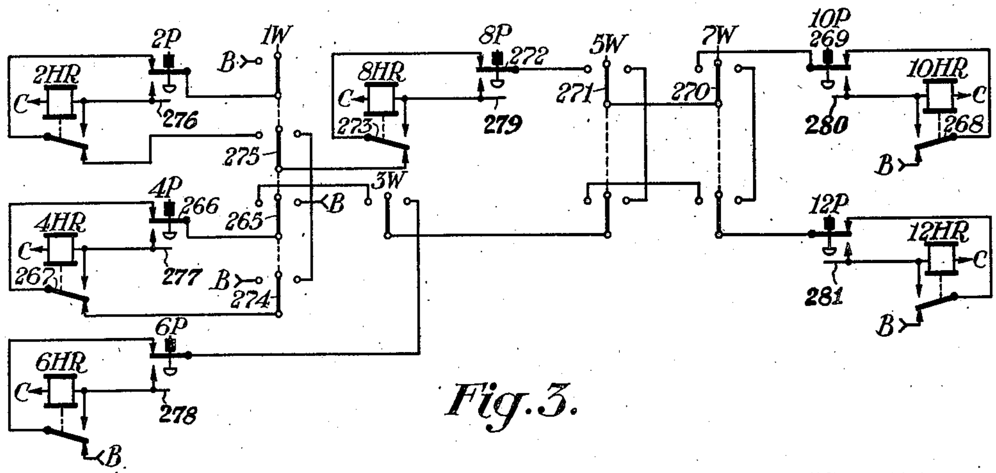

Fig. 3.

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UNITED STATES PATENT OFFICE

2,301,297

RAILWAY TRAFFIC CONTROLLING APPARATUS

Lloyd V. Lewis, Pittsburgh, Pa., assignor to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

Application January 25, 1939, Serial No. 252,803

56 Claims. (Cl. 246—134)

My invention relates to railway traffic controlling apparatus for governing the movement of traffic through a track layout comprising a plurality of track sections interconnected by track switches which may be variously arranged to form different traffic routes. More particularly, my invention relates to an interlocking control system having an illuminated diagram of the track layout in the signal cabin or other point of control, provided with push buttons or the like at locations corresponding to signal locations on the diagram, for controlling the track switches and signals to permit train movements over the several routes.

One object of my invention is the provision of an improved arrangement of circuits for seelcting each route in response to the successive operation of the control buttons for the two ends of the route, which arrangement is particularly adapted to the control of large and complicated track layouts.

Another object of my invention is the provision of improved means for operating the switches by individual levers when desired, together with means for indicating such operation by distinctively illuminating corresponding portions of the track diagram.

A further object of my invention is the provision of means for operating a "call-on" signal or the like in response to the operation of only the button at the entrance to the route which such signal governs and without the use of an auxiliary button as heretofore used. Other objects, purposes and features of my invention will be pointed out as the description proceeds.

My invention is an improvement upon those disclosed in the copending applications, Serial No. 14,868, for Interlocking control apparatus, filed April 5, 1935, by Earl M. Allen and Howard A. Thompson, Serial No. 118,609, for Railway traffic controlling apparatus, filed December 31, 1936, by John M. Pelikan, Serial No. 196,435, for Railway traffic controlling apparatus, filed March 17, 1938, by Ronald A. McCann, and Serial No. 224,165, for Railway traffic controlling apparatus, filed August 10, 1938, by Henry S. Young.

I shall describe two forms of apparatus embodying my invention and one modification thereof, and shall then point out the novel features thereof in claims.

Referring to the accompanying drawings, Figs. 1A to 1H, inclusive, taken together illustrate diagrammatically the circuits for a route interlocking system embodying the first form of my invention. A plan of the track layout which I have chosen to illustrate my invention is shown in the upper portion of Fig. 1F, and a suitable control panel containing a track diagram constituting a miniature representation of this track layout is shown in the upper portion of Fig. 1G. Figs. 2A to 2E, together with Figs. 1F, 1G and 1H, illustrate the circuits and apparatus for the second form of my invention.

Fig. 3 illustrates an auxiliary system of signal control which may be used with either form of my invention by superimposing these circuits upon those of Fig. 1D or Fig. 2D.

Considering the drawings for the first form of my invention in detail, Figs. 1A and 1B show the primary route selecting circuits and relays controlled directly by the push buttons P of the control panel of Fig. 1G. Figs. 1C and 1D show the circuits for switch control relays WR and signal control relays HR, respectively, which relays are governed by the relays of Figs. 1A and 1B.

Fig. 1E shows the circuits for a series of white lamps for at times illuminating the tracks of the operator's track diagram of Fig. 1G.

Fig. 1F shows the track relays TR for the various sections of the track layout, a switch indication relay WP with typical circuits for the repeating relays it controls, two types of circuits for the approach locking relays AS employed in the system of my invention, and the circuits for section locking relays ES and WS.

Fig. 1G contains the circuits for a series of red lamps for at times illuminating the tracks of the operator's track diagram shown therein, and also shows the circuits for red and green lamps for the signal indicators GK located in the push buttons P of the diagram. Fig. 1G also shows, in the lower portion of the operator's panel, a series of switch levers W by means of which the switches may be operated individually, or optional routes may be selected manually. The circuits controlled by the levers W are shown in Figs. 1A, 1B, 1C and 1E.

Fig. 1H shows a signal circuit network for energizing the mechanism G for the signals and also shows the signal indication relays RGP.

Figs. 2A to 2E, inclusive, illustrate modifications of the corresponding views of Figs. 1A to 1E, respectively, as employed in the second form of my invention, both forms employing the same drawings Figs. 1F, 1G and 1H, as already mentioned.

Fig. 3 shows an auxiliary control system in which the buttons P may be used to control the signals individually, without operating the route selecting apparatus, when a route has been established by the operation of the individual switch levers W.

Similar reference characters refer to similar parts in each of the several views.

In order to simplify the description, I shall first explain the functions of the several parts of the first form of my apparatus, and shall then describe its operation in detail, after which I shall point out the distinguishing features of the second form and shall describe the operation of the auxiliary apparatus of Fig. 3.

Referring first to Fig. 1F, it will be seen that the track plan as shown represents two parallel main tracks interconnected by crossovers **1**, **5** and **7**, the lower track being connected to a siding by a single switch **3**. For simplicity each pair of track rails is represented by a single line in the plan. While a specific track layout is disclosed, it is to be understood that the apparatus is adapted to control any track layout encountered in practice, including layouts that may involve entirely different combinations of switches and signals, the present layout having been chosen to illustrate the principles of my invention in a simple manner. As indicated in the drawing, the tracks are divided into sections by insulated joints, the detector sections of the upper track which include the track switches being designated by the references **1**T and **5**T, while those of the lower track bear the references **4**T, **3**T and **7**T. It is to be understood that each track section is provided with the usual closed track circuit including a track battery B and a normally energized track relay, each track relay being identified by the reference TR with a numerical prefix identifying the track section to which it corresponds, as illustrated, for example, by the relay **7**TR for section **7**T. Each detector section track relay such as relay **7**TR controls a slow-pick-up, slow-release repeating relay, such as relay **7**TP, having a circuit extending from one terminal B of a suitable local source of current over the front contact of the track relay, through the winding of the repeating relay to the other terminal C of the same source.

Each track switch of the layout is actuated by a power-operated switch machine SM, as illustrated for switches **7**A and **7**B, which may be understood to be of the type shown in the Zabel Patents Nos. 1,293,290 and 1,413,820. Each switch machine is provided with the usual motor having its operating circuits controlled by the contacts of a polarized switch control relay WR in the manner illustrated in the Willard Patent No. 1,380,452, as indicated diagrammatically for relay **7**WR by dotted line connections in the drawing, and it is to be understood that each switch or pair of switches will be operated to normal, as shown, or to reverse, when the control relay WR is energized and its polar contacts are closed to the left or right, respectively. Each relay WR is controlled in the manner illustrated in Fig. 2C, as hereinafter pointed out.

Each switch machine is provided with the usual switch circuit controller as disclosed in the Zabel patents hereinbefore referred to, for controlling a polarized switch indication relay such as the relay **7**WP. For an understanding of the present invention it will suffice to point out that when both switch machines **7**A—SM and **7**B—SM of the crossover **7** are locked normal or reverse, the corresponding relay **7**WP will be energized and its polar contacts closed to the left or right, respectively. It is also to be understood that relays **1**WP, **5**WP and **3**WP, shown in Figure 1H, are similarly controlled by the switch machines for the crossovers **1** and **5** and the single switch **3**.

Each switch indication relay WP controls a pair of switch correspondence relays such as the relays **7**NWC and **7**RWC, each of which is energized only when the polarized relay WP is energized in a position corresponding to that of the associated switch control relay WR.

Signals **4**A and **10**A are high speed signals governing main line train movements and each is provided with a distant signal **19** or **24**. Each of the signals **2**, **4**C, **6**, **8**, **10**C and **12** is a slow speed signal, while signals **4**C and **10**C also serve as "call-on" signals to admit a train to an occupied block, being controlled for this purpose by the manually governed call-on stick relays **4**COS and **10**COS shown in Figs. 1A and 1B, respectively.

The signals may be of any desired type, but as herein illustrated, it is to be understood that they are of the well-known searchlight type having a mechanism G of the form disclosed in the E. J. Blake Reissue Patent No. 14,940, of August 31, 1920, which mechanisms are controlled in the manner shown in Fig. 1H. Each signal is provided with the usual back lock or signal indication relay RGP, as shown, which relay is energized only when the corresponding signal indicates stop. Each relay RGP controls an approach locking relay AS of corresponding number such as the relay **4**AS or **2**AS of Fig. 1F, and also controls the lamps of the associated signal indicator GK of Fig. 1G.

Each slow speed signal is arranged to indicate either clear or stop. A "distant" relay DR, controlled by the next signal in advance, controls the polarity of the current supplied to the mechanism G for each high speed signal **4**A or **10**A to provide a third, or caution indication. The circuits for relays D are omitted since they form no part of the present invention and suitable circuits are well known.

The manual control of the signal mechanisms G by the route buttons is effected by means of the signal control relays HR shown in Fig. 1D. Each signal control relay HR and the back lock relay for the signal it controls governs the approach locking relay AS for that signal. For each slow speed signal the locking relay is controlled like relay **2**AS in Fig. 1F, which relay is released whenever the corresponding control relay **2**HR is energized to clear signal **2**, and is picked up automatically when signal **2** is put to stop by a train entering a route governed by signal **2**. Relay **2**AS may be picked up by putting signal **2** to stop manually, in which case its energization is delayed for a measured time interval by means of a time element relay **2**TE in a well known manner. Relay **4**AS and the similar relay **10**AS, associated with the high speed signals, operate in a similar manner except that a longer time interval is provided by operating the time element relay **4**TE through a complete cycle by the use of an auxiliary stick relay **4**TES, and further, the time delay is nullified in case signal **4** or **10** is manually put to stop when an approach zone in the rear of the signal is unoccupied. As will be apparent from the drawing, this is accomplished in the case of signal **4** by means of an approach relay **4**AR controlled by the track relays **21**TR and **19**TR.

The approach locking relays AS control a group of section locking relays ES and WS, also shown in Fig. 1F, one relay ES or WS being provided for each direction for each detector section.

These relays function in such a manner that when a signal is cleared, a series of relays ES or WS including one for each section of the route which the signal governs will be released, these relays becoming reenergized successively when the corresponding track sections are vacated. The section locking relays ES and WS and the detector section track relays TR control the switch locking relays LS of Fig. 1C, which relays in turn govern the circuits for the switch control relays WR in such a manner that when a signal control relay HR becomes energized to clear the signal for a route, the circuit for the control relay WR for each switch of the route is opened to electrically lock the switch in the position it then occupies, as required for the route. As will be hereinafter explained in detail, the switch locking relays LS also control the circuits of the signal mechanisms G of Fig. 1H in such a manner that the clearing of a signal in response to the operation of its control relay HR is made dependent upon the locking of each switch of the corresponding route, while the relays AS also control the signal circuits to provide time and approach locking for opposing signals.

One feature of my invention resides in an arrangement of the control apparatus whereby the relays are segregated in two groups in order to simplify and to reduce the cost of construction. One group comprises all of those relays so far described, which relays have to do with the safety of train operation and it is to be understood that these relays are of the standard type generally employed in the railway signaling art. The second group of relays includes those which are used only for communication purposes such as the relays of Figs. 1A and 1B which govern the selection of routes in response to push button operation, and the indication relays which control the lamps of the operator's control panel. These relays are preferably small quick acting relays of a type such as that shown in my Patent No. 1,815,947, granted July 28, 1931, for Electrical relays, and are preferably mounted in a compact array in the control cabinet at the rear of the operator's panel.

Referring now to Fig. 1G, it will be seen that the track diagram is composed of a plurality of linear units or elements each comprising an indicator bearing the reference K with identifying prefix. Each of these indicators is preferably arranged as disclosed in the Pelikan application hereinbefore referred to, comprising a strip of translucent material arranged to be illuminated by one or the other of a pair of lamps mounted in an enclosure at the rear of the strip. Each pair of lamps includes a white lamp, the circuit for which as already mentioned is shown in Fig. 1E, and a red lamp, as shown at the right in Fig. 1G. The approach indicators 4AK and 10AK employ red lamps only.

A push button P for operating circuit controllers as shown in Figs. 1A and 1B and containing a centrally located signal indicator GK is located at the point corresponding to the location of each signal on the track diagram. These buttons are preferably of the type disclosed in a pending application, Serial No. 123,014, filed January 29, 1937, for Circuit controllers, by W. E. Smith, but for an understanding of the present invention it will suffice to point out that each button P is biased to a mid-stroke position and has one or more normally open contacts, such as are shown for buttons 2P and 4P in Fig. 1A, which contacts become closed when the button is pushed, and also a normally closed contact which opens when the button is pulled. The lens or bull's eye of the indicator GK in the center of the button is arranged like the track indicators to be illuminated by one or the other of a pair of lamps mounted in an enclosure at the rear.

In normal operation, all the track switches are controlled as required to establish the different routes and the signals for the established routes are cleared solely by the operations of the buttons P for the ends of the routes, the traffic direction which is established being dependent upon the relative order in which the buttons at the two ends of a route are operated. In systems of this character, however, it is desirable at times to operate the switches individually and for this purpose the control panel is provided with an auxiliary switch lever W for each switch or crossover, as shown. These levers are preferably of the type shown in my Patent No. 1,887,273, issued November 8, 1932, for Circuit controllers. Each lever W normally occupies a central position from which it may be moved to left or right to operate the corresponding switch control relay WR of Fig. 1C to its normal or reverse position, but the circuits are so arranged that such operation is effective only if the lever is moved when conditions are proper for operating the switch as manifested by the energization of the corresponding switch locking relay LS. Each lever W controls the white lamps of Fig. 1E, for the portions of the track diagram comprising the representation of the switch or crossover it controls, in such a manner as to indicate the actual position of the track switch whenever the lever is moved from its center position.

The indication relays for governing the lamps of the control panel include a switch indication relay for each position of each switch or crossover, such as the relays 7NWK and 7RWK of Fig. 1F, which relays, as will be clear from the drawing are repeaters of the correspondence relays 7NWC and 7RWC, respectively, and also include an indication relay SP for each track section of the layout. The relay SP for each section is controlled by the section locking relays ES and WS for the same section, as shown in Fig. 1F. The route selecting apparatus controlled directly by the buttons P includes a set of route selector relays for each direction, each set including a relay for each switch section of a route. Each route selector relay has a directional designation E or W following a designation of the number and position of the track switch with which it is associated. Thus, for example, there are three route selector relays 1ANW, 1RW and 1BNW associated with crossover 1 and two relays 3NW and 3RW associated with switch 3 for the direction right to left. Each route selector relay at the entrance to a route serves also as an entrance stick relay and such relays may be identified by the suffix S following the route designation. Thus associated with crossover 1 for the direction from left to right, the route selector relay 1ANES is controlled by button 2P and relays 1RES and 1BNES are controlled by button 4P. In addition, an exit stick relay XS is provided for each route exit.

In the first form of my apparatus the initial operation of any route button causes the energization of a preliminary route selector for each available route for which the operated button marks the entrance end, each preliminary route selector comprising a series of tandem-connected relays which includes the entrance stick relay for the entrance section and a relay for the corresponding direction for each remaining section of the route, such as the relays 1BNES, 3NE, 5BNE and 7BNE for route 4—12, for example.

These relays are interlocked to prevent the energization of similar relays for conflicting routes having different entrance ends, and each is arranged so that it will not become energized when the corresponding switch is locked in a position which is not in accordance with the route with which the relay is identified. The energization of the last relay of each series lights the white lamp for the indicator for the exit end of the corresponding route to indicate the available exit points on the track diagram, and also marks the button for that end as an exit button, rendering the preliminary selectors it controls nonresponsive.

The subsequent operation of any button marking the exit end of a route causes the energization of a final route selector for that route only, each final selector comprising a series of tandem-connected relays which includes the exit stick relay controlled by the exit button and the route selector for the other direction for each remaining section, such as the relays 12XS, 7BNW, 5BNW, 3NW and 1BNW for route 4—12, for example. The energization of the final selector for the selected route releases the energized preliminary selectors for the other routes having the same entrance end, the relays remaining energized comprising one for each direction for each section of the selected route. The pair of energized relays for each section such as the relays 3NE and 3NW for switch 3 control the corresponding switch or switches as required for the route by energizing the relays WR of Fig. 1C, and also control the lighting of the corresponding portion of the track diagram.

When a route is fully established by the operation of the track switches, a representation of the complete route is displayed as a continuous illuminated strip on the track diagram, the switches are locked electrically by the operation of a signal control relay HR, Fig. 1D, and the signal at the entrance end of the route then clears automatically.

I shall now describe the operation of the first form of my apparatus under different assumed conditions, tracing the circuits in detail. I shall first assume that the apparatus is in the normal condition as shown in the drawings, and that the operator desires to clear signal 4A to pass an approaching train over route 4—12. When the train enters section 21T, Fig. 1F, the release of track relay 21TR opens contact 9 and deenergizes the approach relay 4AR, which relay releases and closes back contact 11, Fig. 1G, to close the circuit for the red lamp of the approach indicator 4AK, this portion of the track diagram of Fig. 1G being thereby illuminated to inform the operator of the approach of the train.

Normally, all the track and signal indication lamps are dark, and each button P is free to be operated to establish the entrance to a route.

To set up route 4—12, the operator will first press button 4P momentarily. This causes the energization of the two route selector relays 1RES and 1BNES for the diverging routes 4—8 (or 4—10) and 4—12. The circuit for relay 1RES may be traced in Fig. 1A from one terminal B of a suitable source of current, contact 13 of track relay 4TR, contact 14 of button 4P, back contact 15 of relay 1RW, relay 1RES, back contact 16 of relay 5BNW, middle contact 17 of switch lever 1W, back contacts 18, 20, 22 and 23 of relays 1BNW, 2XS, 1ANES and 1RWK, front contact 25 of relay 1LS to the other terminal C of the same source. The circuit for relay 1BNES extends from terminal B over contact 13 of relay 4TR, contact 26 of button 4P, back contact 27 of relay 1BNW, relay 1BNES, back contacts 28 and 29 of relays 1RW and 4XS, front contact 30 of relay 1NWK to terminal C. Relays 1RES and 1BNES upon becoming energized complete stick circuits over their contacts 31 and 32 extending to terminal B at contact 13 over the normally closed "pull" contact 33 of button 4P.

The operation of either of these relays lights the red lamp for indicator 4GK to mark button 4P as an operated entrance button by closing a circuit in Fig. 1G from terminal B, back contact 34 of relay 4COS, front contact 35 of relay 4RGP, contact 36 of relay 1RES or contact 37 of relay 1BNES, through the red lamp of indicator 4GK to terminal C.

Relay 1RES upon becoming energized completes a circuit from terminal B at its contact 38, Fig. 1B, over back contacts 39 and 40 of relays 8XS and 5ANES through relay 5ANE, back contact 41 of relay 5RW, middle contact 42 of lever 5W, front contact 43 of relay 5NWK to terminal C. Relay 5ANE picks up and completes a circuit from terminal B at back contact 44 of relay 5ANWS, contact 45 of relay 5ANE through relay 7ANE, contacts 46 and 47 of relay 7RWS, contact 48 of relay 12XS, contact 49 of lever 7W, contact 50 of relay 7NWK to terminal C.

At the same time, the energization of relay 1BNES completes a circuit from terminal B at its contact 51, Fig. 1A, for relay 3NE, which circuit extends over back contacts of the conflicting relays 6XS and 3RES to terminal C at a front contact of relay 3NWK. Relay 3NE picks up and closes its contacts 52 and 53, Fig. 1B, to connect terminal B to the circuits for relays 5BNE and 5RE. The circuit for relay 5BNE is completed to terminal C at front contact 43 of relay 5NWK and relay 5BNE picks up but relay 5RE is prevented from picking up because its circuit is now open at back contact 54 of the conflicting relay 5ANE. Relay 5BNE upon picking up connects terminal B at contact 55 to the circuit for relay 7BNE, which circuit is completed to terminal C at contact 50 of relay 7NWK so that relay 7BNE picks up and by opening contact 56 in the circuit for the conflicting relay 7RE prevents that relay from picking up in response to the energization of relay 5ANE.

It will be seen therefore that the operation of button 4P causes the energization of the preliminary selector for route 4—10 comprising the relays 1RES, 5ANE and 7ANE, and that for route 4—12 comprising the relays 1BNES, 3NE, 5BNE and 7BNE. The circuits for the conflicting relays 5RE and 7RE have been opened, as above described, and in addition, the circuit for relay 1ANES which conflicts with relay 1RES has been opened at contact 57 of relay 1RES, Fig. 1A, and the circuit for relay 3RES which conflicts with relay 3NE has been opened at contact 58 of relay 3NE.

The energized relays 1RES, 7ANE and 7BNE, by closing contacts 59, 60 and 61, respectively, in Fig. 1E, cause the white lamps for the exit section indicators 1K, 10K and 12K, respectively, of the track diagram, to be lighted to thereby indicate the available exits for the routes governed by signal 4. This informs the operator that each of the buttons 8P, 10P and 12P has been marked as an exit button and now controls an exit relay instead of an entrance relay. Button 8P normally controls an entrance stick relay 5ANES over its contact 62, Fig. 1B, but this circuit is now open at contact 63 of relay 5ANE, and a circuit for the exit relay 8XR has been prepared from terminal B at contact 38 of relay 1RES over contact 64 of button 8P, contact 65 of relay 8XS, relay 8XR, contact 66 of relay 5ANW to terminal C. The operation of contacts 67 and 68 of relays 7ANE and 7BNE places the exit stick relays 10XS and 12XS under the control of buttons 10P and 12P, respectively, in place of relays 7ANWS and 7BNWS. Relay 7RWS has been rendered nonresponsive to the operation of button 12P by the opening of contact 56 of relay 7BNE.

The operator now completes the selection of the desired route by momentarily operating the corresponding exit button. Since route 4—12 is to be selected, he will operate button 12P, completing the circuit for relay 12XS from terminal B, contact 69 of relay 7TR, contact 70 of button 12P, front contact 68 of relay 7BNE, back contacts 71 and 72 of relays 7RWS and 7BNWS, relay 12XS to terminal C. Relay 12XS picks up and completes a stick circuit over its contact 73 and back contact 74 of relay 7RE, which extends to terminal B at contact 55 of relay 5BNE.

Relay 12XS upon becoming energized causes the successive energization of relays 5BNW, 3NW and 1BNW, these relays together with relay 12XS comprising the final selector for route 4—12. The circuits for these relays are generally similar to the selector circuits previously traced, the circuit for relay 5BNW including front contacts 75 and 76 of relays 12XS and 7BNE, and the circuits for relays 3NW and 1BNW including front contacts 77 and 79, Fig. 1A, of relays 5BNW and 3NW, respectively. Relay 5BNW also closes contact 78 in the circuit for relay 3RW but that relay does not pick up because its circuit includes contact 58 of relay 3NE which is now open.

Relay 1BNW upon becoming energized opens contact 18 in the circuit for relay 1RES and since contact 80 of relay 1BNES bridging contact 18 is also open, relay 1RES releases and consequently relays 5ANE and 7ANE release, extinguishing the white lamps for indicators 1K and 10K and reconditioning buttons 8P and 10P and also 2P as entrance buttons, so that these buttons may now be operated to establish a parallel route 4—8 or 4—10. Button 6P, which controls a conflicting route, remains nonoperative. Relay 1BNW by closing contact 81, Fig. 1E, lights the white lamp for indicator 4K to mark the completion of the route selection. The selector relays for route 4—12 are now electrically isolated from the relays for all conflicting routes.

Since it has been assumed that all switches are normal, no switch operation is required in the present case and the white lamps for each of the switch sections 7BNK, 5BNK, 3NK and 1BNK of Fig. 1E become lighted as soon as the selection of the corresponding route portion is completed, that is, upon the closing of contacts 82, 84, 86 and 88, Fig. 1G, of relays 12XS, 5BNW, 3NW and 1BNW, respectively, since contacts 83, 85, 87 and 89 of relays 7BNE, 5BNE, 3NE and 1BNES are also closed.

Relay 1BNW upon becoming energized also completes a circuit in Fig. 1D to energize the signal control relay 4HR, which circuit may be traced from terminal B over back contacts 90 and 91 of relays 7BNWS and 7RWS, front contacts 92, 93 and 94 of relays 7BNE, 7NWK and 5NWK, front contacts 95, 96, 97 and 98 of relays 3NWK, 1NWK, 1BNW and 1BNES, relay 4HR to terminal C.

My apparatus is so arranged that the clearing of a signal in response to the operation of its control relay is made dependent upon the locking of each switch of the route which such signal governs, as described in the Allen and Thompson application hereinbefore referred to. The initial result of the operation of relay 4HR is to open back contact 99, Fig. 1F, in the circuit for relay 4AS, which relay therefore releases and opens its contact 100 to release the section locking relay 4ES. Relay 4ES in turn opens contact 101 to release relay 3ES. Relay 3ES upon releasing, opens contacts 102 and 103 in the circuits for relays 5ES and 7ES, releasing relay 7ES. Relay 5ES, which is associated with a section 5T not included in route 4—12, is not released because contact 102 is bridged by the closed contact 104 of relay 5NCR. Relay 4AS, by closing back contact 105, Fig. 1H, prepares a circuit over contacts 106 and 107 of relay 4HR, for the signal mechanism 4AG.

Relays 4ES, 3ES and 7ES, by closing their respective back contacts 108, 109 and 110, Fig. 1F, cause the energization of the corresponding indication relays 4SP, 3SP and 7SP, and these relays close contacts in the circuits of Fig. 1E for each of the white lamps for the tracks indicators for route 4—12. It follows that indicators B1K, 3K and 7K now become lighted in response to the closing of contacts 111, 112 and 113 of the SP relays, to complete the strip lighting for the route; that is, a substantially continuous white line corresponding to route 4—12 is now displayed on the track diagram to indicate that the route is fully established.

At the same time, contacts 114 and 115, Fig. 1C, of relays 4ES and 7ES open to release the switch locking relays 1LS and 7LS, respectively, and relay 3ES opens its contacts 116 and 117 to release relays 3LS and 5LS, thereby electrically locking the switches by opening the circuit for each of the polar stick relays WR. The closing of the back contacts of the LS relays completes the signal circuit, which may be traced in Fig. 1H from terminal B, contact 118 of relay 12AS, contact 119 of relay 7NCR, back contacts 120 and 121 of relays 7LS and 5LS, contact 122 of relay 5NCR, back contact 123 of relay 3LS, contact 124 of relay 3NCR, back contact 125 of relay 1LS, contact 126 of relay 1NCR, back contact 105 of relay 4AS, contact 106 of relay 4HR, normal polar contacts 127, 128, 129 and 130, relays 1WP, 3WP, 5WP and 7WP, contacts 131, 132 and 133 of the track relays 7TR, 3TR and 4TR, thence over the pole-changer contacts 134 and 135 of the line relay 4DR through the winding of mechanism 4AG to terminal C at contact 107 of relay 4HR.

Signal 4A now clears and relay 4RGP releases in response to the opening of back contact 136 of mechanism 4AG, and at its contact 35, Fig. 1G, relay 4RGP controls the circuits for indicator 4GK to cause the indication displayed by the lens in button 4P to change from red to green.

If now the approaching train enters the first detector section 4T of the route, relay 4TR will release and by opening contact 13, Fig. 1A, will cause relay 1BNES and consequently all the route selector relays for route 4—12 to release, and relay 1BNES will release relay 4HR. Mechanism 4AG releases in response to the opening of contact 133 of relay 4TR and its circuit is also opened at contacts 106 and 107 of relay 4HR. Relay 4RGP now picks up, and by opening its back contact 35, causes indicator 4GK to become dark. Relay 4RGP also completes a pick-up circuit for relay 4AS which may be traced in Fig. 1F from terminal B, back contact 137 of mechanism 19G for the distant signal 19, contacts 99 and 138 of relays 4HR and 4RGP, back contact 139 of the slow acting repeater 4TP of the track relay for section 4T through relay 4AS to terminal C. Relay 4AS therefore picks up and completes its stick circuit at contact 140. Relay 4AS also closes contact 100, Fig. 1F, in the circuit for relay 4ES, which relay however, does not pick up until section 4T is vacated to close contact 141 of relay 4TR. It follows therefore that relays 4SP, 3SP and 7SP are held energized by relay 4TR as long as section 4T is occupied. Relay 4TP by opening its front contact 142, Fig. 1E, extinguishes the white lamps for the indicators 4K, 1BNK and B1K and by closing its back contact 143, Fig. 1G, lights the corresponding red lamps for these indicators as long as section 4T remains occupied.

Since contacts such as 86 and 87 of relays 3NW and 3NE in the circuits for the white lamps for the indicators for route 4—12 are now bridged by contacts of the corresponding SP relays such as contact 144 of relay 3SP, it is apparent that the white lamps for the unoccupied sections in advance of the train will be maintained lighted by the relays SP until these sections become occupied, the indicators for the sections becoming red successively in response to the release of relays 3TP and 7TP, and then becoming dark as these relays pick up when the train vacates the corresponding sections. Thus when section 4T is vacated, relay 4TR picks up closing contact 141 to energize relay 4ES, thereby releasing relay 4SP, which is quick acting, and opening contacts such as 111 in the circuits for the white lamps for the indicators for section 4T, before the slow acting relay 4TP controlled by relay 4TR has closed its front contact 142 in these circuits. Relay 3ES does not pick up as long as contact 145 of relay 3TR remains open and consequently relays 3SP and 7SP are held energized by relay 3TR as long as section 3T is occupied, and similarly, relay 7SP is held energized by relay 7TR as long as section 7T is occupied.

One advantage of this arrangement is that it provides a distinctive "approach locked" indication of the track switches. Assume, for example, that route 4—12 is cancelled manually by "pulling" button 4P to open contact 33 in the stick circuit for relay 1BNES momentarily, before the train enters the route. This will release the route selector relays and cause indicator 4GK to become dark, but if the approach zone is occupied, relay 4AR will be in its released position and the reenergization of relay 4AS will be delayed until the time element measured by relays 4TE and 4TES is completed. Consequently, the relays SP will remain energized and the white lights for the locked route will not be extinguished until the time element is completed, this indication being distinctive because the indicators GK for both ends of the route are dark. It is also evident that if the section locking relay ES or WS for any section fails to pick up after a train passes through the section, the white lamps for the section will become lighted as soon as the section is vacated to indicate that condition. It follows that the normally dark condition of the panel indicates that these relays are properly energized.

I shall next assume that with the apparatus in the normal condition as shown that buttons 4P and 12P are operated in the reverse order, button 12P being operated first so as to set up route 12—4 for a train movement from right to left.

In response to the operation of the entrance button 12P, Fig. 1B, a circuit is closed over its contact 78 and back contact 68 of relay 7BNE to pick up relay 7BNWS, and another circuit is closed over its contact 146 and back contact 147 of relay 7RE to pick up relay 7RWS, and these relays complete stick circuits at contacts 148 and 149 extending to terminal B over the closed contact 150 of button 12P and contact 69 of relay 7TR.

Relay 7BNWS, by closing contact 151, picks up relay 5BNW and at the same time relay 7RWS closes contacts 152 and 153 to pick up relays 5ANW and 5RW. The circuit for relay 5ANW includes back contact 154 of relay 5ANE and is completed to terminal C at contact 43 of relay 5NWK while that for relay 5RW extends to terminal C at contact 155 of relay 5LS, and while both relays are energized momentarily only relay 5ANW will remain energized, the circuit for relay 5RW being opened at back contact 156 of relay 5BNW. Relay 5RW has a corresponding back contact 41 in the circuit for relay 5BNW, but if this contact opens momentarily, it is without effect because contact 41 is now bridged by the closed back contact 157 of relay 5RE.

Relay 5BNW by closing contacts 77 and 78, Fig. 1A, picks up relays 3NW and 3RW, and relay 5ANW by closing contacts 158 and 159, picks up relays 1ANW and 1RW.

Relay 3NW energizes relay 1BNW over the circuit which extends from terminal B at contact 79 of relay 3NW through relay 3BNW, contacts 160 and 29 of relays 5BNW and 4XS, contact 30 of relay 1NWK to terminal C. Relay 1BNW picks up and by opening its contact 161, bridging contact 16 of relay 5BNW which is now open, releases relay 1RW.

Three preliminary route selectors are now energized; one for route 12—2 comprising relays 7RWS, 5ANW and 1ANW, one for route 12—4 comprising relays 7BNWS, 5BNW, 3NW and 1BNW, and one for route 12—6 comprising relays 7BNWS, 5BNW and 3RW, the white lamps of the corresponding exit indicators 2K, 4K and 6K being lighted by the closing of contacts 162, 81 and 227 of relays 1ANW, 1BNW and 3RW.

The conflicting route buttons 8P and 10P have been rendered nonoperative by the opening of contacts 66 and 164 of relay 5ANW and by the opening of contact 46 of relay 7RWS, respectively.

Buttons 2P, 4P and 6P have been conditioned as exit buttons and now control their respective exit relays 2XS, 4XS and 6XS. Since route 12—4 is to be selected, the operator now operates button 4P completing the circuit for relays 4XS from terminal B at contact 13 of relay 4TR, contact 26 of button 4P, front contact 27 of relay 1BNW, back contacts 165 and 166 of relays 1RES and 1BNES, relay 4XS to terminal C, and relay 4XS picks up completing a stick circuit at its contact

163 extending to terminal B at contact 79 of relay 3NW.

Relay 4XS upon picking up, closes its contacts 167 and 168 and energizes the final selector for route 12—4. Contact 167, Fig. 1B, is in series with the open back contact 169 of relay 1BNW and is therefore ineffective, but contact 168, Fig. 1A, which is in series with the front contact 170 of relay 1BNW completes the circuit for relay 3NE which picks up and closes contacts 52 and 53. Contact 53 is not effective to pick up relay 5RE because the circuit is now open at contact 156 of relay 5BNW, but relay 5BNE picks up in response to the closing of contact 52 and in turn closes its contact 55 to pick up relay 7BNE, and the latter relay by closing its contact 61 lights the entrance indicator 12K, thereby completing the selection for route 12—4.

When relay 3NE picked up it released relay 3RW by opening its back contact 58, and when relay 7BNE picked up it opened the circuit for relay 7RWS at contact 56, thereby releasing relays 7RWS, 5ANW and 1ANW and extinguishing the white lights for sections 6K and 2K. The remaining operations are similar to those already described, except that relay 12HR will become energized in place of relay 4HR and signal 12 will clear in place of signal 4A.

Returning now to a consideration of route 4—12, I shall assume that the operator desires to clear the call-on signal 4C to admit a second train to section 4T while that section is occupied by a first train moving from left to right. A connection to terminal B for picking up relay 1BNES becomes available at back contact 171 of relay 4TP shortly after relay 4TR releases, and it follows that the route may be set up again by operating buttons 4P and 12P as previously described. Relay 4HR will pick up, but mechanism 4AG will remain deenergized because its circuit is open at contact 133 of relay 4TR and indicator 4GK will continue to display a red light after the exit button 12P is operated.

To clear signal 4C for route 4—12, the operator will again press button 4P after he has picked up relay 4HR as above described, the operation of button 4P in this case completing a pick-up circuit for relay 4COS from terminal B, contact 171 of relay 4TP, contact 26 of button 4P, front contact 27 of relay 1BNW, back contact 165 of relay 1RES, front contact 166 of relay 1BNES, contacts 172 and 173 of relays 4RGP and 4HR, relay 4COS to terminal C, and relay 4COS will pick up to complete a stick circuit over contact 173 and its own contact 174 which extends to terminal B over contact 13 of relay 4TR or contact 171 of relay 4TP.

Relay 4COS completes a circuit in Fig. 1H for mechanism 4CG which is a branch of the circuit for mechanism 4AG already described extending from terminal B at contact 118 of relay 12AS to contact 106 of relay 4HR and thence over contact 175 of relay 4COS, contact 176 of mechanism 4AG, the winding of mechanism 4CG, contact 107 of relay 4HR to terminal C.

Signal 4C now clears, relay 4RGP releasing due to the opening of contact 177 of mechanism 4CG.

When relay 4COS picked up, it caused indicator 4GK to display a distinctive flashing red indication by closing its front contact 34, Fig. 1G, which is connected to terminal B over contact 178 of a continuously operating flasher relay CD. When signal 4C clears, indicator 4GK will display a continuous flashing green indication due to the closing of back contact 35 of relay 4RGP. Since relay 1BNES is now energized over back contact 171 of relay 4TP, it will not release if the second train enters section 4T before the first train vacates that section. In this case, the operator will cancel the route manually by pulling the button 4P to open the stick circuit for relay 1BNES.

I shall next assume that with the apparatus in the normal condition, as shown, that the operator presses buttons 4P and 8P in that order to establish route 4—8. The result of pressing button 4P under this condition has already been described. When button 8P is operated, the pick-up circuit in Fig. 1B already traced for relay 8XR will become closed at contact 64, relay 8XR will pick up and will prepare a circuit for relay 8XS extending from terminal B at contact 38 of relay 1RES, contact 179 of relay 8XR, through relays 8XS and 8XR, contact 66 of relay 5ANW to terminal C, but relay 8XS does not pick up at this time because it is short circuited by a connection to terminal B at contact 33 over contacts 64 and 65. When button 8P is released, however, relay 8XS picks up in series with relay 8XR and maintains both relays energized.

Relay 8XS upon picking up closes contacts 180 and 181, Fig. 1A, in the circuits for relays 1ANW and 1RW. The circuit for relay 1ANW is open at contact 57 of relay 1RES and only relay 1RW picks up, lighting the entrance indicator 4K by closing its contact 182, Fig. 1E. By opening its back contact 28, Fig. 1A, relay 1RW releases relays 1BNES, 3NE, 5BNE and 7BNE, thereby reconditioning buttons 6P and 12P as entrance buttons and causing indicator 12K to become dark. Relay 8XS, by opening contact 39, releases relays 5ANE and 7ANE, reconditioning buttons 8P and 10P as entrance buttons and causing indicator 10K to become dark.

In Fig. 1C, relay 1RW completes a circuit from terminal B at contact 183 of relay 1LS through the right-hand winding of relay 1WR, contacts 184, 185 and 186 of relays 1LS, 1RW and 1RES to terminal C. Relay 1WR is a stick polar relay arranged to remain in its last operated position when deenergized and it now reverses, closing its right-hand contacts to operate switches 1A and 1B to reverse, at the same time releasing relays 1NWC and 1NWK which are controlled in the same manner as the corresponding relays for crossover 7 shown in Fig. 1F. Relay 1NWK by closing contact 187, Fig. 1G, completes a circuit over back contact 188 of relay 1RWK for the red lamp for the diagonal indicator 1RK. Since the white lamps for indicators 1K and 4K are now lighted due to the closing of contacts 59 and 182 of relays 1RES and 1RW, respectively, a distinctive indication is provided on the track diagram indicating that switches 1A and 1B are unlocked or in transit.

It will also be seen that since the circuit for the red lamp 1RK over back contacts 187 and 188 is independent of the route control, a distinctive indication will be displayed in the event a track switch becomes displaced at any time from its proper normal or reverse position, so that the operator may promptly take the proper action to correct the defect.

When switches 1 complete their movement and become locked reverse, relay 1WP becomes energized in the reverse direction and relays 1RWC and 1RWP pick up. Relay 1RWK opens the circuit for the red lamp for indicator 1RK and at contact 189, Fig. 1E, completes a circuit over contacts 190 and 191 of relays 1RW and 8XS for the white lamp of indicator 1RK. The white lamps for indicators 4K, 1RK and 1K are now lighted, indicating that route 4—8 is fully established.

Relay 4HR now becomes energized over a circuit in Fig. 1D from terminal B, contacts 192, 193, 194 and 195 of relays 8XS, 1RWK, 1RW and 1RES, relay 4HR to terminal C. Relay 4HR picks up, releasing relay 4AS by opening contact 99, and relay 4AS releases relay 4ES by opening contact 100, but relay 3ES does not release as previously described, contact 101 of relay 4ES in its circuit being now bridged by the closed contact 196 of relay 1RCR. Relay 1LS is released by the opening of contact 114 of relay 4ES but it is the only switch locking relay released and upon the closing of the back contact 202 of this relay a circuit is completed for mechanism 4CG which may be traced in Fig. 1H from terminal B at contact 198 of relay 1WS, over contact 199 of relay 4HR, back contacts 200, 201 and 202 of relays 1NCR, 2HR and 1LS, contact 203 of relay 1RCR, back contact 105 of relay 4AS, contact 106 of relay 4HR, reverse contact 127 of relay 1WP, contact 176 of mechanism 4AG, the winding of mechanism 4CG, contact 107 of relay 4HR to terminal C. Signal 4C will therefore clear and indicator 4GK will change from red to green as in the case previously described.

It will be noted that the circuit just traced is connected to terminal B over contact 198 of relay 5WS. This relay is controlled by relay 10AS as shown in Fig. 1F and contact 198 therefore functions like contact 118 of relay 12AS in the circuit for mechanism 4AG to provide time locking of opposing signals.

By referring to Figs. 1E and 1G it will be seen that when the train enters route 4—8, the white lamps for indicators 4K and 1RK will be extinguished and the red lamps lighted by the operation of contacts 142 and 204 of relay 4TP, indicator 1K also becoming red due to the closing of contact 205 of relay 1TP when the train enters section 1T. Indicator 4K becomes dark when the train vacates section 4T but the red lamp for indicator 1RK is maintained lighted over contact 206 of relay 1TP until the locking of switches 1 is released as the train vacates section 1T. This arrangement has the advantage that it warns the operator that route 4—12, for example, although unoccupied, cannot be set up because switch 1B is locked reverse by a train occupying section 1T.

I shall next assume that after having set up route 4—8 as above described, the operator pushes buttons 8P and 10P to set up route 8—10.

Button 8P serves as an entrance button as long as relay 5ANE is deenergized, that is, not only when no button such as 4P in the rear has been operated, but also following the release of relay 5ANE after button 8P has been operated as an exit button. In the present case, button 8P is operated again after route 4—8 has been set up as above described, and the closing of its contact 62 completes the circuit for relay 5ANES, which relay upon picking up closes contact 40 to pick up relay 5ANE, and the latter relay closes contacts 45 and 207 to pick up relays 7ANE and 7RE. The white lamps for the exit indicators 10K and 12K become lighted due to the closing of contacts 60 and 208 of relays 7ANE and 7RE, marking buttons 10P and 12P as exit buttons.

Button 10P is now operated, completing a circuit from terminal B at contact 209 of relay 5TR, contact 210 of button 10P, front contact 67 of relay 7ANE, back contact 211 of relay 7ANWS, relay 10XS to terminal C. Relay 10XS picks up, closing contact 212 to complete its stick circuit extending to terminal B over contacts 44 and 45 of relays 5ANWS and 5ANE. Relay 10XS at contact 213 connects terminal B to a circuit, one branch of which extends over front contacts 214 and 154 of relays 7ANE and 5ANE through relay 5ANWS to terminal C at contact 43 of relay 5NWK. Another branch of this circuit extends over front contact 215 of relay 7ANE through relay 5RW, but this branch is open at contact 54 of relay 5ANE. Relay 5ANWS picks up and at contact 216 closes its stick circuit extending to terminal B over contacts 214 and 213. Relay 10XS opens its back contact 217, thereby releasing relay 7RE and extinguishing the white lamp for indicator 12K. This completes the route selection, and since the remaining operations involved in the clearing of signal 8 are similar to those previously described, a detailed explanation is believed to be unnecessary.

It has already been explained that when the entrance button 4P is operated, both buttons 8P and 10P become exit buttons. A feature of my invention is the provision of "through routing" past intermediate signals, the apparatus being so arranged that if buttons 4P and 10P are operated in that order, the two routes 4—8 and 8—10 will become established without operating button 8P, precisely as if button 8P were operated twice in succession prior to the operation of button 10P as above described.

Assuming that with the apparatus in its normal condition as shown, that button 4P is operated. The preliminary selector comprising relays 1RES, 5ANE and 7ANE will become energized and if button 10P is operated while relay 7ANE is energized, relays 10XS and 5ANWS will become energized as already described. Button 8P not having been operated, relay 5ANWS upon becoming energized completes a pick-up circuit for relay 8XR which may be traced from terminal B, contact 38 of relay 1RES, contacts 218 and 219 of relays 5ANES and 5ANWS, contact 65 of relay 8XS, relay 8XR, contact 66 of relay 5ANW to terminal C. Relay 8XR picks up and completes a pick-up circuit for relay 5ANES from terminal B at contact 209 of relay 5TR, contacts 220 and 221 of relays 5ANWS and 8XR, through relay 5ANES to terminal C at contact 43 of relay 5NWK. Relay 5ANES picks up, closing its stick circuit at contact 222, and by opening contact 218 causes relay 8XS to pick up in series with relay 8XR, and relay 8XS closes contact 181 to pick up relay 1RW, thereby completing the selection of the through route 4—10.

It will be seen that when a train passes signal 4C to enter route 4—10, relays 1RES, 8XR, 8XS and 1RW will be released by the opening of contact 13 of relay 4TR without effect upon the relays 5ANES, etc. for route 8—10, the latter relays being released when the train passes signal 8, by the opening of contact 209 of relay 5TR.

I shall next assume that the apparatus is in the normal condition as shown and that buttons 10P and 4P are operated in that order to set up route 10—4. The operation of button 10P picks up relay 7ANWS over back contact 67 of relay 7ANE and relay 7ANWS closes contacts 223 and 224 in the circuits for relays 5ANW and 5RW. Relays 5ANW and 5RW pick up, relay 5ANW opening contacts 66 and 164 to render relays 8XR, 8XS, 5ANES and 5ANWS nonresponsive, and closing contacts 158 and 159, Fig. 1A, in the circuits for relays 1ANW and 1RW. Relays

1ANW and 1RW pick up and light the white lamps for the exit indicators 2K and 4K. Relay 5RW closes contacts 225 and 226 in the circuits for relays 3NW and 3RW. Relays 3NW and 3RW pick up, relay 3NW closing contact 79 in the circuit for 1BNW but this relay does not pick up because its circuit is open at contact 23 of relay 1RW. Relay 3RW closes contact 227 lighting the white lamp for the exit indicator 6K.

Assuming that the exit button 4P is now operated, relay 4XS is picked up over front contact 15 of relay 1RW, closing contact 167 to pick up relay 5ANE, and relay 5ANE closes contact 45 to pick up relay 7ANE. When relay 4XS picks up, the opening of its back contact 29 releases relay 1ANW, since contact 228 of relay 1RW is now open. When relay 5ANE picks up, the opening of its back contact 54 releases relays 5RW and consequently relays 3NW and 3RW release. This completes the selection for route 10—4. It will be noted that relay 5ANWS is operated only when a route for traffic moving from left to right is being set up, and that relay 5ANW is operated only when a route from right to left is being set up. These relays are interlocked, the circuit for each relay including a back contact of the other and serve as directional stick relays to properly govern the apparatus associated with the intermediate button 8P when the traffic direction is determined by the relative order of operation of buttons at other locations.

An important feature of my invention is the provision of means for insuring proper operation when the track layout provides a plurality of alternative routes between the same route ends, there being a number of such situations in the layout chosen, as is obvious from the drawings. Considering the two routes 4—10 for example, route 4—10 over 1 reverse is chosen as the preferred route over the one including 5 reversed because it frees a parallel route 6—12. This choice is effected in a very simple manner by merely omitting one of the cross checks for the route selector relays which are ordinarily provided when no alternatives exist. For example, in the case of routes 4—12 and 6—12, it will be seen that the corresponding relays 3NE and 3RES are fully cross checked, the circuit for each relay including a back contact of the other. In the case of the alternative routes 4—10 over 5 normal and 5 reversed, the circuit for relay 5RE includes back contact 54 of relay 5ANE, but there is nothing to prevent the energization of relay 5ANE if terminal B is connected to both relays at the same time, the back contact 157 of relay 5RE in the circuit for relay 5ANE being bridged by back contact 41 of relay 5RW, consequently only the route 4—10 over 5 normal becomes established when both are available. If for any reason relay 5ANE is prevented from picking up, as would be the case for example, if switches 1 were locked normal by a train occupying section 1T, relays 1BNES, 3NE, 5RE and 7ANE would pick up in response to the operation of the entrance button 4P, but relay 1RES would be prevented from picking up because its circuit would be open at contact 25 of relay 1LS, this relay occupying its released position when section 1T is occupied. The operation of the exit button 10P would then pick up relays 10XS, 5RW, 3NW and 1BNW to complete the selection for the secondary route 4—10 over 5 reversed. When relays 5RE and 5RW are both energized, the circuits for relays 5BNE, 5BNW, 5ANE, 5ANES, 5ANW and 5ANWS are open at contacts 41 and 157 of relays 5RE and 5RW so that the secondary route when established is isolated and is not interfered with if the preferred route subsequently becomes available. For the opposite direction similar provisions are included in the circuits for relays 1RW and 1BNW, route 10—4 over 1 reversed being chosen as the preferred route and route 10—4 over 1 normal as the secondary route. Similar provisions permit the automatic selection at times of the "run-around" routes 4—12 and 12—4 over 1 and 7 reversed, as will be apparent from the drawings.

My apparatus is also arranged so that any secondary route may be selected at will by the operator by the operation of one or more of the individual switch levers W which define such route. This is accomplished by including contacts of the levers W at the proper points in the route selector relay circuits. For example, assume that switch 7 remains reversed and does not respond to the operation of buttons 4P and 12P to establish route 4—12 over 7 normal. The operator after cancelling the set up by pulling button 4P momentarily will reverse lever 7W to agree with the position of the crossover 7 and will then reoperate the entrance button 4P. In this case, relays 1RES, 5ANE and 7RE will become energized, and also relays 1BNES and 3NE, but the circuit for relay 7BNE is open at contact 49 of lever 7W, Fig. 1B, which contact now occupies its right-hand position. The operation of the exit button 12P will then cause relays 12XS, 5RW and 1RW to pick up, relay 1RW releasing relays 1BNES and 3NE, thereby completing the selection of the "run-around" route 4—12 over 1 and 7 reversed. Similarly, the secondary "run-around" route 4—12 over 5 and 7 reversed may be selected by reversing both levers 5W and 7W, and the secondary route 4—10 or 10—4 over 5 reversed may be selected by reversing lever 5W or 1W, respectively. In no case however, can a route set up be interfered with by an inadvertent movement of a switch lever after the route is established. In the case described involving lever 7W, for example, it will be apparent that since contact 229 of relay 7RE is open, the circuits for the conflicting route selectors 7BNE, etc. are held open at back contact 47 or 48 of relay 7RWS or 12XS, if lever 7W is moved to close contact 49 after the route is established. On the other hand, when a route including crossover 7 in its normal position is set up, relay 7ANE or 7BNE will be energized to close contact 230 or 231, and in this case the opening of contact 49 as the result of an inadvertent movement of lever 7W to reverse is without effect. Furthermore, relay 7WR is nonresponsive to the operation of lever 7W after a route is established because relay 7LS is then released.

The arrangements for operating the track switches individually will be readily apparent from a consideration of Fig. 1C. For example, if lever 1W is moved to the left or right while relay 1LS is energized, a circuit is completed from terminal B, contact 183 of relay 1LS, through the left-hand or right-hand winding of relay 1WR, contact 232 or 184 of relay 1LS over the left-hand or right-hand contact 233 of lever 1W to terminal C, to operate the contacts of relay 1WR to a position to correspond with that of the lever contact. In systems employing individual switch levers it is desirable to arrange the levers so they are ineffective unless operated while the switch locking is released. This is accomplished in a novel manner in the present system by providing each lever W with a center contact which must be closed in order to effect the energization of the associated locking relay LS. Thus relay 1LS has a pick-up circuit which extends from terminal B at contact 114 of relay 4ES over front contacts of the locking and track relays for sections 1T and 4T, through the winding of relay 1LS, contact 233 to terminal C, the lever contact 233 being bridged by a front contact of relay 1LS when that relay becomes energized.

Since switches 1 will remain locked unless 1W is restored to its center position and the operator may fail to note an inadvertent displacement of a switch lever from that position, it is desirable to indicate such displacement on the track diagram and to also distinctively indicate the operation of the track switch when it is operated individually by the corresponding lever W. This is accomplished in a novel manner by providing normal and reverse contacts of each lever, such as contacts 224, 225 and 226 of lever 1W, in the circuits for the white lamps for each of the indicating sections for the corresponding switch, as shown for sections 1ANK, 1RK and 1BNK in Fig. 1E, for example. It will be apparent that whenever lever 1W is moved to left or right, the white lamps 1ANK and 1BNK will become lighted over circuits including contacts 224 and 226 of lever 1W and contacts 227 and 228 of relay 1NWK, respectively, or lamp 1RK will become lighted over contact 225 of lever 1W and contact 189 of relay 1RWK, depending upon the actual position of the track switch, irrespective of whether lever 1W occupies its left-hand or right-hand position. If the switch responds to the lever operation, the lamp which became lighted as a result of the lever movement, becomes dark, but then the red lamp for indicator 1RK becomes lighted over the circuit of Fig. 1G including back contacts 187 and 188 of the switch indication relays to display the transit indication, and the white lamp for the position to which the switch is operated becomes lighted when the switch completes its operation. On the other hand, if the switch fails to respond to the lever movement because it is locked or because it already occupies the required position, the lamp which became lighted as the result of lever movement remains lighted. It follows that the normal dark condition of the indicators is obtained only when lever 1W is in its center position, and that the arrangement indicates individual switch lever operation in a distinctive manner and also gives the operator full information as to how the switch responds to such operation.

The second form of my invention as disclosed in Figs. 2A to 2E, inclusive, differs principally from the first form in the employment of a different arrangement of route selector circuits. In the second form a pair of route relays NR and RR is provided for each single switch and three route relays ANR, RR and BNR for each crossover. The exit relays XS are not required, except for the intermediate signal 8, and the route selector relays are employed in only one direction at a time.

To explain the second form of the apparatus, I shall first assume that the apparatus is in the normal condition as shown and that the operator desires to clear signal 4A.

To set up route 4—12, the operator will operate buttons 4P and 12P as previously described. The operation of button 4P of Fig. 2A completes circuits over contacts 13, 14 and 26 to pick up relays 1RES and 1BNES, energizing the preliminary selectors for routes 4—10 and 4—12 and lighting the exit lamps precisely as described in connection with the first form of the apparatus.

Likewise, relays 3NE, 5ANE and 7BNE at contacts 58, 54 and 56 open the circuits for the conflicting relays 3RES, 5RE and 7RE in Figs. 2A and 2B.

When the exit button 12P is operated, a circuit is closed from terminal B at contact 69 of relay 7TR over its contact 70 and front contact 68 of relay 7BNE to energize the route relay 7BNR, which relay picks up and closes a stick circuit over its contact 229 extending to terminal B over contact 230 of relay 7BNE, and also closes contact 231, Fig. 2A, to pick up the route relay 3NR over a circuit including contact 232 of relay 3NE. Relay 3NR upon becoming energized, closes contact 233 to pick up the route relay 1BNR over a circuit including contact 234 of relay 1BNES. Relays 7BNR, 5BNR, 3NR and 1BNR open their respective back contacts 235, 236, 237 and 238 in the circuits for the corresponding RE and RW relays, thereby isolating the route circuits for route 4—12. The opening of contact 238 of relay 1BNR releases relay 1RES and the remaining energized route selector relays associated with the diverging routes 4—8 and 4—10.

Assuming the switches to be already in the position required for route 4—12, as shown, the operation of the route relays completes a circuit for relay 4HR which may be traced in Fig. 2D from terminal B at back contact 90 of relay 7BNES and front contacts of the route relay NR and the corresponding indication relay NWK for each switch of the route, thence over front contact 93 of relay 1BNES through relay 4HR to terminal C. Relay 4HR becomes energized and affects the clearing of signal 4A as explained in connection with Figs. 1F and 1H in the description of the first form of the apparatus.

In Figs. 2C and 2E only a portion of the circuits are shown, these being generally similar to the circuits of Figs. 1C and 1E already described, differing therefrom only in that each pair of route selector relay contacts which is closed in Fig. 1C to complete the selection of a route portion, such as contacts 185 and 186 of relays 1RW and 1RES, is replaced in Fig. 2C by a single route relay contact, such as contact 239 of relay 1RR, having the corresponding function. Similarly, each pair of contacts such as contacts 88 and 89 of relays 1BNW and 1BNES for completing the circuit for the white lamp of indicator 1BNK in Fig. 1E is replaced in Fig. 2E by a single contact such as contact 240 of relay 1BNR. The operation of relays WR by the circuits of Fig. 2C and the lighting of the track diagram lamps is effected in the same manner in the second form of the apparatus as already described.

I shall next assume that with the apparatus of the second form of my invention in the normal condition as shown that buttons 12P and 4P are operated in that order to set up route 12—4. Button 12P when operated completes the circuits for relays 7BNWS and 7RWS at contacts 79 and 146 to energize the preliminary selectors for routes 12—2, 12—4 and 12—6 and to light the exit indicators 2K, 4K and 6K, as explained in the description of the first form of the apparatus.

When the exit button 4P is operated, a circuit is completed at contact 26 over front contact 27 of relay 1BNW to energize relay 1BNR, which relay picks up and closes its stick circuit at its contact 241 extending to terminal B at contact 242 of relay 1BNW. Relay 1BNR opens its back contact 238 in the circuits for relays 1RES and 1RW and closes contact 243 to complete a circuit over contact 244 of relay 3NW to energize relay 3NR. Relay 3NR picks up, opening back contact 237 in the circuits for relays 3RES, 3RW and 3RR, thereby releasing relay 3RW and closing contact 245, Fig. 2B, to complete a circuit over contact 246 of relay 5BNW for relay 5BNR. Relay 5BNR picks up, opening its back contact 236 in the circuits for relays 5RE, 5RW and 5RR and closing its contact 247 to complete a circuit over contact 248 of relay 7BNWS for relay 7BNR. Relay 7BNR picks up, opening its back contact 235 in the circuit for relay 7RW to release the preliminary selector relays for route 12—2. This isolates the circuits for route 12—4 and completes the selection.

I shall next assume that route 4—12 has been set up as above described in connection with the second form of the apparatus, but that signal 4—A fails to clear due to the route being occupied by a train, and that the operator desires to operate the call-on signal 4—C to permit a second train to enter route 4—12. The call-on signal 4—C may be cleared by operating button 4P as in the first form of the apparatus. It will be clear from Fig. 2A that since the energization of relay 1BNR completes the selection of route 4—12, its front contact 249, Fig. 2A, closes at the proper time to place relay 4COS under the control of button 4P for the purpose stated.

I shall next assume that the operator desires to establish routes 4—8 and 8—10. The operation of button 4P picks up relay 1RES, closing contact 38, Fig. 2B, to prepare circuits for relays 8XR and 8XS and to pick up relay 5ANE, the latter relay opening contact 63 to prevent the energization of relay 5ANES when button 8P is operated. Relay 8XR picks up over the circuit including contacts 64 and 65 when button 8P is pressed and relay 8XS becomes energized in series with relay 8XR when button 8P is released, as previously described, relay 8XS closing contact 250, Fig. 2A, to pick up relay 1RR to complete the selection of route 4—8, relay 5ANE releasing due to the opening of contact 39 of relay 8XS, restoring the circuits for route 8—10 to normal.

Assuming that button 8P is now operated as an entrance button, the closing of contact 62 completes a circuit for relay 5ANE which picks up again and by closing contact 45 reenergizes relay 7ANE. The exit button 10P is now operated, a circuit being completed at its contact 210 over front contact 67 of relay 7ANE to energize relay 7ANR. Relay 7ANR picks up, closing its stick circuit at contact 251 and at contact 252 completing a circuit over front contacts 253 and 254 of relays 5ANE and 5ANES to pick up relay 5ANR, this completing the selection of route 8—10.

Through routing is also provided in this form of the apparatus. If buttons 4P and 10P are operated in order, button 8P not being operated, relay 5ANE will be energized over contact 38 of relay 1RES and back contacts 39 and 40 of relays 8XS and 5ANES and will pick up relay 7ANE, and consequently relay 7ANR will become energized over front contact 67 when button 10P is operated as previously described. In this case, when relay 7ANR picks up, the closing of its contact 252 completes a circuit over contact 253 of relay 5ANE and back contact 254 of relay 5ANES to energize an auxiliary relay 8PBR which serves like relay 5ANWS in the first form of the apparatus to pick up relays 8XR, 8XS and 5ANES. Relay 8XR picks up when contact 255 of relay 8PBR closes, this contact bridging contact 64 of button 8P. Relay 5ANES picks up over contact 256 of relay 8PBR when contact 221 of relay 8XR closes and the operation of contact 254 of relay 5ANES releases relay 8PBR and also completes the circuit for relay 5ANR. The opening of contact 255 when relay 8PBR releases permits relay 8XS to pick up in series with 8XR. It is evident therefore that the effect of the operation of relay 8PBR is the same as if button 8P were operated twice and that routes 4—8 and 8—12 are selected in a manner very similar to that described in connection with the first form of the apparatus.

If buttons 4P and 10P are operated in the reverse order, relays 7ANWS, 5ANW, 1RW, 1RR, 5ANR and 7ANR will pick up in that order to complete the selection of route 10—4 and button 8P will be rendered nonoperative because the circuit for relay 5ANES will be open at contact 164 of relay 5ANW, in Fig. 2B, and because relays 1ANES and 1RES will be prevented from picking up to prepare the pick-up circuit for relay 8XR due to the energization of relays 1RR and 1RW, respectively, in Fig. 2A.

It will be evident from the explanation of the individual operation of the track switches in the foregoing description of the first form of the apparatus that the switch levers W constitute an auxiliary system of control which may be used to establish routes without operating the route buttons or route selecting relays, and after a route has been established in this manner and has been indicated by the lighting of the track lamps for the switch sections of the control panel, the proper signal may be cleared by operating the entrance and exit buttons for the established route. However, in order to insure against interruptions of service to the maximum extent, it may be desirable to provide an auxiliary system for clearing the signals under the conditions mentioned which is independent of the route buttons so as to permit train movements over routes established by individual lever operation without operating any of the route selecting apparatus.

One manner in which this result may be attained is illustrated in Fig. 3. This view shows an auxiliary circuit network for the signal control relays HR which is so arranged that it may be superimposed either upon the circuits for these relays shown in Fig. 1D in the first form, or upon those of Fig. 2D in the second form of the apparatus. When the modification shown in Fig. 3 is used, each relay HR is provided, in addition to its energizing circuit controlled by the route selecting relays, with an auxiliary pick-up circuit and a stick circuit. Each auxiliary pick-up circuit is controlled by a push button which may be independent of the corresponding route button P, but preferably each such circuit includes a normally open "pull" contact of the associated button P and these circuits are arranged in a route network corresponding to the track layout and including contacts of the levers W as shown in Fig. 3. It is to be understood that wires 276 to 281, inclusive, in Fig. 3 are the wires connecting the relays HR to the route network circuits of Fig. 1D or 2D as indicated by the similarly designations of corresponding wires in those views. It will be seen, therefore, that when Fig. 3 is used, relay 4HR has connections to the normally open contacts 266 and 267 as shown in Fig. 3, in addition to the connections to the normally open contacts 195 and 93 of Fig. 1D, and that each remaining relay HR is similarly arranged.

To explain the modification shown in Fig. 3, I shall assume that with the track switches normal, as shown, the operator moves lever 1W to the right or reverse control position and levers 5W and 7W to the left or normal control position to establish route 4—10 or 10—4. The white lamps for indicators 5ANK, 5BNK, 7ANK and 7BNK of Fig. 1G will become lighted due to the closing of the lever contacts 257, 258, 259 and 260, Fig. 1E, because switches 5 and 7 already occupy the positions required for the route and contacts 261 and 262 of relay 5NWK and contacts 263 and 264 of relay 7NWK are closed. The movement of lever 1W by closing right-hand contact 233 causes relay 1WR to reverse, releasing relays 1NWC and 1NWK, relay 1NWK by closing its back contact 187, Fig. 1G, lighting the red lamp for indicator 1RK, this indication changing to white as soon as switches 1 complete their movement to reverse due to the opening of back contact 188 and the closing of contact 189, Fig. 1G. Route 4—10 may then be traced on the diagram by observing the indicators 1RK, 5ANK and 7ANK. Although indicators 5BNK and 7BNK are also lighted, they do not indicate a complete route because indicators 3NK and 3RK remain dark.

I shall now assume that the operator pulls the entrance button 4P momentarily. This completes a circuit in Fig. 3 which may be traced from terminal B at right-hand contact 265 of lever 1W, the lower contact 266 of button 4P, relay 4HR to terminal C. Relay 4HR picks up and upon the release of the button the stick circuit for relay 4HR is completed from terminal B at contact 265 over the upper contact 266 of button 4P, contact 267 and winding of relay 4HR to terminal C. As previously described, the energization of relay 4HR causes the release of relays 4AS, 4ES and 1LS. Relay 4ES upon releasing energizes relays 4SP and 1SP to complete the strip lighting for route 4—8 by lighting the white lamps for indicators 4K and 1K but the red lamp in button 4P is not lighted. A circuit for mechanism 4CG is completed in Fig. 1H as previously described to clear signal 4C and relay 4RGP releases to light the green lamp for indicator 4GK.

When the train enters route 4—8, the operator will restore lever 1W to the center position which it normally occupies, thereby releasing relay 4HR and closing the center contact 233, Fig. 1C, of lever 1W to permit the release of the switch locking.

In order to establish the portion 8—10 of the route and to clear signal 8, the operator will pull button 8P momentarily to pick up relay 8HR over the circuit of Fig. 3 extending from terminal B at back contact 268 of relay 10HR, the upper contact 269 of button 10P, left-hand contacts 270 and 271 of levers 7W and 5W, the lower contact 272 of button 8P, relay 8HP to terminal C. Relay 8HR picks up and upon the release of button 8P completes its stick circuit at contact 273, clearing signal 8 and completing the strip lighting for route 8—10. Relay 8HR is released subsequently upon the restoration of levers 5W and 7W to their center positions.

Similarly, the operator may clear signal 10C to permit a train movement over route 10—4 by pulling button 10P momentarily instead of buttons 4P and 8P. In this case a circuit is completed from terminal B at contact 265 of lever 1W, the upper contact 266 of button 4P, back contact 267 of relay 4HR, right-hand contacts 274 and 275 of lever 1W, back contact 273 of relay 8HR, the upper contact 272 of button 8P, left-hand contacts 271 and 270 of levers 5W and 7W, the lower contact 269 of button 10P, relay 10HR to terminal C, and relay 10HR picks up to complete its stick circuit at its front contact 268.

It will be apparent from the foregoing that each button P may be used for four or five different purposes without confusion. If a button is pushed when the associated indicators are dark, it serves as an entrance button, the response of the apparatus to such operation being indicated by the steady lighting of the red lamp in the button and by the lighting of the exit indicator for each available route for which the location of the operated button is an entrance point. When the exit indicator adjacent to the button has been lighted by the operation of a button for the opposite end of a route, the button is marked as the exit button for such route and the response to its operation under this condition is indicated by the lighting of the remaining track indicators for the route as the route becomes established and also by the extinguishing of the exit indicators for other routes having the same entrance point at the opposite end of the track diagram. Each button for the entrance to a route having a call-on signal is marked as a call-on button after the corresponding route has been set up, provided the red indication of the button indicator persists and its operation as a call-on button is indicated by the display of a flashing indication by the button indicator. If the button is pulled momentarily after it has been operated as an entrance button, the corresponding entrance stick relay will be released to cancel the route set up, causing the indicator to become dark. Finally, in accordance with the modification shown in Fig. 3, if the button is pulled momentarily after a route has been established by individual lever operation, it serves as an emergency lever by means of which the signal for the route may be cleared without operating the route selecting relays. Furthermore, the single lens in the button provides four distinctive light indications in addition to its normal dark condition.

It is obvious that the control and indicating apparatus of the control panel as herein disclosed is extremely compact, a feature which is highly desirable in apparatus of this character in order to enable large and complicated track layouts to be more conveniently controlled by a single operator.

In the foregoing I have explained but a few of the many possible operations of the apparatus of my invention, but it is believed that since the remaining operations are carried out in a manner generally similar to those described, that they will be readily understood without further explanation.

Although I have herein shown and described but two forms of apparatus embodying my invention and one modification thereof, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In an interlocking control system, a track

layout including parallel tracks interconnected by track switches adapted to form different traffic routes, entrance and exit buttons for the ends of the routes, preliminary and final route selecting circuits for each route, switch indication and locking relays controlled by traffic conditions in said track layout and having contacts for controlling said circuits in accordance with the position and locked condition of the track switches in the corresponding routes, a contact controlled by each entrance button for energizing the preliminary circuits for each route having its entrance end marked by such button, provided each switch of such route is in the required position or is free to be operated thereto as manifested by said switch indication and locking relay contacts, a contact controlled by each button marking the exit end of a route having its preliminary selecting circuits fully energized for energizing the final selecting circuits for such route, selecting relays governed by said energized preliminary circuits and rendered effective as said circuits become energized to open contacts controlling the preliminary selecting circuits for conflicting routes having different entrance ends, route relays governed by the energized final selecting circuits and rendered effective as said circuits become energized to open contacts controlling the preliminary selecting circuits for conflicting routes having different exit ends, and means comprising the route relays controlled by said energized final circuits for operating the track switches as required to establish the corresponding route.

2. In an interlocking control system, a track layout including parallel tracks interconnected by track switches adapted to form different traffic routes, a single route button for each route end, a preliminary and a final electroresponsive route selector for each route, contacts controlled by said selectors in circuits for controlling the selectors for conflicting routes, contacts controlled by each route button normally effective upon operation of the button to energize the preliminary selector for each available route having its entrance end marked by such button, means controlled by each energized preliminary selector for rendering the contacts controlled by the route button for the exit end of the corresponding route effective to control the final selector for such route and at the same time rendering such button ineffective to control the preliminary selectors for any route having its entrance end marked by such button, means controlled by the energized preliminary and final selectors for any route for opening said contacts in circuits controlling the selectors for conflicting routes whereby but one preliminary selector and but one final selector remain energized in response to the operation of the buttons for the opposite ends of any route, and means controlled by said energized final selector for operating the track switches as required to establish the corresponding route.

3. In an interlocking control system, a track layout including parallel tracks interconnected by track switches adapted to form different traffic routes, a single route button for each route end, a preliminary and a final electroresponsive route selector for each route, contacts controlled by said selectors in circuits for controlling the selectors for conflicting routes, means controlled by each route button normally effective upon operation of the button to energize the preliminary selector for each available route having its entrance end marked by such button, means controlled by the second of any two route buttons to be operated to mark the opposite ends of a desired route and rendered effective upon energization of the preliminary selector controlled by the first operated route button to energize only the final selector for such route in response to the operation of such second button, means controlled by each energized preliminary selector for opening said contacts in circuits controlling the selectors for all conflicting routes not having the same entrance end, means controlled by said energized final selector for opening said contacts in circuits controlling the selectors for the remaining conflicting routes, and means controlled by said energized final selector for operating the track switches as required to establish said desired route.

4. In an interlocking control system, a track layout including parallel tracks interconnected by track switches adapted to form different traffic routes, a single route button for each route end, a preliminary and a final electroresponsive route selector for each route, a particular selector relay included in each preliminary selector which becomes energized only when each track switch of the corresponding route occupies the position required for the route or is free to be operated to such position, contacts controlled by said selectors in circuits for controlling the selectors for conflicting routes, means effective when the button for one end only of a route is operated to energize the preliminary selector for each available route having one end marked by such button, means effective when the button for the opposite end of a route is operated following this operation of the button for one end of such route to energize the final selector for such route, provided said particular selector relay in the preliminary selector for such route is energized, means controlled by the energized selectors for opening said contacts in circuits for selectors for conflicting routes, and means controlled by said energized final selector for operating the track switches as required to establish the corresponding route.

5. In an interlocking control system, a track layout including parallel tracks interconnected by track switches or crossovers adapted to form different traffic routes, entrance and exit buttons for the ends of the routes, a preliminary and a final selector for each route each comprising a series of tandem-connected relays including one for each switch or crossover of the route, the relays of each series becoming successively energized when current is supplied to the first relay of such series, a circuit for each such relay including back contacts of relays included in the selectors for conflicting routes, means controlled by each entrance button for supplying current to the first relay of the preliminary selector for each available route having its entrance end marked by said button to energize one or more series of relays to thereby open said contacts in the circuits for the selectors for conflicting routes having different entrance ends, means controlled by the energized preliminary selector relay for the switch or crossover nearest the exit end of each such route to condition the button marking that end of the route to function as an exit button, means responsive to the operation of any route button so conditioned for energizing the final selector relays for such route thereby opening the back contacts of such relays to re-

lease the energized preliminary selector relays for routes having different exit ends, and means controlled by each energized final selector relay for operating the associated track switch or crossover as required to establish the corresponding route.

6. In an interlocking control system, a track layout including parallel tracks interconnected by track switches and crossovers adapted to form different traffic routes, entrance and exit buttons for the ends of the routes, a preliminary and a final selector for each route each comprising a series of tandem-connected relays including one for each switch or crossover of the route, the relays of each series becoming successively energized when current is supplied to the first relay of such series, a circuit for each such relay including back contacts of relays included in the selectors for conflicting routes, means controlled by each entrance button for supplying current to the first relay of the preliminary selector for each available route having its entrance end marked by said button to energize one or more series of relays to thereby open said contacts in the circuits for the selectors for conflicting routes having different entrance ends, means controlled by the energized preliminary selector relay for the switch or crossover nearest the exit end of each such route to condition the button marking that end of the route to function as an exit button, means responsive to the operation of any button so conditioned for energizing the final selector relays for such route thereby opening the back contacts of such relays to release the energized preliminary selector relays for routes having different exit ends, and a switch control circuit for each switch or crossover controlled jointly by the energized final selector relay and by the preliminary selector relay for the same or crossover for operating that switch or crossover to normal or reverse as required to establish the corresponding route.

7. In an interlocking control system, a track layout including parallel tracks interconnected by track switches and crossovers adapted to form different traffic routes, locking relays for the switches and crossovers which when deenergized prevent their operation, indication relays controlled by the switches and crossovers to indicate their positions, entrance and exit buttons for the ends of the routes, a preliminary and a final route selector for each route each comprising a series of tandem-connected route relays including one for each switch or crossover in the corresponding route, a circuit for each route relay including back contacts of route relays of selectors for conflicting routes in series with contacts of indication relays closed only when the corresponding switch or crossover is in the position required for the route said indication relay contacts being bridged by contacts of the switch locking relay for the same switch or crossover closed only when such locking relay is energized, means normally responsive to the operation of the button for the entrance end of any desired route for successively energizing the preliminary selector relays for such route, provided the route is available as manifested by the condition of said indication and locking relay contacts, means controlled by said preliminary selector relays when all are energized and responsive to the operation of the button for the exit end of the same route for energizing the final selector relays for each switch or crossover of such route, and means controlled by each energized final selector relay for operating the corresponding track switch or crossover as required to establish the desired route.

8. In an interlocking control system, a plurality of traffic routes through a track layout including movable track switches and/or crossovers, route buttons for the ends of the routes, a preliminary and a final selector for each route each including a relay for each switch or crossover of the route, means responsive to the momentary operation of the button marking one end of a particular route for energizing the preliminary selector relays for each route having the same one end, the energization of each such relay being dependent upon the position and locked condition of the associated track switch or crossover means responsive to the subsequent operation of the button for the other end of said particular route for energizing the final selector relays for said particular route only, but only if such route is available as manifested by the energization of the preliminary selector relays for such route, and means controlled by the energized final selector relays for establishing said particular route and for releasing the energized relays for routes conflicting therewith.

9. In an interlocking control system, a plurality of traffic routes through a track layout including movable track switches, route buttons marking the ends of the routes, a selector relay for the exit end of each route, means normally responsive to the operation of any route button for energizing the selector relay for the exit end of each of the available routes which has its opposite end marked by the operated button, and means responsive to the subsequent operation of a button marking the exit end of a selected route having its selector relay energized for releasing all such relays except the one for the selected route and for operating the track switches as required to establish such route.

10. In an interlocking control system, a plurality of traffic routes through a track layout including movable track switches, route buttons for the ends of the routes, there being only one route button for each route end in said track layout, a selector for each direction for each route, means normally responsive to the operation of any route button for energizing the selector for one direction for each route having one end marked by such button, means responsive to the subsequent operation of the route button for the other end of a selected one of said routes for releasing all said selectors except the one for the selected route and for operating the track switches as required to establish such route, and means dependent only upon the relative order in which the buttons for the two ends of a route are operated for determining the direction of traffic movements over that route when established.

11. In combination, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, route buttons for the ends of the routes, there being only one route button for each route end in said track layout, a selector for each route, means normally responsive to the momentary operation of any route button for energizing the selector for each route having its entrance end marked by such route button, means responsive to the subsequent momentary operation of the button for the other end of a selected one of said routes for releasing all said selectors except the one for the selected route and for operating the track switches as required to establish that route, and

means for automatically releasing said one selector when a train enters the first track section of the route.

12. In an interlocking control system, a track layout comprising a plurality of track sections interconnected by track switches to form different routes, route buttons for the ends of the routes, a preliminary selector for each route including a selector relay for the exit end of such route, a final selector for each route, means responsive to the momentary operation of the button marking the entrance end of diverging routes for energizing the preliminary selector for each such route to thereby pick up the selector relay for each available exit, means controlled by the track relay for the track section at said entrance end for maintaining said preliminary selectors energized, means responsive to the subsequent momentary operation of the button for the exit end of a selected one of said routes having its selector relay picked up for energizing the final selector for the selected route, means controlled by said final selector for releasing all said preliminary selectors except the one for the selected route, means controlled by the preliminary selector for the selected route for maintaining said final selector energized, and means controlled by said final selector for operating the track switches as required to establish the selected route.

13. In an interlocking control system, a railway track switch operable to normal and reverse positions for establishing different traffic routes over the switch, route buttons for the ends of the routes, two normal and two reverse control relays for controlling the switch, means responsive to the operation of the button for one end of a route over the switch for energizing one normal or reverse control relay, means responsive to the subsequent operation of the button for the other end of said route for energizing the other normal or reverse control relay, and means effective when both normal or both reverse control relays are energized for operating the switch to a corresponding position.

14. In an interlocking control system, a track layout including parallel tracks interconnected by track switches and crossovers adapted to form different traffic routes, control relays for said switches, a route button for each route end for each end of said layout, means responsive to the successive operation of the buttons for the opposite ends of a route to successively energize two series of said relays one series in response to the operation of each button each such series including a relay for each switch or crossover of such route, means effective when the relays of both series are energized for operating the track switches and crossovers as required to establish the route, and means dependent only upon the relative order in which said buttons are operated for determining the direction of traffic movements over said route when established.

15. In an interlocking control system, a track layout including parallel tracks interconnected by track switches and crossovers to form different traffic routes, control relays for said switches, a manually operable contact for each route end in said layout, a first chain of relays for each route each such chain including one relay for each switch or crossover of the route, means for successively energizing the chain of relays for a route in response to the momentary closing of the contact for one end of the route, means controlled by the energized relays of said chain for preventing the energization of similar relays for conflicting routes converging upon the selected route in one direction, a second chain of relays for each route including a relay for each switch or crossover of the route, means for successively energizing the second chain of relays for a route in response to the momentary closing of the manually operable contact for the other end of the route provided the relays of the first chain for that route are energized, means controlled by the relays of the second chain for preventing the energization of similar relays for conflicting routes converging upon the selected route in the other direction, and means controlled by each relay of the second chain for operating the corresponding track switch or crossover to the position required for the route.

16. In combination, a track layout including a plurality of track switches and crossovers adapted to be arranged to form different traffic routes, a locking relay for each switch or crossover effective when deenergized to prevent operation of that switch or crossover, a signal for governing the movement of traffic over a particular route through the track layout, a signal control relay for controlling said signal, a route relay for each switch or crossover of said route effective when energized to operate that switch or crossover to a position in accordance with said route, circuits for successively energizing said route relays, the circuit for each relay including a front contact of the locking relay for the corresponding switch or crossover, each said front contact being bridged by a contact closed only when the switch or crossover is in a position in accordance with the route, means governed by said route relays for energizing the signal control relay when the corresponding route is fully established, means controlled by said signal control relay for releasing the locking relay for each switch or crossover of the route, and means controlled by said signal control relay but effective only when the locking relay for each switch or crossover of the route is released for clearing said signal.

17. In combination, a track layout including a plurality of track switches adapted to be arranged to form different traffic routes, a locking relay for each single switch or pair of switches constituting a crossover effective when deenergized to prevent operation of the corresponding switch or crossover, route buttons for the ends of the routes, a selector for each direction for each route, means responsive to the operation of each route button for energizing the selector for one direction for each route having one end marked by such button, means preventing the effective energization of each said selector unless the locking relay for each switch or crossover of the corresponding route is energized or the switch or crossover which such locking relay controls is already in the position required for the route, means responsive to the subsequent operation of the button for the other end of a selected one of said routes for releasing all said selectors except the one for the selected route and for operating the track switches and crossovers as required to establish such route, and means for releasing the locking relay for each switch or crossover of a route when such route is fully established.

18. In an interlocking control system, a track layout including a plurality of track switches adapted to be arranged to form different traffic routes including two alternative routes between

the same route ends, a route button for each route end, an electroresponsive route selector for each route, means responsive to the operation of each button for energizing the selector for each route having one end marked by such button, said means being normally effective when a button at the end of said alternative routes is operated to permit the energization of the selector for but one of said alternative routes at a time, means responsive to the subsequent operation of the button for the other end of a selected route for releasing all of said selectors except the one for the selected route and for operating the track switches as required for the route, and selecting means for at times preventing the energization of said selector for one alternative route to thereby permit the energization of the selector for the other in response to the operation of the button at one end of said routes.

19. In an interlocking control system, a track layout including a plurality of track switches adapted to be arranged to form different traffic routes including two alternative routes between the same route ends, a route button for each route end, an electroresponsive route selector for each route, means responsive to the operation of each button for energizing the selector for each route having one end marked by such button, said means being normally effective when a button at the end of said alternative routes is operated to permit the energization of the selector for but one of said alternative routes at a time, means responsive to the subsequent operation of the button for the other end of a selected route for releasing all of said selectors except the one for the selected route and for operating the track switches as required for the route, and selecting means automatically effective in the event a portion of said one alternative route is occupied by a train when the other is available to prevent the energization of the selector for said one alternative route to thereby permit the energization of the selector for the other in response to the operation of the button at one end of said routes.

20. In an interlocking control system, a track layout including a plurality of track switches adapted to be arranged to form different traffic routes including two alternative routes between the same route ends, a route button for each route end, an electroresponsive route selector for each route, means responsive to the operation of each button for energizing the selector for each route having one end marked by such button, said means being normally effective when a button at the end of said alternative routes is operated to permit the energization of the selector for but one of said alternative routes at a time, means responsive to the subsequent operation of the button for the other end of a selected route for releasing all of said selectors except the one for the selected route and for operating the track switches as required for the route, and manually controllable selecting means effective when operated to prevent the energization of the selector for said one alternative route to thereby permit the energization of the selector for the other in response to the operation of the button at one end of said routes.

21. In an interlocking control system, a plurality of routes through a track layout each including a plurality of track switches, a route button for each route end in said layout, two normal and two reverse control relays for each of said switches which is operated singly or for each pair of switches operated as a crossover, means responsive to the operation of each button for one end of a route through said layout for energizing at least one normal or reverse control relay for each switch or crossover of such route, means responsive to a subsequent operation of the button at the opposite end of said route for energizing the other normal or reverse control relay for each switch or crossover of such route, and means effective when the two normal relays or the two reverse control relays for a switch or crossover are both energized for operating that switch or crossover to a corresponding normal or reverse position.

22. In an interlocking control system, a plurality of routes through a track layout each including a plurality of track switches, a control panel comprising a representation of said layout having a route button for each route end, means responsive to the operation of the button for one end of a plurality of diverging routes for visually indicating the other end of each of such routes on the track diagram, and means responsive to the subsequent operation of the button for the other end of a selected one of said routes for operating the track switches as required to establish said route and to cancel said indications for routes other than the selected route.

23. In an interlocking control system, a plurality of routes through a track layout each including a plurality of track switches, a control panel comprising a representation of said layout having a route button for each route end, an indication lamp for the end of each route, means responsive to the operation of each button for lighting the lamp for the opposite end of each available route having its one end marked by such button, and means responsive to the operation of the button for the opposite end of a selected one of said routes for operating the track switches as required to establish such routes and for extinguishing the lamps for the ends of the other routes.

24. In an interlocking control system, a plurality of routes through a track layout each including a plurality of track switches, a control panel comprising a representation of said layout having a route button for each route end, a preliminary and a final selector for each route, an indication lamp for the end of each route, means responsive to the operation of each button for energizing the preliminary selector for each route having one end marked by said button, means controlled by each preliminary selector for lighting the lamp for the opposite end of the corresponding route, means responsive to the operation of the button for the opposite end of a selected route having its indication lamp lighted for energizing the final selector for that route having its two ends marked by the operated buttons, and means controlled by said final selector for releasing each of said preliminary selectors except the one for the selected route.

25. In combination, a detector section of railway track including a track switch, a track relay for said section, a track diagram representing said detector section formed of a plurality of linear portions, switch control means for operating said track switch to its normal and reverse positions, a route selector for operating said switch control means, means responsive to the operation of said route selector and effective when the track relay is energized for illuminating certain of said portions including one indicating

the position of the switch to indicate when a route is available, means effective when the track relay is deenergized for illuminating said portions by light of a different color to indicate when said route is occupied by a train, and means independent of said track relay for illuminating one switch indicating portion only by said light of different color to indicate when the switch is displaced from its normal or reverse position or is not in correspondence with its control means.

26. In combination, a detector section of railway track including a track switch, a track relay for said section, a track diagram representing said detector section and provided with two linear portions arranged to be illuminated to indicate the position of the switch, switch control means for operating said switch, means independent of said track relay for illuminating one of said portions when the switch is displaced from its normal or reverse position, and means effective if the control means is operated and said track relay is energized for differently illuminating one of said portions or the other in accordance with the position of the switch when said switch assumes a position corresponding to that of its control means.

27. In an interlocking control system, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a track relay for each section, a miniature track diagram of said track layout having linear portions representing the track sections, route control means for each route effective when energized to operate the track switches as required to establish such route, a directional stick relay for each direction for each track section, means effective when a route is fully established for releasing selected ones of said relays for one direction including one relay for each section of such route, an indication relay for each section controlled by back contacts of the two directional relays for such section, means effective when the track relay and the indication relay for a section are both energized for illuminating the corresponding section of the representation of the established route in the track diagram, and means responsive to the movement of a train over such route to reenergize the stick relays for the route.

28. In an interlocking control system, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a track relay for each section, a miniature track diagram of said track layout having linear portions representing the track sections, route control means for each route effective when energized to operate the track switches as required to establish such route, a directional stick relay for each direction for each track section, means effective when a route is fully established for releasing selected ones of said relays for one direction including one relay for each section of such route, means controlled by a front contact of each track relay and by back contacts of the directional relays for the same section for illuminating a portion of the representation of the established route on the track diagram, means controlled by a back contact of each track relay for differently illuminating such portion to indicate the presence of a train in the corresponding section, and means responsive to the movement of a train over such route to reenergize the stick relays for the route to successively cancel the illumination of the sections as such sections are vacated.

29. In an interlocking control system, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a track relay for each section, a miniature track diagram comprising linear portions representing the track switches in their normal and reverse positions such portions being interconnected by intervening portions to represent the track layout, route control means for each route effective when energized to operate the track switches as required for such route, a plurality of directional stick relays one for each direction for each track section, means effective when each switch assumes the position required for a route in response to the operation of said route control means to illuminate the corresponding portion of the diagram to indicate the position of the switch, means effective when a route is fully established for releasing selected stick relays for one direction including one relay for each track section of such route, means controlled by the directional relays for a route when released for illuminating said intervening portions to complete the representation of such route in the track diagram, means releasing the control means for route when a train enters the first section of such route, and means reenergizing each directional relay in response to the movement of said train through the corresponding track section.

30. In an interlocking control system, a track layout comprising a plurality of track sections containing track switches adapted to be interconnected to form different traffic routes, a track relay for each section, a miniature track diagram of said track layout having linear portions representing the track sections, route control means for each route effective when energized to operate the track switches as required to establish such route, a section locking relay for each direction for each track section each effective when deenergized to prevent the operation of any track switch in such section, means effective when a route is established for releasing selected ones of said relays for one direction including one for each section of said route, means effective as long as the track relay for a section is energized and one section locking relay or the other for such section is deenergized for illuminating the corresponding portion of the representation of the established route on the track diagram, and means responsive to the movement of a train over each section of a route to reenergize the locking relay for such section.

31. In combination, a detector section of railway track including a track switch, a track relay for said section, a locking relay which when deenergized prevents operation of the switch, a track diagram representing said detector section including portions for indicating the position of the track switch, lamps for illuminating said portions, a normal and a reverse control relay for operating the switch, a normal and a reverse indication relay for the switch, a circuit including a front contact of said track relay and front contacts of corresponding control and indication relays for selectively lighting the lamp for one of said switch indicating portions to indicate the position of the switch, means for releasing the switch control relay when a train enters a route including the switch but before the train occupies said detector section, and means including a back contact of said locking relay for maintaining such lamp lighted until the train enters said detector section.

32. In an interlocking control system, a plurality of routes through a track layout each including a track switch, a control panel comprising a representation of said layout having a route button for each route end, a route selector controlled by the buttons at opposite ends of the routes for operating the track switch, two normally dark switch indication lamps, means effective when said selector is operated and the switch assumes its normal or reverse position as required for a route including said switch to light the corresponding normal or reverse indication lamp, a normally inactive switch lever having a normal and a reverse control position for operating the track switch without operating said selector, and means effective when said lever is moved to either control position to light the indication lamp corresponding to the position the switch then occupies.

33. In an interlocking control system, a plurality of routes through a track layout each including a track switch, a control panel comprising a representation of said layout having a route button for each route end, a route selector controlled by the buttons at opposite ends of the routes for operating the track switch, a normally inactive switch lever having a normal and a reverse control position for individually operating the track switch, a normal and a reverse indication lamp for indicating the position of the switch, a circuit for each lamp each including a contact closed when the switch is operated by said selector to the corresponding normal or reverse position, each said contact being bridged by a contact closed when said lever is moved to either control position, and switch indication means for completing the circuit for the normal or reverse indication lamp when the switch occupies the corresponding position.

34. In combination with a railway track switch, a locking relay which when deenergized prevents operation of the switch, a control lever having an inactive position and a normal and a reverse control position, a pick-up circuit for said locking relay controlled by traffic conditions and including a contact closed by said lever in its inactive position, a stick circuit for said locking relay independent of said lever contact, two normally dark indication lamps, circuits for lighting one said lamp or the other at times in accordance with the position of the switch, means for operating the track switch to normal or reverse when the lever is moved to its corresponding control position provided said locking relay is energized, and means comprising contacts closed when the lever occupies either control position for completing the circuit for lighting one indication lamp or the other so as to indicate the actual position of the switch only when said lever occupies either control position.

35. In combination with a railway track switch, a locking relay which when deenergized prevents operation of the switch, a control lever having an inactive poistion and a normal and a reverse control position, a pick-up circuit for said locking relay controlled by traffic conditions and including a contact closed by said lever in its inactive position, a stick circuit for said locking relay independent of said lever contact, means for operating the track switch to normal or reverse effective when the lever is moved to the corresponding control position provided said locking relay is energized, and normally inactive indication means controlled in accordance with the condition of the track switch rendered effective to indicate the actual position of the switch upon the movement of said lever from its inactive position.

36. In an interlocking control system, a track layout including parallel tracks interconnected by track switches adapted to form different traffic routes, signals for governing traffic movements over said routes in opposite direction, a route button for each signal, a selector relay for each end of each route, means controlled by each button actuated when no button for a conflicting or opposing signal has been actuated for energizing the selector relays for the ends of each route governed by the corresponding signal, means controlled by each button for a signal at the opposite end of one of said routes actuated after the selector relays for such route are energized for operating the track switches as required for the route and for releasing the energized selector relays for conflicting routes, and means controlled by the selector relays which remain energized for clearing the signal for the corresponding route when that route becomes established.

37. In an interlocking control system, a track layout including parallel tracks interconnected by track switches adapted to form different traffic routes, signals for governing traffic movements over said routes including a main signal and a call-on signal at the entrance to a particular route, a route button for each route end, a preliminary and a final selector for each route, means responsive to the operation of each button for the entrance end of a route to energize the preliminary selector for such route, means responsive to the operation of each button at the exit end of a route having its preliminary selector energized to energize the final selector for such route, means controlled by each final selector for operating the track switches as required to establish the corresponding route and for releasing the energized preliminary selectors for conflicting routes, means controlled by the preliminary selector which remains energized for clearing the signal for one direction for the corresponding route when such route is fully established, means controlled by traffic conditions for at times preventing the clearing of said main signal when said particular route is established, and means responsive to an operation of the button for the entrance to said particular route provided said main signal remains at stop after said particular route has been established for clearing said call-on signal.

38. In an interlocking control system, a track layout including parallel tracks interconnected by track switches adapted to form different traffic routes, signals for governing traffic movements over said routes including a main signal and a call-on signal at the entrance to a particular route, a route button for each route end, a preliminary and a final selector for each route, means responsive to the operation of each button for the entrance end of a route to energize the preliminary selector for such route, means responsive to the operation of each button at the exit end of a route having its preliminary selector energized to energize the final selector for such route, means controlled by each final selector for operating the track switches as required to establish the corresponding route and for releasing the energized preliminary selectors for conflicting routes, means controlled by the preliminary selector which remains energized for clearing the signal for one direction for the cor-

responding route when such route is fully established, the preliminary selector for said particular route being normally effective to clear said main signal only, and means responsive to a subsequent operation of the button for the entrance to said particular route in the event said main signal fails to clear for clearing said call-on signal.

39. In an interlocking control system, a traffic route through a track layout, signals at the ends of said route for governing the movement of traffic over said route in either direction including a main signal and a call-on signal at one end, a route button for each route end, means effective when both buttons are operated for establishing said route, means dependent only upon the relative order of operation of said buttons for selectively clearing said main signal or the signal at the opposite end of the route, and means responsive to a second operation of the button for one end following the operation of the button for the opposite end of the route in the event said main signal fails to clear for clearing said call-on signal.

40. In an interlocking control system, a plurality of traffic routes through a track layout including movable track switches, a single route button for each route end in said layout, a selector relay for the exit end of each route, means normally responsive to the operation of any route button for energizing the selector relay for the exit end of each available route having its entrance end marked by such button, an exit relay for each button, means responsive to the subsequent operation of a button for the exit end of any route having the associated selector relay already energized for energizing the corresponding exit relay, and means controlled by said energized exit relay for releasing the energized selector relays for routes conflicting with the one having its ends marked by the operated buttons and for operating the track switches as required to establish such route.

41. In an interlocking control system, a first signal at one end of a track layout for governing the movement of traffic over a first portion of a traffic route through said layout, a second signal at an intermediate point in said route for governing the movement of traffic in the same direction over a second portion of said route, a route button for each end of said route and for said intermediate point, a stick relay normally responsive to the operation of the button for said intermediate point, means responsive to the operation of the button for the exit end of said route when said stick relay is energized for clearing said second signal, a selector relay responsive to the operation of the button for the entrance end of said route for rendering the button for said intermediate point ineffective to control said stick relay, an exit relay responsive to the operation of the button for said intermediate point when said selector relay is energized for clearing said first signal, and means controlled by said exit relay for releasing said selector relay to render said stick relay responsive to a subsequent operation of said intermediate button.

42. In an interlocking control system, a first signal at one end of a track layout for governing the movement of traffic over a first portion of a traffic route through said layout, a second signal at an intermediate point in said route for governing the movement of traffic in the same direction over a second portion of said route, a route button for each end of said route and for said intermediate point, a stick relay normally responsive to the operation of the button for said intermediate point, means responsive to the operation of the button for the exit end of said route when said stick relay is energized for clearing said second signal, a selector relay responsive to the operation of the button for the entrance end of said route for rendering the button for said intermediate point ineffective to control said stick relay, an exit relay responsive to the operation of the button for said intermediate point when said selector relay is energized for clearing said first signal, means controlled by said exit relay for releasing said selector relay to render said stick relay responsive to a subsequent operation of said intermediate button, and means responsive to the operation of the button for the exit end of said route following operation of the button for the entrance end of the route for energizing said exit relay and said stick relay for clearing said first signal and said second signal.

43. In an interlocking control system, a track layout comprising a plurality of branched track sections each including a track switch, indication means for each switch for indicating its position, a track relay for each section, a miniature diagram of the track layout having linear portions representing the track sections, means controlled only by the track relay for each section for illuminating the representation of such section to indicate when the section is occupied by a train, and means controlled by the indication means for each switch for preventing the illumination of the representation of that branch of the corresponding section which a train in said section does not occupy due to the position of said switch.

44. In an interlocking control system, a track layout comprising a plurality of branched track sections each including a track switch, indication means for each switch for indicating its position, a track relay for each section, a route indicator comprising a miniature diagram of the track layout having linear portions representing the track sections, means for establishing different traffic routes over said switches in different positions, means for indicating the movement of a train over an established route through said layout comprising means controlled only by the track relay for each section for illuminating the portion of the representation of the section extending in the facing direction from the track switch in such section, and means controlled only by the track relay for each section and by the indication means for the switch in such section for selectively illuminating one branch or the other of the representation of that section extending in the trailing direction from the switch in such section.

45. In an interlocking control system, a track layout including parallel tracks interconnected by track switches adapted to form different traffic routes, signals for governing the movement of traffic over said routes, route buttons for the ends of said routes, route selecting means responsive to the operation of the buttons for the two ends of a route for establishing that route and for clearing the corresponding signal, auxiliary switch control means for each switch for operating the switches individually without operating said route selecting means, and auxiliary means for clearing each signal rendered effective in response to the operation of the button at one end only of the route which such signal governs

when the auxiliary switch control means for each switch of the route has been operated to the position required to establish such route.

46. In an interlocking control system, a track layout including parallel tracks interconnected by track switches adapted to form different traffic routes, signals for governing the movement of traffic over said routes, route buttons for the ends of said routes, route selecting means responsive to the operation of the buttons for the two ends of a route for establishing that route and for clearing the corresponding signal, a three-position switch control lever for each switch having an inactive position, and two control positions for operating the switch to normal or reverse without operating said route selecting means, a route circuit network comprising wires corresponding to said tracks and contacts of said levers closed in their normal or reverse control positions including a route circuit for each traffic route through the layout, auxiliary means for clearing each signal comprising the route circuit for the route which such signal governs and a normally open contact controlled by the button for one end of a route, and means effective when a signal for a route has been cleared requiring the lever for each switch of that route to occupy its inactive position before such switch can again be operated.

47. In an interlocking control system, a track layout including parallel tracks interconnected by track switches adapted to form different traffic routes, signals for governing the movement of traffic over said routes, route buttons for the ends of said routes, route selecting means responsive to the operation of the buttons for the two ends of a route for establishing that route and for clearing the corresponding signal, a three-position switch control lever for each switch having an inactive position and two control positions for operating said switch without operating said route selecting means, auxiliary means for clearing the signal for a route without operating said route selecting means rendered effective when each switch of the route has been operated to the required position by its control lever, and means effective when a signal for a route has been cleared requiring the lever for each switch of that route to occupy its inactive position before such switch can again be operated.

48. In a switch control system of the entrance-exit type for governing the power operation of track switches at the opposite ends of the crossovers of a track layout to set up different routes for train movement between signal locations at opposite ends of the track layout constituting entrance and/or exit ends of routes, said track layout affording at least two alternative routes between the same entrance and exit signal locations by reason of two crossovers interconnecting two tracks, a control panel having thereon a miniature track diagram, route buttons located on said diagram at points corresponding to said signal locations and operable at any time to their actuated positions to close entrance or exit contacts to identify their corresponding locations as entrance or exit ends of routes, a normal and a reverse control relay for each of said track switches for respectively controlling its normal and reverse operation, one conditioning circuit network having a feed point for each signal location governing train movement from right to left and effective upon the application of an energizing potential to a given feed point to cause energization of a normal or a reverse switch control relay for each of those track switches which would be trailed in a corresponding normal or reverse position by a train moving to the left over each available route from that signal location, another conditioning circuit network having a feed point for each signal location governing train movement from left to right and effective upon the application of an energizing potential to a given feed point to cause energization of a normal or a reverse switch control relay for each of those switches which would be trailed in a corresponding normal or reverse position by a train moving to the right over each available route from that signal location, contacts of said normal and reverse switch control relays included in said one and said another conditioning circuit networks to interlock said relays for allowing the reverse switch control relays for the opposite ends of a crossover to be energized only if both of the normal relays for the opposite ends of that crossover are deenergized and for preventing energization of the normal switch control relay each end of such crossover only if the reverse switch control relays for both ends of that crossover are energized, circuit means effective upon the closure of an entrance contact for a particular signal location to supply energy to that conditioning network having a feed point for that signal location, and circuit means rendered effective upon the closure of an exit contact to supply energy to that conditioning circuit network having a feed point for such signal location, whereby the closure of an entrance contact for a signal location at the entrance to said alternative routes and the closure of an exit contact for the signal location at the exit end of such routes causes both of said conditioning networks to be energized and pick up the proper switch control relays to establish a predetermined route only between such signal locations.

49. In a switch control system of the type described for setting up different routes between signal locations at opposite ends of a track layout by the power operation of track switches and crossovers in response to the designation of the entrance and exit ends of such routes, a group of switch control relays associated with each of said track switches and crossovers for controlling the normal and reverse operation of such switch or crossover, one conditioning circuit network having a feed point for each signal location governing train movement from right to left and effective upon the application of an energizing potential to a given feed point to cause the energization of a switch control relay for each of those track switches which would be trailed in a normal or a reverse position by a train moving to the left over each available route from that signal location, another conditioning circuit network having a feed point for each signal location governing train movement from left to right and effective upon the application of an energizing potential to a given feed point to cause the energization of a switch control relay for each of those switches which would be trailed in a normal or a reverse position by a train moving to the right over each available route from that signal location, circuit means associated with each switch or crossover and responsive to the energization by one conditioning network of a switch control relay for a particular position of that switch or crossover included in any particular route for also causing another switch control relay of the group of relays for

that switch or crossover to be energized over the other of said conditioning circuit networks, circuit means responsive to the manual designation of a particular signal location as the entrance end of a desired route for applying energy to that conditioning circuit network having a feed point for that signal location, and responsive to the manual designation of a signal location as the exit end of such desired route for applying energy to the other conditioning network having a feed point for that signal location, whereby there are two relays energized for each switch or crossover included in any given route having its entrance and exit ends manually designated, and switch control circuit means for each switch or crossover effective to cause its power operation when and only when two switch control relays of its group of switch control relays are energized.

50. In an interlocking control system of the entrance-exit type for setting up different traffic routes through a railway track layout which includes a track switch operable to reverse or normal to extend one or another of two alternative routes to a common exit, manually operable contacts designating the common entrance and exit to said alternative routes, a normal and a reverse selecting relay for governing the operation of said track switch to normal or reverse, a third relay associated with said track switch, an energizing circuit for said reverse relay closed in response to the operation of said entrance contact provided said normal relay is deenergized and said one alternative route is available, an energizing circuit for said normal relay closed in response to the operation of said entrance contact provided said reverse relay or said third relay is deenergized and said other alternative route is available, and an energizing circuit for said third relay closed in response to the operation of said exit contact only when said reverse relay is energized for rendering said other alternative route unavailable when said one route is set up.

51. In an interlocking control system, a track layout including a plurality of track switches adapted to form different traffic routes, entrance and exit buttons for the ends of said routes, a group of at least three selecting relays for each single switch or crossover in said layout, each group including a normal and a reverse relay, a route circuit network controlled by the buttons for the route ends at one end of the track layout including a circuit for one selecting relay of each group; another route circuit network controlled by the buttons for the route ends at the other end of the track layout including a circuit for another selecting relay of each group, said circuits being arranged to effect the energization of a pair of selecting relays for each single switch or crossover in any route which has been designated by the operation of the entrance and exit buttons for its two ends, one relay of each said pair being in each network and each pair including at least one normal or reverse relay for selecting the required switch position, and a switch control relay for each single switch or crossover controlled jointly by the two relays of the corresponding pair for operating the associated switch or switches to the selected position.

52. In an interlocking control system of the entrance-exit type for setting up different traffic routes through a railway track layout which includes a track switch operable to reverse or normal to extend one route or another to a common exit, manually operable contacts designating the entrances and exits to said routes, a normal and a reverse selecting relay and a third relay associated with said track switch, an energizing circuit for said reverse relay closed in response to the operation of the contact for the entrance to said one route, an energizing circuit for said normal relay closed in response to the operation of the contact for the entrance to said other route, an energizing circuit for said third relay closed in response to the operation of the contact for the common exit to said routes provided either said normal or said reverse relay is energized, and control circuits for operating said track switch to normal and reverse including front contacts of said normal relay and reverse relay, respectively, each said circuit also including a contact of said third relay.

53. A switch and signal control system of the entrance-exit type for track layouts including parallel tracks connected by one or more crossovers and affording a plurality of routes between entrance and exit signal locations, manually operable buttons for designating signal locations to constitute the entrance and exit ends of desired routes, four switch control relays associated with each crossover comprising two relays relating to the normal position and two relating to the reverse position, means for operating each crossover to the normal position when both of the relays relating to the normal position are energized and to the reverse position when both of the relays relating to the reverse position are energized, initiating circuits responsive to the operation of a button to designate any given entrance signal location for energizing one of the normal or the reverse relays for each end of a crossover that would be trailed in the corresponding normal or reverse position by train movement over any one of the available routes originating at said entrance signal location, and circuit means responsive to the subsequent actuation of a button to designate the exit end of a particular one of said available routes for energizing the other normal or reverse relay as the case may be for each of the crossovers included in said particular route and thereby cause operation of said crossover to the normal or the reverse position as required to provide said route.

54. In a switch and signal control system of the entrance-exit type for track layouts including parallel tracks connected by one or more crossovers, manually operable buttons for designating the signal locations of said track layout to constitute the entrance and exit ends of routes, four relays associated with each cross over and adapted when energized in different combinations of two relays each to govern operation of said crossovers to the normal and the reverse position, conditioning circuits responsive to the actuation of a button to designate any given entrance signal location for conditioning one of said relays associated with each trailed end of a crossover included in any one of the available routes originating at said entrance signal location and thereby preselect the position of said crossovers to conform with said routes, and circuit means responsive to the actuation of a button to designate the exit end of a particular one of said routes and controlled by the relays conditioned by said initiating circuits for energizing another one of the relays associated with each of those crossovers included in said particular route and deenergizing those relays conditioned by energization of said initiating circuits and relating

to all other routes originating at the same entrance signal location.

55. In an interlocking control system, a plurality of traffic routes through a track layout including movable track switches, route buttons for the ends of the routes, a selector for each direction for each route for rendering buttons effective to perform exit functions for the ends of that route, means responsive to the operation of each button for applying energy to the selector for one direction for each route having one end marked by such button, route completion means responsive to the subsequent operation of the button for the other end of a selected one of said routes for rendering ineffective all said selectors except the one for the selected route and for operating the track switches in turn as required to establish such route, and means dependent only upon the relative order in which the buttons for the two ends of a route are operated for determining the direction of traffic movements over that route when established.

56. In an interlocking control system, a plurality of traffic routes through a track layout including movable track switches, a single route button for each route end in said layout, an entrance relay for each button, an exit relay for the exit end of each route, means responsive to the operation of each button for energizing its associated entrance relay and for preparing for operation the exit relay for the exit end of each available route having its entrance end marked by such button, means responsive to the subsequent operation of the button for the exit end of an available route for energizing the corresponding exit relay instead of the corresponding entrance relay, and route establishing means controlled by the energized entrance and exit relays for any given route for initiating the operation of each switch in turn required to establish that given route beginning at said exit end and at the same time cancelling the preparation of the exit relays for all routes conflicting with said given route.

LLOYD V. LEWIS.

CERTIFICATE OF CORRECTION.

Patent 2,301,297. November 10, 1942.

LLOYD V. LEWIS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 14, first column, line 39, claim 6, after "same" insert --switch--; and second column, line 70, claim 11, after "such" strike out "route" and insert the same before "button" in line 71, same claim; page 18, first column, line 64, claim 35, for "poistion" read --position--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 5th day of January, A. D. 1943.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)