Oct. 27, 1942. H. S. YOUNG 2,300,272

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Dec. 23, 1939 7 Sheets-Sheet 1

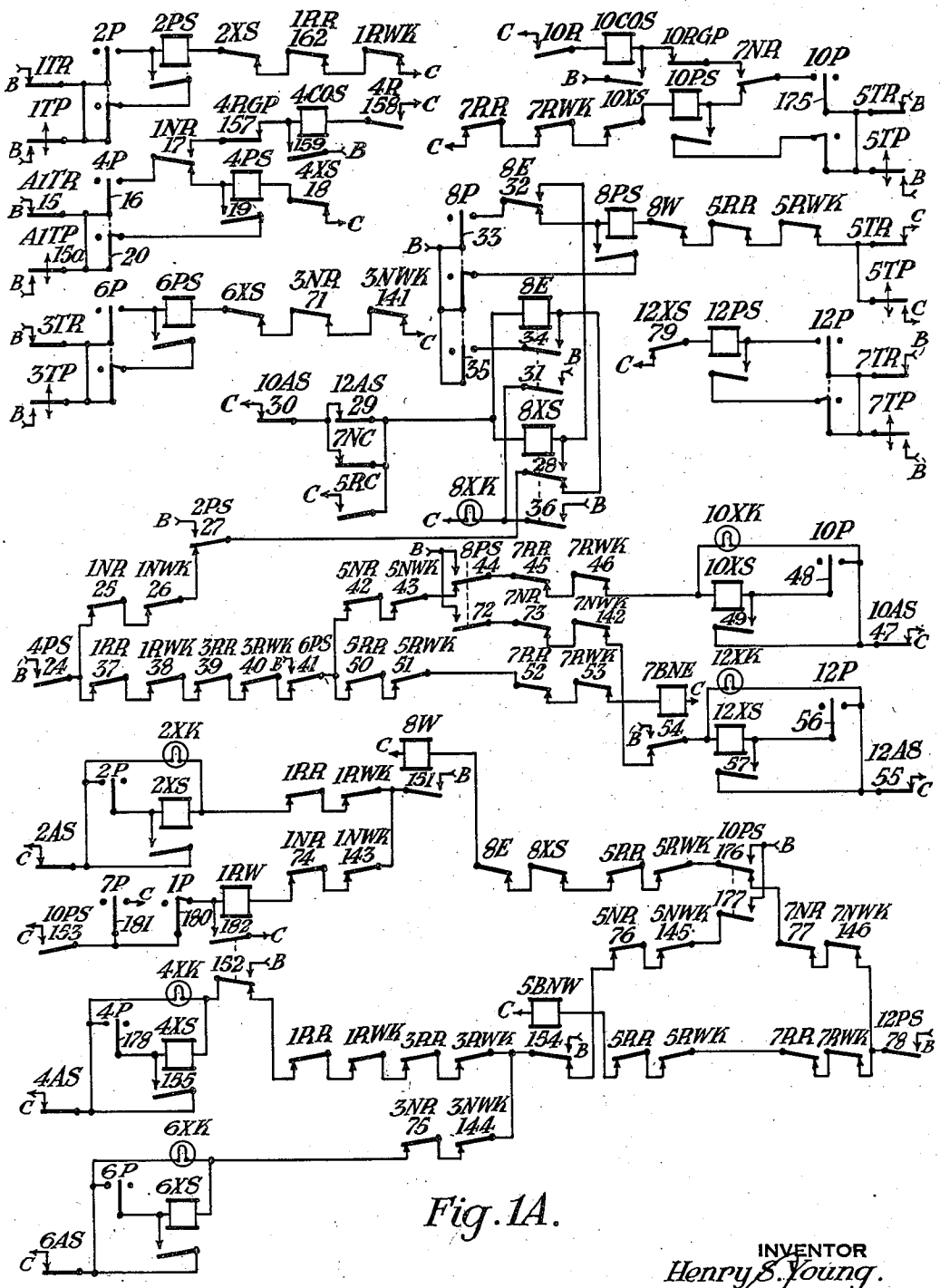


Fig. 1A.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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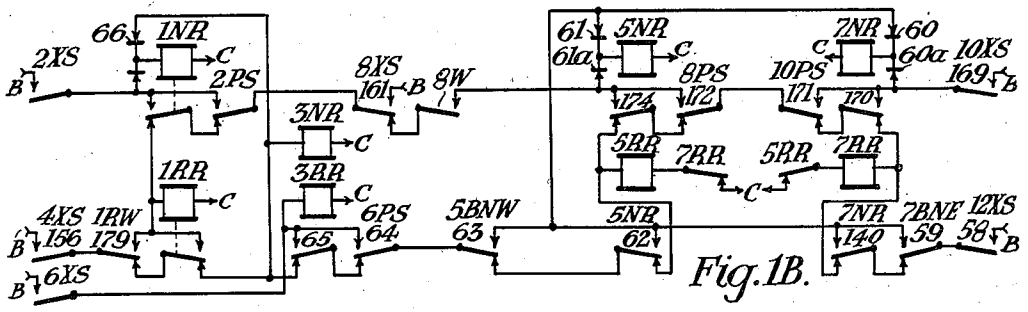


Fig. 1B.

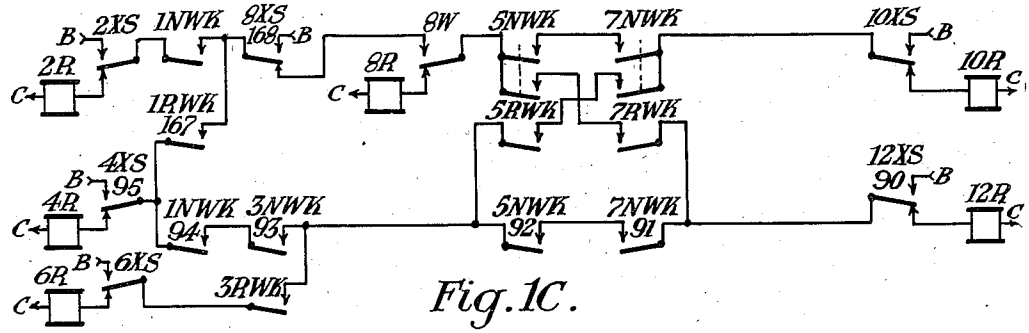


Fig. 1C.

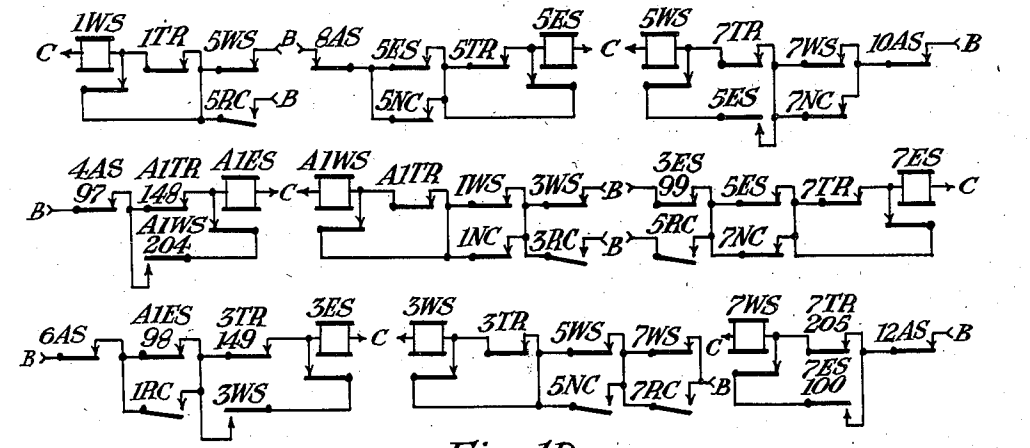


Fig. 1D.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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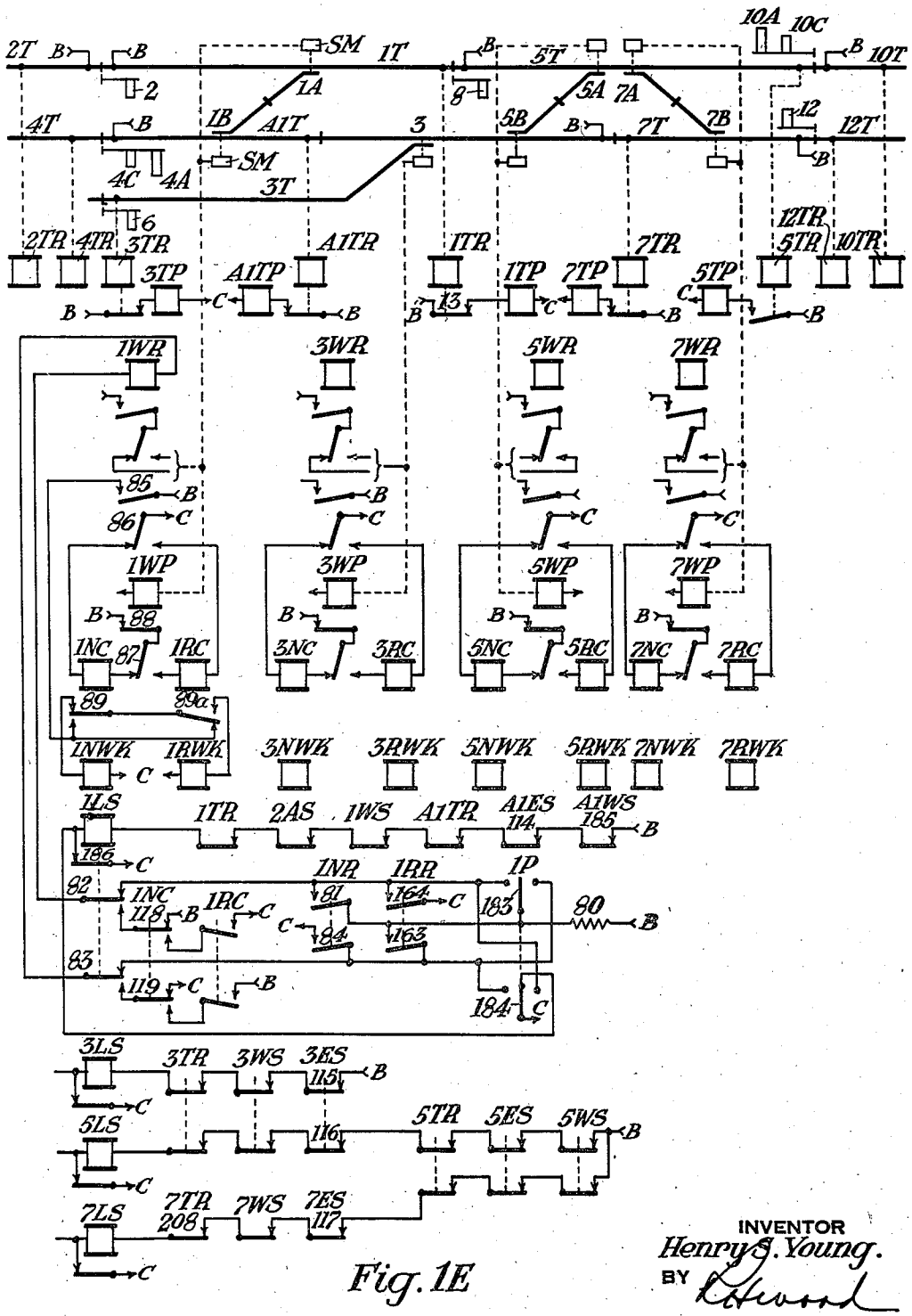


Fig. 1E

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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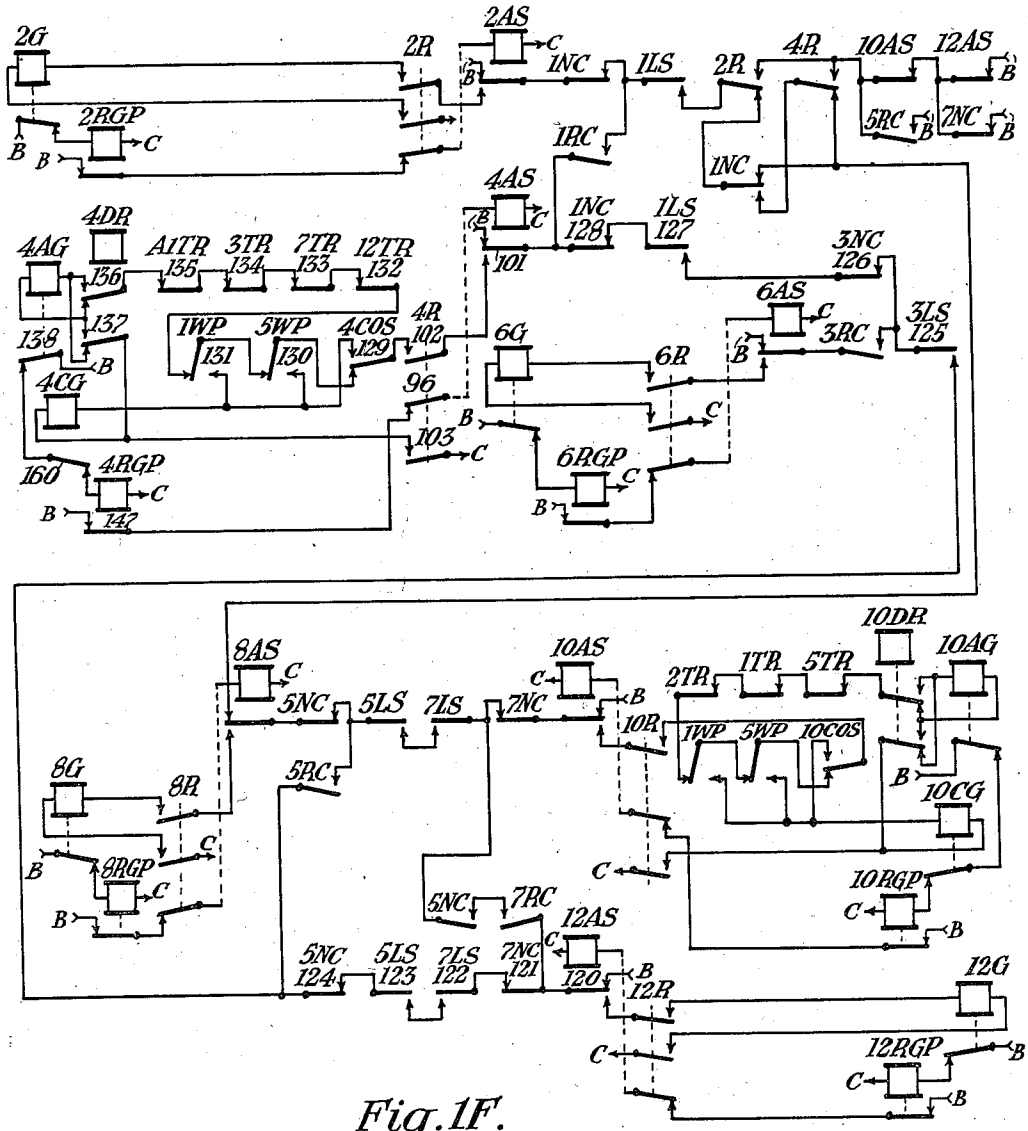


Fig. 1F.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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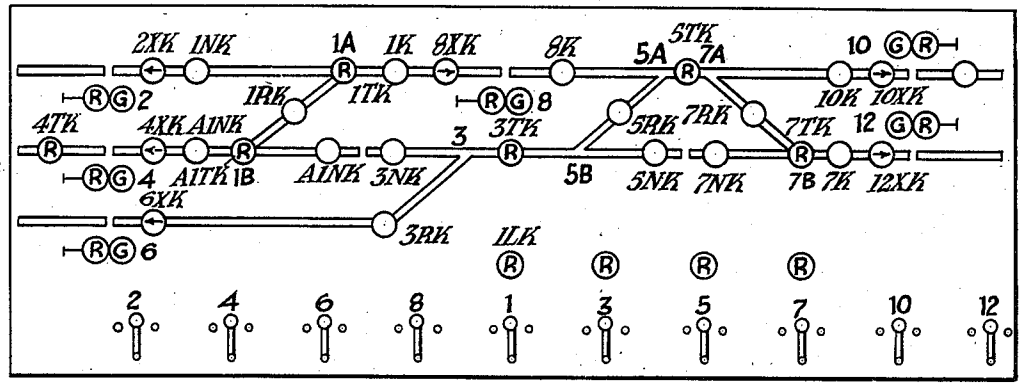


Fig. 1G.

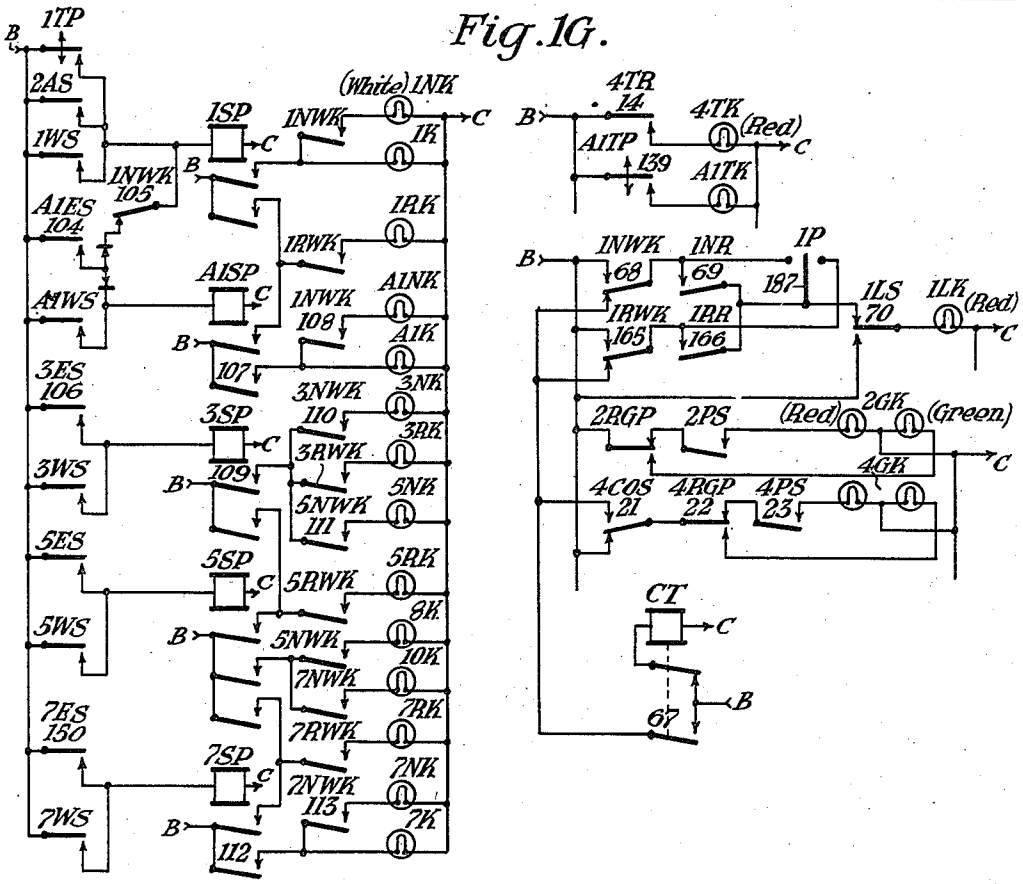


Fig. 1H.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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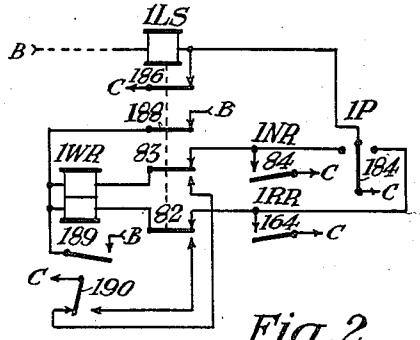


Fig. 2.

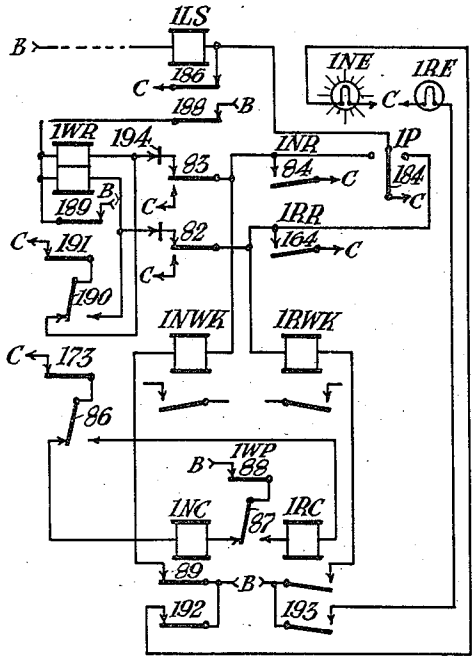


Fig. 3.

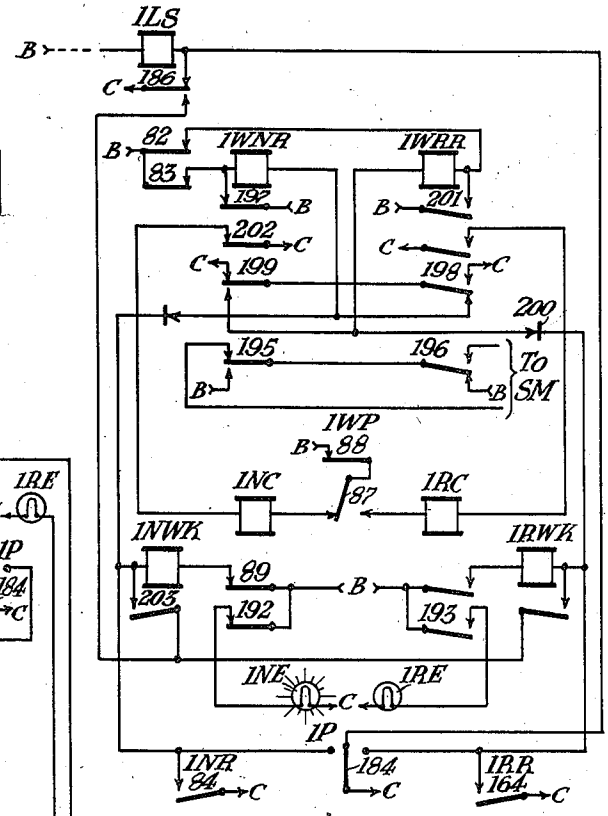


Fig. 4.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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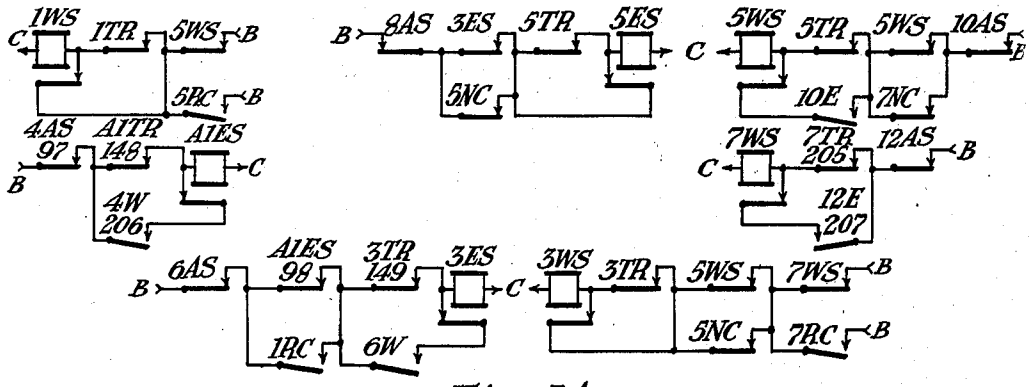


Fig. 5A.

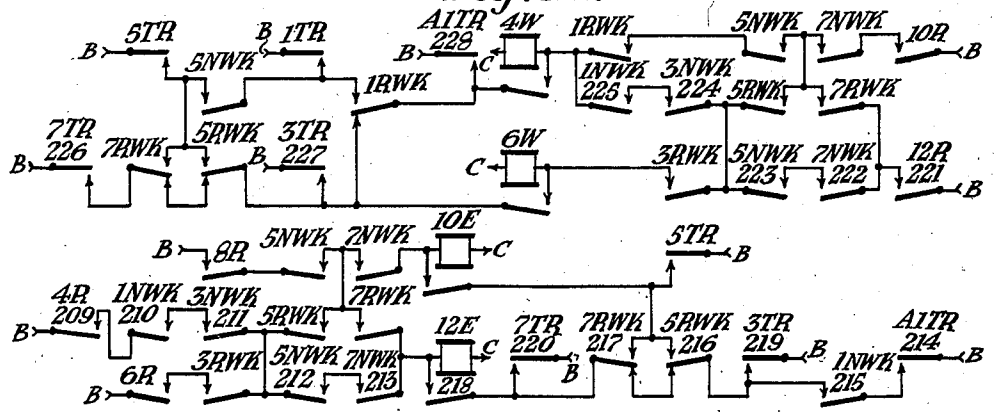


Fig. 5B.

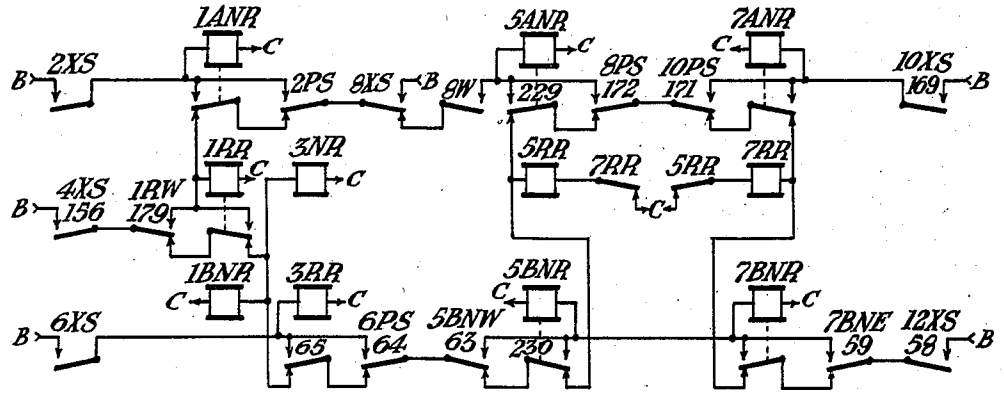


Fig. 6.

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UNITED STATES PATENT OFFICE

2,300,272

RAILWAY TRAFFIC CONTROLLING APPARATUS

Henry S. Young, Wilkinsburg, Pa., assignor to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

Application December 23, 1939, Serial No. 310,798

28 Claims. (Cl. 246—134)

My invention relates to railway traffic controlling apparatus, and more particularly to an interlocking control system 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.

The system of my invention is of the route interlocking type, in which the switches and signals for the different traffic routes are governed by momentarily closing two contacts controlled by levers associated with the entering and leaving ends, respectively, of the route which it is desired to establish, and in which the levers are free to be operated at any time and the interlocking is effected electrically by the provision of suitable circuits. One feature of my invention resides in the provision of an improved arrangement of route selecting circuits for a system of this character employing a lesser number of relays and relay contacts than heretofore. Other features of my invention comprise the interlocking of the route selecting circuits by means of indication relays controlled by the track switches and the associated locking relays in such a manner as to prevent any route from being set up which conflicts with another route which is occupied by a train, and in the provision of improved section locking circuits which function in such manner that all of the switches of a route become locked when a train enters a route from either end irrespective of whether a signal has been cleared to permit such movement or not. Still 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 for Letters Patent of the United States, Serial No. 14,868 for Interlocking control apparatus, filed April 5, 1935, by Earl M. Allen and Howard A. Thompson now Patent No. 2,237,804, issued April 8, 1941; Serial No. 118,609, for Railway traffic controlling apparatus, filed December 31, 1936, by John M. Pelikan, now Patent No. 2,244,401, issued June 3, 1941; and Serial No. 252,803, filed January 25, 1939, by Lloyd V. Lewis, for Railway traffic controlling apparatus.

I shall describe one form of apparatus embodying my invention and several modifications thereof, and shall then point out the novel features of my invention in claims.

Referring to the accompanying drawings, Figs. 1A to 1H, inclusive, taken together illustrate the circuits for a route interlocking system embodying my invention. More particularly, Fig. 1A shows the circuits for the route selecting relays controlled directly by the levers of the operator's control panel; Fig. 1B shows a route circuit network controlled by the relays of Fig. 1 for controlling route relays for governing the track switches; Fig. 1C shows a signal control circuit network for controlling relays for governing the signals; Fig. 1D shows section locking relays for electrically locking the switches of a route; Fig. 1E shows the track plan and the switch control and locking circuits; Fig. 1F shows the signal circuits; Fig. 1G shows the operator's control panel, and Fig. 1H shows the circuits for the indication lamps of the panel. Figs. 2, 3 and 4 illustrate various alternative forms of switch control circuits which may be used in the system of my invention in place of the switch control circuits of Fig. 1E; Fig. 5A shows an alternative arrangement for the section locking relays which may be used in place of the relays of Fig. 1D; Fig. 5B shows a group of direction selecting relays employed when the section locking relays of Fig. 5A are used, while Fig. 6 shows an alternative arrangement of circuit network for the route relays which may be used in place of Fig. 1B.

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

In order to simplify the description, I shall first explain the function of the several parts of the system of my invention illustrated in Figs. 1A to 1H, inclusive, and shall then describe its operation in detail after which I shall explain the operation of the apparatus of Figs. 2, 3 and 4, 5A and 5B, and Fig. 6.

Referring first to Fig. 1E, the diagram at the top of the sheet represents a plan of the track layout chosen to illustrate my invention in which, for simplicity, each pair of track rails representing a stretch of track is represented as a single line. While a specific track layout is disclosed, it is to be understood that the apparatus of my invention is adapted to control any track layout encountered in practice including layouts that may involve entirely different combinations of switches and signals. The layout shown has been chosen to illustrate the principles of my invention in a simple manner and represents two parallel tracks connected by crossovers comprising the pairs of associated track switches identified by the reference characters 1A and 1B, 5A and 5B and 7A and 7B, respectively, the lower main track being also connected to a siding by a single switch 3. All of the track switches are in their normal positions, as shown. Train move-

ments over the various traffic routes through the track layout are governed by the signals 2, 4, 6, 8, 10 and 12, which signals are normally at stop, as shown. Signals 4 and 10 are two arm signals each having a main arm such as 4A for governing high speed train movements over the main track in the normal direction and also having a slow speed arm such as 4C which governs train movements over diverging routes and also serves as a "call-on" signal which may be cleared to admit a train to an occupied block. The remaining signals are all slow speed signals.

As indicated conventionally on the track plan, the rails are divided into track sections by insulated joints, the upper track including the detector sections 1T and 5T, an approach section 10T and an advance section 2T, while the lower track includes the detector sections A1T, 3T and 7T, an approach section 4T and an advance section 12T. Each track section is provided with the usual track circuit having a source of current connected across the track rails at one end as indicated conventionally by the reference character B, and a track relay TR connected across the rails at the other end.

The operator's control panel, shown in Fig. 1G, includes a track diagram which is a miniature representation of the track layout to be controlled. In order to enable large track layouts to be more conveniently controlled from a single operator's position, it is advantageous to provide as compact an arrangement as possible and to this end the linear light units as used heretofore, as in the disclosure of the above-mentioned Pelikan patent, for example, have been replaced by lamp units K of smaller dimensions, the present arrangement being an improvement upon that disclosed in my Patent No. 2,179,462, issued November 7, 1939. These units, for example, may be of the telephone lamp type such as is shown in the Lewis Patent No. 1,897,668, issued February 14, 1933, for Lamp receptacles. The indicators K include a signal indicator GK having red and green lamps for each route entrance, a white exit lamp XK bearing an arrow designation for each route exit, and a red lamp TK for each detector or approach section which is lighted when the corresponding track section is occupied by a train. The remaining indicators K on the diagram are white route lamps which are lighted in different combinations to represent the various traffic routes. When each route is established by the operator, a corresponding series of route lamps becomes lighted, and these lamps then remain lighted as long as the track switches of the route remain locked even though the route set up is cancelled manually by the operator or automatically by a train entering the route. To conserve space, the entrance-exit route levers for the ends of the routes, which heretofore in systems of this character have been located on the diagram, have been mounted in a row below the track diagram, as shown, each lever being identified on the panel by the number of the signal at the corresponding route entrance, and on the circuit plans by the reference character F with an identifying numerical prefix. The row of levers also includes a group of switch levers numbered 1, 3, 5 and 7 for controlling the corresponding track switches individually and independently of the route control, each switch lever being provided with an indicator LK located directly above the lever. Each of the control levers P is of the three-position type and may be moved to the left or right from the center position which it normally occupies, suitable levers being shown, for example, in the Lewis Patent No. 1,887,273, issued November 8, 1932, for Circuit Controllers. The route levers preferably are biased by centering springs in a well-known manner so as to return automatically to their center positions when released.

In the circuit plans shown herein, each relay is identified by a letter or combination of letters prefixed by the designation of the switch or signal with which it is associated, and in order to enable the circuits to be more readily understood, they are arranged in the written circuit form with similar circuits grouped together in the same view, and each contact is identified by a number and by showing the designation of the relay which operates it above the contact. Furthermore, instead of showing the local source of current for energizing the relays, I have shown only the terminals which are designated by the reference characters B and C referring to the positive or supply terminal and to the negative or common return terminal, respectively, of the local source of current. For example, in Fig. 1E, each detector or switch section track relay TR is provided with a slow pick-up slow release track repeater relay TP, the circuit for relay 1TP, for example, being normally closed from one terminal B of the local source over contact 13 of relay 1TR through the winding of relay 1TP to the other terminal C of the source.

Each track switch of the layout is actuated by a power operated switch machine SM, as illustrated for the crossover switches 1A and 1B. The switch machines may be of the type shown in the Zabel Patents Nos. 1,293,290 and 1,413,820, having a reversible motor controlled by a polarized switch control relay WR, as indicated diagrammatically by dotted line connections in the drawing. It is to be understood that each switch or pair of switches will be operated to normal, as shown, or to reverse, when the corresponding control relay WR is energized and its polar contacts are closed to the left or right, respectively.

Each switch machine is provided with the usual indication circuit controller as disclosed in the Zabel patents hereinbefore referred to, governing circuits for controlling a polarized switch indication relay such as the relay 1WP which is energized with its polar contacts closed to the left or right only when the corresponding switches are locked normal or reverse, respectively.

Each switch indication relay WP in Fig. 1E controls a pair of switch correspondence relays such as the relays 1NC and 1RC, each of which is energized only when the corresponding polarized relay WP is energized in a position corresponding to that of the associated switch control relay WR, as will be readily apparent from the drawings.

The correspondence relays NC and RC control the signal network circuits of Fig. 1F, and control the selection of the section locking relays of Fig. 1D in such a manner as to provide a series of relays for each direction for each route which becomes deenergized to lock the switches of a route when the route becomes established for a traffic movement in the corresponding direction.

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 over a signal network of interconnected circuits in the

manner shown in Fig. 1F. 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 stick relay AS of corresponding number such as the relay 4AS of Fig. 1F and also controls the lamps of the associated signal indicator GK of Fig. 1H.

Each slow speed signal is arranged to indicate either clear or stop. A "distant" relay 4DR or 10DR, Fig. 1F, controlled by the next signal in advance, not shown, controls the polarity of the current supplied to the mechanism G for each high speed signal 4A or 10A, to provide a third or caution indication. The circuits for relays DR are omitted since they form no part of the present invention and suitable circuits are well-known.

The circuits are so arranged that the signal at the entrance to a route will clear automatically as soon as all switches for the route are locked in the required positions. This is accomplished through the medium of the signal control relays R shown in Fig. 1C. In case the high speed signal 4A or 10A fails to clear when the corresponding route has been set up, the call-on signal 4C or 10C may then be cleared manually by re-operating the lever for the entrance end of the route to pick up a call-on stick relay, such as the relay 4COS or 10COS shown in Fig. 1A.

Each signal control relay R also controls the approach locking relay AS for the associated signal in the manner indicated diagrammatically in Fig. 1F. To simplify the drawings, the circuits for the approach locking stick relays AS are not shown in detail further than to indicate by dotted line connections that each relay AS is energized only when both the signal control relay R and the mechanism G for the corresponding signal are deenergized. The circuits for the approach locking relays may be arranged as disclosed in the Allen and Thompson application, or in my patent, hereinbefore referred to, to provide the usual time and approach locking of the switches and of opposing signals so that when a signal assumes the stop position, the energization of the associated relay AS is delayed for a predetermined time interval provided the signal is put to stop manually, this delay being nullified by the release of the corresponding track relay when the signal is automatically put to stop by a passing train. The approach locking relays AS control the section locking relays ES and WS by means of the circuits of Fig. 1D, which relays provide directional control of the switch locking and function in a well-known manner so that when a train enters a route, the locking of each switch ahead of the train will be maintained while the locking of each switch in the rear of the train will be released as soon as the corresponding track section is vacated. This is accomplished by arranging the circuits so that when a signal is cleared, a series of relays ES or WS selected by the switch correspondence relays NC and RC, and 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. 1E, which relays in turn govern the circuits for the switch control relays WR in such a manner that when a signal control relay R becomes energized to clear the signal for a route, the pick-up circuit for the control relay WR for each switch of the route is opened, but each relay WR is held energized by the relay NC or RC for the switch it controls to electrically lock the switch in the position it then occupies until the corresponding section of the route is vacated. The switch locking relays LS also control the circuits of the signal mechanisms G of Fig. 1F in such a manner that the clearing of a signal in response to the operation of its control relay R is made dependent upon the locking of each switch of the corresponding route, while the relays AS also control the signal circuits of Fig. 1F and the route selecting circuits of Fig. 1A to provide time and approach locking for opposing signals.

In order to simplify the construction, the relays employed in the system herein disclosed are arranged in two groups. 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 route lever operation, and such indication repeating relays as are required for the control of the route circuits and of the indication lamps associated with the operator's control panel. These relays are preferably small quick acting relays of a type such as that shown in the Lewis 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.

The indication repeating relays referred to include a switch indication relay for each position of each switch or crossover, such as the relays INWK and IRWK of Fig. 1E which relays, as will be clear from the drawing, are normally deenergized repeaters of the correspondence relays INC and IRC, respectively, and also include the indication relays SP of Fig. 1H, there being one 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 as shown in Fig. 1H.

The selection of a desired route by the operation of the apparatus of my invention is effected in two stages, the first of which is initiated by momentarily rotating the button P identifying the entrance end of the desired route, in a direction corresponding with the desired direction of traffic movement, and is completed by the resulting energization of a selecting circuit, or a series of tandem-connected selector circuits, for each available route having the same entrance as the desired route, whereupon an exit indicator for each of these routes becomes lighted on the track diagram to inform the operator which exits are available.

These route selecting circuits are shown in Fig. 1A, the circuits for each direction being combined in circuit networks similar in form to the track layout, with movable contacts at the points corresponding to the locations of the track switches which are operated upon the energization of any selecting circuit to isolate that circuit from those for routes having different entrance ends.

The route selecting apparatus controlled directly by the route levers P as shown in Fig. 1A

includes a route selecting or entrance stick relay PS for each route entrance and an exit relay XS for each route exit. The exit relays for the two directions are controlled over the separate networks referred to, by the entrance relays PS, and govern the route relays of Fig. 1B. The circuits of Fig. 1A include certain additional route selecting relays identified by the suffix E when associated with circuits for traffic movements from left to right, and by the reference W when associated with traffic movements from right to left. One such selecting relay is required for each switch which forms the junction of converging routes provided the switch is located in a section which is not adjacent the entrance end of a route, examples being the relays 7BNE, 1RW and 5BNW of Fig. 1A. These relays are repeaters of the entrance relays and are not required for the entering sections because then the entrance relay itself in a corresponding situation serves as a route selecting relay to select one or the other of the two converging routes, examples being the relays 2PS, 6PS, 8PS and 12PS, whereas the relays 4PS and 10PS, being associated with the common entrance end of diverging routes, function differently. An intermediate signal such as signal 8 requires a pair of direction selecting relays, such as the relays 8E and 8W.

The second stage of the route selection is initiated by the momentary rotation, in a direction corresponding with the desired direction of traffic movement, of the button P for the exit end of a route, to energize the exit relay XS for the desired route, which relay in turn completes a route circuit in Fig. 1B or Fig. 6 to energize a route relay NR or RR for each switch of the desired route.

These route circuits, like the route selecting circuits of Fig. 1A, are combined in a circuit network corresponding with the track layout, but differ in that they are non-directional, that is, the route relays NR and RR are connected to the route circuits in parallel, and each route circuit is arranged to be energized in response to the operation of the exit relay XS at either end. The energization of the route relays for a route opens contacts in the circuits of Fig. 1A and Fig. 1B or 6 which fully isolates the circuits for the selected route from the corresponding circuits for conflicting routes.

This completes the selection of the desired route, which then becomes established automatically due to the operation of the switch control relays WR of Fig. 1E, hereinbefore referred to, by the route relays NR and RR. When the track switches assume the required positions the proper signal control relay R, Fig. 1C, becomes energized to lock the switches in the required position, to clear the signal at the entrance to the selected route, and to indicate the route by lighting a corresponding series of lamps on the track diagram.

The established route may be cancelled manually by operating the entrance relay momentarily in a direction opposite to that corresponding to the established traffic direction, otherwise it will be cancelled automatically when a train enters the first track section. In either case, the route selecting circuits of Fig. 1A for each section of the route are maintained isolated until the switch locking for such section becomes released, this being accomplished in a novel manner through the medium of the switch indication relays NWK and RWK.

I shall now describe the operation of the apparatus of Figs. 1A to 1H, inclusive, 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 the approach section 4T, Fig. 1E, the release of track relay 4TR closes back contact 14, Fig. 1H, to complete the circuit for the red lamp of the approach indicator 4TK, this indicator becoming lighted to inform the operator of the approach of the train.

Normally, all the indication lamps are dark and each route lever P is free to be operated to the left or to the right to mark the entrance or exit to a route.

To set up route 4—12, the operator will first move lever 4P momentarily to the right to pick up relay 4PS. The pick-up circuit for relay 4PS may be traced in Fig. 1A from terminal B, front contact 15 of track relay A1TR, right-hand contact 16 of lever 4P, back contact 17 of route relay 1NR, relay 4PS, back contact 18 of the associated exit relay 4XS to terminal C. Relay 4PS upon becoming energized completes at its front contact 19 a stick circuit which extends to terminal B at contact 15 of relay A1TR over the normally closed contact 20 of lever 4P, and in Fig. 1H, relay 4PS completes an indication circuit from terminal B, back contact 21 of relay 4COS, front contacts 22 and 23 of relays 4RGP and 4PS through the red lamp of indicator 4GK to terminal C, thereby indicating that point 4 on the track diagram is an entrance point. Relay 4PS by closing its front contact 24, Fig. 1A, completes circuits for relays 8E and 7BNE and for the lamps for the exit indicators 8XK, 10XK and 12XK, thereby indicating each available exit on the track diagram, and also prepares circuits for relays 8XS, 10XS and 12XS.

The circuit for relay 8E corresponds to route 4—8 and extends from terminal B, contact 24 of relay 4PS, back contacts 25, 26, 27 and 28 of relays 1NR, 1NWK, 2PS and 8XS, relay 8E, front contacts 29 and 30 of the approach locking relays 12AS and 10AS for the opposing signals 12 and 10 to terminal C. Relay 8E by closing contact 31 causes lamp 8XK to be lighted and at contact 32, relay 8E connects relay 8XS in place of relay 8PS to contact 33 of lever 8P.

Lever 8P is now conditioned to function as an exit lever and if moved to the right momentarily, relay 8XS is picked up to be held subsequently over its stick circuit including its own front contact 28 and contact 24 of relay 4PS. As long as lever 8P is held reversed, relay 8E is held energized over its stick circuit including contacts 34 and 35, but when lever 8P is restored to normal, relay 8E releases to reestablish lever 8P as an entrance lever and lamp 8XK remains lighted, being energized over contact 36 of relay 8XS after relay 8E releases. However, in the present instance, it is to be understood that lever 8P is not operated.

The circuit for lamp 10XK corresponds to route 4—10 via 5 reversed and extends from terminal B, contact 24 of relay 4PS, back contacts 37 to 46, inclusive, of various relays as designated on the drawing, lamp 10XK, front contact 47 of relay 10AS to terminal C.

Lever 10P is therefore conditioned to function as an exit lever and if moved to the right momentarily, completes at contact 48 a branch of the circuit for lamp 10XK comprising a pick-up circuit for relay 10XS, and relay 10XS upon be-

coming energized completes its stick circuit at contact 49. However, in the present instance, it is to be understood that lever 10P is not to be operated.

The circuit for relay 7BNE corresponds to the main line route 4—12, and extends from terminal B, contact 24 of relay 4PS, back contacts 37 to 41, inclusive, and thence over back contacts 50 to 53, inclusive, of the relays designated on the drawings through relay 7BNE to terminal C. Relay 7BNE picks up and completes a circuit from terminal B at its front contact 54 through lamp 12XK, contact 55 of relay 12AS to terminal C, thereby lighting the exit lamp 12XK and conditioning lever 12P to function as an exit lever. The operator therefore has a choice of three exit points and it will be assumed that he now completes the selection of the desired route 4—12 by moving lever 12P momentarily to the right, completing the pick-up circuit for relay 12XS at contact 56. Relay 12XS picks up and completes its stick circuit at contact 57 and is held energized in multiple with lamp 12XK over contact 24 of relay 4PS.

Relay 12XS upon picking up, completes in Fig. 1B a branched route circuit for energizing a route relay for each switch of the selected route. The selected route circuit extends from terminal B over contact 58 of relay 12XS, front contact 59 of relay 7BNE, and from this point one branch extends through rectifier 60, relay 7NR to terminal C and another through rectifier 61, relay 5NR to terminal C so that relays 7NR and 5NR are energized. When relay 5NR picks up, the route circuit is extended from contact 59 over front contact 62 of relay 5NR, and back contacts 63, 64 and 65 of relays 5BNW, 6PS and 3RR, and from back contact 65 one branch extends through relay 3NR to terminal C and another branch through rectifier 66 and relay 1NR to terminal C so that relays 3NR and 1NR are also energized.

When relay 1NR picks up, it completes, in Fig. 1H, a circuit from terminal B, contact 67 of a flasher or interrupter relay CT, back contact 68 of relay 1NWK, front contact 69 of relay 1NR, front contact 70 of relay 1LS through the red lamp of indicator 1LK to terminal C causing the indicator 1LK above lever 1P on the control panel to display a flashing indication. It is to be understood that each of the remaining indicators LK is provided with circuits, not shown, which are similar to those for indicator 1LK, and it follows that in the present case each displays a flashing indication, because each of the route relays NR is energized.

Referring now to Fig. 1A, it will be seen that the route relays controlled by relay 12XS open the selecting circuits for each of the diverging routes having the common entrance point 4 except that for the selected route 4—12. Thus relay 5NR opens its back contact 42 in the selecting circuit for route 4—10 via 5 reversed, thereby extinguishing lamp 10XK, and relay 1NR opens its back contact 25 in the selecting circuit for route 4—8, thereby releasing relay 8E and extinguishing lamp 8XK. The route relays also prevent closing the selecting circuits for any of the converging routes having the exit point 12 except the selected route 4—12. Thus relay 3NR opens the circuit for relay 6PS which controls the selecting circuits for the conflicting route 6—12 and for the cross route 6—10, at its back contact 71. The selecting circuit for route 8—12, which extends from terminal B at front contact 72 of relay 8PS to relay 12XS, is now open at back contact 73 of relay 7NR as well as at back contact 54 of relay 7BNE. In the selecting circuit network for the opposite direction, the circuit for the opposing route 12—4 which extends from contact 78 of relay 12PS to relay 4XS is isolated from the others by the open back contacts 74, 75, 76 and 77 of relays 1NR, 3NR, 5NR and 7NR and is held open at front contact 78 of relay 12PS, this relay being held deenergized because its circuit includes back contact 79 of relay 12XS which contact is now open. Similarly, in Fig. 1B, it will be readily seen that the circuits for the route relays 1RR, 3RR, 5RR and 7RR are each held open at one or more points. The selector and route relays for route 4—12 are therefore electrically isolated from the relays for all conflicting routes.

Referring now to Fig. 1E, it will be seen that relay 1NR upon becoming energized completes the normal operating circuit for the switch control relay 1WR which extends from terminal B, resistor 80, front contacts 81 and 82 of relays 1NR and 1LS, relay 1WR, contacts 83 and 84 of relays 1LS and 1NR to terminal C. Relay 1WR picks up in its normal direction, but since route 4—12 requires all track switches to occupy their normal positions, no switch operations are required in the present case and each of the polarized indication relays such as relay 1WP as well as each of the switch control relays WR already occupies its normal position, as shown, and consequently each of the normal correspondence relays NC is energized over a circuit similar to that for relay 1NC which circuit extends from terminal B, front contact 88 and normal polar contact 87 of relay 1WP, relay 1NC, normal polar contact 86 of relay 1WR to terminal C. It follows that when relay 1WR picks up, relay 1NWK becomes energized over the circuit from terminal B over front contact 85 of relay 1WR, back contact 89*a* of relay 1RC and front contact 89 of relay 1NC through relay 1NWK to terminal C. Each of the remaining relays WR functions similarly and therefore the normal indication repeating relay NWK for each switch of route 4—12 becomes energized, and closes a front contact such as contact 68 of relay 1NWK, Fig. 1H, to connect the lamp of the corresponding indicator 1LK directly to terminal B, so that each of the indicators LK now becomes steadily lighted.

Referring now to Fig. 1C, when the relays NWK for all the track switches of route 4—12 become energized, indicating that the route is fully established, a circuit is completed for the signal control relay 4R from terminal B, front contact 90 of relay 12XS, contacts 91 to 94 of the relays NWK, back contact 95 of relay 4XS, relay 4R to terminal C. Relay 4R therefore picks up with the result that its back contact 96, Fig. 1F, in the circuit for relay 4AS is opened. Relay 4AS consequently releases and opens its contact 97, Fig. 1D, to release the section locking relay A1ES. Relay A1ES in turn opens contact 98 to release relay 3ES, and relay 3ES upon releasing opens contact 99 in the circuit for relay 7ES. Relay 7ES upon releasing closes back contact 100 to complete the stick circuit for relay 7WS to prevent the release of relay 7WS when section 7T becomes occupied subsequently by the train moving from left to right over route 4—12, contact 100 being for a purpose described hereinafter in connection with Figs. 5A and 5B. Relay 4AS by closing back contact 101, Fig. 1F, prepares a circuit over front contacts 102 and

103 of relay 4R for the signal mechanism 4AG.

Referring now to Fig. 1H, it will be seen that relay A1ES upon releasing completes at contact 104 a circuit for relay A1SP. Contact 104 also connects terminal B to the circuit for relay 1SP, but that relay does not pick up because back contact 105 of relay 1NWK is now open. Relays 3ES and 7ES upon releasing complete the circuits for relays 3SP and 7SP at their back contacts 106 and 150, Fig. 1H. Relay A1SP picks up and at contact 107 completes circuits for indicators A1K and A1NK, the circuit for the latter including the closed contact 108 of relay 1NWK. Relay 3SP picks up and at contact 109 completes circuits for indicators 3NK and 5NK over contacts 110 and 111 of relays 3NWK and 5NWK, respectively. Relay 7SP picks up and at contact 112 completes circuits for indicators 7NK and 7K, the circuit for indicator 7NK also including contact 113 of relay 7NWK, so that now all the white lamps of the row representing route 4—12 on the track diagram are lighted.

At the same time, relay A1ES opens its front contact 114, Fig. 1E, thereby releasing the switch locking relay 1LS which at its back contact 70, Fig. 1H, completes a circuit for maintaining lamp 1LK lighted after the route relay 1NR is released. Similarly, relay 3ES opens its front contacts 115 and 116, Fig. 1E, to release the switch locking relays 3LS and 5LS and relay 7ES opens contact 117 to release relay 7LS. All of the track switches are now locked electrically, the operating circuit by which the relays WR are controlled by the route relays NR and RR being open at the front contacts of the relays LS. However, the switch control relays WR are held energized over holding circuits as long as the switches are locked, as illustrated for relay 1WR in Fig. 1E. The closing of back contacts 82 and 83 of relay 1LS, it will be seen, completes a holding circuit for relay 1WR extending over front contacts 118 and 119 of relay 1NC to hold relay 1WR in its normal position as long as relay 1LS remains released. The closing of other back contacts of the LS relays, namely, the contacts 122, 123, 125 and 127, Figs. 1F, completes the circuit for the signal mechanism 4AG which circuit extends from terminal B, front contacts 120 and 121 of relays 12AS and 7NC, back contacts 122 and 123 of relays 7LS and 5LS, front contact 124 of relay 5NC, back contact 125 of relay 3LS, front contact 126 of relay 3NC, back contact 127 of relay 1LS, front contact 128 of relay 1NC, back contact 101 of relay 4AS, front contact 102 of relay 4R, back contact 129 of relay 4COS, normal polar contacts 130 and 131 of relays 5WP and 1WP, front contacts 132, 133, 134 and 135 of relays 12TR, 7TR, 3TR and A1TR thence over the pole changer contacts 136 and 137 of the line relay 4DR through the winding of mechanism 4AG to terminal C at contact 103 of relay 4R.

Signal 4A now clears and relay 4RGP releases in response to the opening of back contact 138 of mechanism 4AG and at its contact 22, Fig. 1H, relay 4RGP controls the circuits for indicator 4GK to cause the indication displayed thereby to change from red to green.

I shall next assume that the approaching train accepts the cleared signal 4A and enters the first detector section A1T of the route. The track relay A1TR and its slow-acting repeater relay A1TP release successively, relay A1TP by closing its back contact 139, Fig. 1H lighting the red lamp indicator A1TK to indicate that section A1T is occupied. Relay A1TR, by opening contact 15, Fig. 1A, releases relay 4PS, and relay 4PS, by opening contact 24, releases relay 7BNE which relay, in turn, releases relay 12XS, causing indicator 12XK to become dark. Referring now to Fig. 1B it will be seen that the route relay circuits are arranged in a novel manner so that the selected circuit is not interferred with by the release of the entrance relay and of the selector relay 7BNE controlled thereby but remain intact as long as terminal B remains connected to the circuit at the front contact of the exit relay, due to the provision of a connection which is completed over front contact 140 of relay 7NR after relay 7BNE releases and drops its contact 59, and that the route circuit is not opened to release relays 1NR, 3NR, 5NR and 7NR until relay 12XR releases to open contact 58. Heretofore in circuits of this character, it has been necessary either to use front contacts only of the selecting relays, requiring a larger number of such relays, or to employ separate network circuits for the two directions for the route relays.

When the route relays are released, relay 4R, Fig. 1C, is released by the opening of contact 90 of relay 12XS, and from Fig. 1A it will be seen that the selecting circuit for route 4—12 remains isolated and the circuit for selecting any route conflicting with route 4—12 governing traffic movements from left to right cannot be set up at this time because these conflicting circuits include open back contacts such as contacts 26, 141, 43 and 142 of the energized relays NWK in series with the NR relay contacts 25, 71, 42 and 73 hereinbefore referred to. Similarly, the circuits for selecting conflicting routes for governing traffic movements from right to left cannot be set up because they include the open contacts 143 to 146, inclusive, of the NWK relays, which relays are held picked up by the WR relays as long as the switch locking remains effective. This arrangement is an improvement upon the arrangement disclosed in my Patent No. 2,179,462, where the sectional release of the route selecting circuits is provided by including front contacts of the switch indication relays in the circuits and by bridging these contacts by front contacts of the switch locking relays. The present arrangement possesses the advantage not only of requiring fewer contacts, but of simplifying the wiring, since the locking relays are of a different type and are usually located at some distance from the selecting and route relays.

When relay A1TR releases, its contact 135 opens, deenergizing mechanism 4AG which releases to put signal 4A to stop, and then relay 4RGP picks up and by opening its back contact 22, Fig. 1H, restores the entrance indicator 4GK to its normal dark condition. Relay 4RGP also completes a circuit for relay 4AS at contact 147, Fig. 1F. Relay 4AS now picks up in the usual manner and at contact 97, Fig. 1D, prepares a circuit for relay A1ES, which relay, however, remains deenergized as long as section A1T is occupied and consequently the series of lamps representing route 4—12 on the diagram remain lighted. It is to be understood that each of the track indication lamps such as 3TK and 7TK is controlled by the associated track repeater relay as illustrated for lamp A1TK in Fig. 1H, and that lamps 3TK and 7TK become lighted successively as the train passes over route 4—12.

When section A1T is vacated, relay A1TR picks up and at contact 148, Fig. 1D, completes

the circuit for relay A1ES which picks up and closes its contact 114, Fig. 1E, reenergizing relay 1LS. Since relay 1NR has already been released, the opening of back contacts 82 and 83 of relay 1LS releases relay 1WR and consequently relay 1NWK releases. Relay A1ES by opening its back contact 104, Fig. 1H, releases relay A1SP, extinguishing the lamps A1K and A1NK. Relay A1TP also picks up and extinguishes lamp A1TK and relay 1LS by opening its back contact 70 extinguishes lamp 1LK. The locking of switch 1B is in this manner released behind the train as soon as the detector section A1T is vacated so that a conflicting route such as the route 4—8 involving only that section of the occupied route 4—12 now may be set up.

When section 3T is vacated, relay 3TR picks up completing the circuit for relay 3ES, Fig. 1D, at contact 149 and relay 3ES upon becoming energized closes contacts 115 and 116, Fig. 1E, to pick up relays 3LS and 5LS. Relay 3ES also opens contact 106, Fig. 1H, releasing relay 3SP, extinguishing lamps 3NK and 5NK. The locking of switch 3 is released as indicated by the track diagram, permitting a conflicting route such as 4—10, 6—10 or 6—12 to be set up if desired. When section 7T is vacated, relay 7TR closes its front contact in the circuit for relay 7ES and relay 7ES picks up, opening contact 150, Fig. 1H, to release relay 7SP, and closing contact 117, Fig. 1E, to pick up relay 7LS. Indicators 7NK, 7TK and 7K now become dark, thereby completing the restoration of the apparatus to its normal condition.

I shall next assume that with the apparatus in normal condition as shown that levers 4P and 12P are operated momentarily to the left, in the reverse order, button 12P being operated first to set up route 12—4 for a train movement from right to left. In response to the operation of lever 12P to the left, relay 12PS picks up and is held energized over its stick circuit and at contact 78, Fig. 1A, completes circuits for relays 8W and 5BNW, as will be apparent from the drawing. Relay 8W picks up and at contact 151 completes a circuit for indicator 2XK. A branch of this circuit extends over contacts 143 and 74 through relay 1RW, but this branch is open at contact 153 of relay 1PS. Relay 5BNW picks up and at contact 154 completes circuits for indicators 4XK and 6XK. Relay 12PS also completes a circuit not shown, but similar to that for indicator 2GK, Fig. 1H, for lighting the red lamp for indicator 12GK. Since route 12—4 is to be selected, the operator now moves lever 4P momentarily to the left to pick up relay 4XS which is then held energized over its stick circuit including its own front contact 155 by relay 5BNW, which relay in turn is held energized by relay 12PS.

Relay 4XS upon picking up closes contact 156, Fig. 1B, to pick up relays 1NR and 3NR, and a branch of the circuit for these relays is completed over front contact 63 of relay 5BNW to pick up relays 5NR and 7NR. When these relays pick up, indicator 6XK, Fig. 1A, is extinguished by the opening of back contact 75 of relay 3NR and relay 8W released and indicator 2XK extinguished by the opening of back contact 77 of relay 7NR. The remaining operations are similar to those already described, and it will be readily apparent from the drawings that relay 12R, Fig. 1C, will pick up over front contact 95 of relay 4XS as soon as each of the relays NWK pick up, and that relay 12R will release relay 12AS, Fig. 1F. It will also be apparent, from Figs. 1D and 1E that relay 12AS upon releasing will cause the successive release of the section locking relays of the series comprising relays 7WS, 3WS and A1WS to release the switch locking relays 7LS, 5LS, 3LS and 1LS to permit the clearing of signal 12 in a manner similar to that already described in connection with signal 4.

I shall next assume that the operator cancels route 12—4 manually, by moving lever 12P to the right to release relay 12PS and all of the relays controlled thereby. Signal 12 will assume the stop position and relay 12RGP will pick up, but it is to be understood that relay 12AS will remain deenergized for a predetermined time interval to provide the usual "time locking" to prevent the reversal of traffic direction directly in advance of the train approaching signal 12. Under this condition, not only is front contact 120 of relay 12AS, Fig. 1F, held open to prevent the clearing of signal 4A or 4C for route 4—12, but contact 55 of relay 12AS, Fig. 1A, also remains open to prevent the lighting of lamp 12XS or the energization of relay 12XS to set up route 4—12, until the time interval has expired.

Returning now to a consideration of route 4—12, I shall assume that a train governed by signal 4A has entered the route, and that the operator desires to clear the call-on signal 4C to admit a second train to section A1T while that section is still occupied by the first train moving from left to right. A connection to terminal B for picking up relay 4PS becomes available at back contact 15*a* of relay A1TP shortly after relay A1TR is released by the first train entering section A1T and it follows that the cancelled route 4—12 may then be set up again by moving levers 4P and 12P momentarily to the right as previously described. Relay 4R will pick up, but mechanism 4AG, Fig. 1F, will remain deenergized because its circuit is open at contact 135 of relay A1TR, or at contact 134, 133 or 132 if the train has advanced beyond section A1T, and indicator 4GK will continue to display a red light after the route has been fully set up.

To clear signal 4C for route 4—12, the operator will again move lever 4P momentarily to the right after he has picked up relay 4R as above described, the operation of lever 4P in this case completing a pick-up circuit for relay 4COS, Fig. 1A, from terminal B, contact 15*a* of relay A1TP or contact 15 of relay A1TR, contact 16 of lever 4P, front contact 17 of relay 1NR, front contact 157 of relay 4RGP, relay 4COS, contact 158 of relay 4R to terminal C, and relay 4COS will pick up to complete a stick circuit over contact 158, which circuit extends to terminal B over its own contact 159.

Relay 4COS completes a circuit in Fig. 1F for mechanism 4CG which is a branch of the circuit for mechanism 4AG already traced, extending from terminal B at contact 120 of relay 12AS as already described to contact 102 of relay 4R, and thence over front contact 129 of relay 4COS, the winding of mechanism 4CG, contact 103 of relay 4R to terminal C.

Signal 4C now clears, relay 4RGP releasing due to the opening of the back contact 160 of mechanism 4CG.

When relay 4COS picked up, it caused indicator 4CG to display a distinctive flashing red indication by closing its front contact 21, Fig. 1H, which is connected to terminal B over contact 67 of the continuously operating flasher relay

CT. When signal 4C clears, indicator 4GK will display a continuous flashing green indication due to the closing of back contact 22 of relay 4RGP. Since relay 4PS is now energized over back contact 15a of relay AITP, it will not release if the second train enters section AIT before the first train vacates that section. In this case, the operator may cancel the route manually by operating lever 4P momentarily to the left to open the stick circuit for relay 4PS at contact 20.

I shall next assume that with the apparatus in the normal condition, as shown, that the operator moves levers 4P and 8P momentarily to the right in that order to establish route 4—8. The operation of lever 4P energizes relay 4PS which causes relay 8E, Fig. 1A, to pick up, as has already been described. It will be seen that the circuit for relay 8E includes contacts of the approach locking relays associated with the opposing signals 10 and 12, and the circuits are so arranged as to prevent the setting up of route 4—8 or 2—8 when route 10—2, 10—4, 12—2, or route 12—4 via 7 reversed is set up, but not when the non-conflicting route 10—6 is set up. When lever 8P is operated with relay 8E energized, the pick-up circuit for relay 8XS is closed from terminal B at contact 33 of lever 8P over front contact 32 of relay 8E and relay 8XS picks up, establishing its stick circuit at front contact 28, and relay 8E releases due to the opening of contact 35 when lever 8P is restored to normal. Lamp 8XK is now energized over contact 36 or relay 8XS and at contact 161, Fig. 1B, relay 8XS closes the circuit for relay 1RR which picks up to complete the route selection.

Relay 1RR at contact 37, Fig. 1A, opens the circuits for lamps 10XK and 12XK and also opens contact 162 in the circuit for relay 2PS. Relay 1RR closes contacts 163 and 164, Fig. 1E, completing the reverse energizing circuit for relay 1WR which relay reverses and operates the track switches 1A and 1B to reverse, this operation being indicated by the flashing of lamp 1LK, the circuit for which is closed from terminal B over contact 67 of the flasher relay CT, Fig. 1H, back contact 165 of relay 1RWK, front contacts 166 and 70 of relays 1RR and 1LS, lamp 1LK to terminal C, lamp 1LK becoming steadily lighted when the switches complete their movement to reverse to energize relays 1WP, 1RC and 1RWK.

When relay 1RWK picks up, the closing of its contact 167, Fig. 1C, completes a circuit for relay 4R extending to terminal B at contact 168 of relay 8XS and relay 4R picks up, releasing relays 4AS, AIES and 1LS and thereby completing a circuit in Fig. 1F for the signal mechanism 4C.

Referring to Fig. 1H, it will be apparent that relay AIES now completes the circuits for relay 1SP as well as that for relay AISP and that the route indicator lamps AIK, 1RK and 1K are lighted to indicate route 4—8 on the diagram.

I shall next assume that the operator sets up route 8—10 by moving levers 8P and 10P momentarily to the right. It will be seen that lever 8P serves as an entrance lever as long as relay 8E is deenergized, that is, not only when no lever in the rear such as 2P or 4P has been operated, but also following the release of relay 8E after relay 8XS has been energized. Since relay 8E is now deenergized, the closing of contact 33 of lever 8P completes the pick-up circuit for relay 8PS which relay picks up closing front contacts 44 and 72 to energize the exit indicators 10XK and 12XK. The subsequent closing of the right-hand contact 48 of lever 10P causes relay 10XS to become energized.

Referring now to Fig. 1B, it will be seen that a circuit is now closed from terminal B, contact 169 of relay 10XS, rectifier 69a of relay 7NR to terminal C. Relay 7NR therefore picks up and completes a branch circuit from terminal B at contact 169 over front contact 170 of relay 7NR, back contact 171 of relay 10PS, front contact 172 of relay 8PS, rectifier 61a, relay 5NR to terminal C. Relay 5NR picks up and at its back contact 174 disconnects the branch circuit which extends over back contact 172 of relay 8PS through relay 5RR to terminal C. The circuits are arranged so that relay 5RR does not become energized upon the closing of back contact 172 following the release of relay 8PS, but relay 5NR is held energized over its front contact 174 until terminal B is disconnected from the branched route circuits by the opening of contact 169 of relay 10XS. The remaining operations involved in completing the set-up for route 8—10 and the clearing of signal 8 are similar to those already described and a detailed description is believed to be unnecessary.

I shall next assume that the apparatus is in the normal condition as shown and that levers 10P and 4P are moved momentarily to the left in that order. There are two routes 10—4, a preferred route over crossover 1 reversed and a secondary route over 5 reversed, the arrangement being such that the preferred route is selected automatically if available. The operation of lever 10P to the left completes the circuit for relay 10PS at contact 175, Fig. 1A, and relay 10PS picks up and closes contacts 176 and 177 to energize relay 8W and lamp 4XS. Relay 8W closes contact 151, thereby energizing relay 1RW over the circuit extending to terminal C at front contact 153 of relay 10PS, and relay 1RW upon becoming energized, at its back contact 152 opens the circuit for lamp 4XK which extends to terminal B over contact 177 of relay 10PS, but maintains lamp 4XK energized by reason of the connection to terminal B over front contact 152. It will be seen, therefore, that if lever 4P is now moved momentarily to the left to close contact 178, relay 4XS becomes energized over the route circuit for route 10—4 via 1 reversed, and that preference is given to one alternative route over the other when both are available in a very simple manner, as the choice depends merely upon which of the two converging route circuits includes the selecting relay such as 1RW. Relay 4XS when energized completes circuits in Fig. 1B from terminal B over front contacts 156 and 179 of relays 4XS and 1RW for energizing the route relays 1RR, 5NR and 7NR for the preferred route.

The secondary route 10—4 over 5 reversed is selected in case relay 1RW is prevented from picking up, as would be the case if crossover 1 were locked normal due to the persence of a train in route 2—8, for example. In this case, relay 1NWK would be energized and the circuit for relay 1RW in Fig. 1A would be open at back contact 143 of relay 1NWK. The energization of relay 4XS with relay 1RW deenergized results in the energization of the route relays 1NR, 3NR, 5RR and 7NR for the secondary route 10—4, as will be apparent from Fig. 1B.

The apparatus is also arranged so that a secondary route may be selected manually by the operation of one or more of the individual switch levers which define such route. This is accom-

plished by including contacts of the switch levers in the route selecting circuits. Thus, for example, the secondary route 10—4 over 5 reversed may be selected even though the preferred route is available by moving the switch lever 1P to its left-hand or normal operating position to open the circuit for relay 1RW at the lever contact 180.

The "run-around" route 12—4 over crossovers 7 and 1 reversed may be selected instead of the corresponding main line route by moving the switch lever 7P to its right-hand or reverse operating position before operating levers 12P and 4P to the left. If this is done, the lever contact 181 provides a connection to terminal C to permit relay 1RW to be energized by relay 8W when the latter relay is energized by relay 12PS. It will be noted that the circuit for relay 1RW has a direct connection to terminal C over its own front contact 182 which is completed when relay 1RW picks up. This is provided in order to prevent the release of relay 1RW due to the inadvertent movement of lever 7P or 1P after the circuits for a route requiring the energization of that relay have been set up.

The arrangements for operating the track switches individually will be readily apparent from a consideration of Fig. 1E. It will be seen that if lever 1P is moved to the left or right while relay 1LS is energized, a circuit is completed from terminal B, resistor 80, contact 183 of lever P through the winding of relay 1WR, contacts 82 and 83 of relay 1LS and the left-hand or right-hand contact 184 of lever 1P 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 as in my Patent No. 2,179,462 by providing each switch lever 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 185 of relay A1WS over front contacts of the section locking and track relays for sections 1T and A1T through the winding of relay 1LS, center contact 134 of lever 1P to terminal C, and a stick circuit independent of the lever which extends to terminal C over front contact 186 of relay 1LS.

In order to indicate the response of the track switch to the operation of the individual switch lever, normal and reverse contacts of each lever, such as contact 187 of lever 1P, Fig. 1H, are included in the circuit for the corresponding indication lamp 1LK in multiple with the route relay contacts such as contacts 69 and 166. It will be apparent that whenever lever 1P is moved to left or right, lamp 1LK will flash until the switches assume the corresponding position and then will be steadily lighted until the lever is restored to its normal center position.

In the foregoing, I have explained but a few of the many possible operations of the apparatus of Figs. 1A to 1H, inclusive, 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.

It will be noted that the switch control circuits of Fig. 1E are arranged to require but two wires from the tower or control office to each relay WR for the control of the relay. This is of advantage when the relays WR are at a considerable distance from a tower, but when this distance is short or in case the relays WR are grouped with the other relays in the tower, the arrangement of Fig. 2 employing fewer control contacts may be preferred. In Fig. 2, the relay 1WR has two oppositely connected windings and when the normal route relay 1NR is picked up or when lever 1P is moved to the left, or normal control position, the upper or normal winding of relay 1WR is energized from terminal B, contact 188 of relay 1LS, relay 1WR, front contact 83 of relay 1LS, contact 84 of relay 1NR (or left-hand contact 184 of lever 1P) to terminal C. When relay 1LS releases, a normal holding circuit is established from terminal B, contact 189 and the normal winding of relay 1WR, back contact 83 and the normal polar contact 190 of relay 1WR to terminal C. Similarly, when relay 1RR is energized or lever 1P is moved to the right, corresponding reverse pick-up and holding circuits are completed over contact 164 of relay 1RR or the right-hand contact 184 of lever 1P through the lower winding of relay 1WR. It is believed obvious that circuits of Fig. 2 may be readily substituted in the system in place of the corresponding circuits of Fig. 1E.

In Figs. 1E and 2, the switch indication relays NWK and RWK are normally deenergized. It may be preferred to display indications of the positions of the track switches continuously and to maintain the switch control relays energized normally to control suitable indication lamps for that purpose. In that case the arrangement of Fig. 3 or that of Fig. 4 may be used.

Referring to Fig. 3, it will be seen that the pick-up circuits for relay 1WR are generally similar to those of Fig. 2, but that the holding circuit does not include back contacts of relay 1LS and hence is not opened when relay 1LS picks up, and therefore relay 1WR is normally energized. Assuming relay 1WR to occupy its normal position, as shown, if contact 164 of the reverse route relay 1RR is closed, current will flow from terminal B at contact 188 or 189 through the lower or reverse winding of relay 1WR over contacts 82 and 164 to terminal C to neutralize or balance the effect of the current flowing in the holding circuit extending from terminal B at contact 188 or 189 through the upper or normal winding and contacts 190 and 191 of relay 1WR, consequently relay 1WR will release, opening its holding circuit at contact 191, and opening the circuit for relay 1NC at contact 173, whereupon the circuit through the reverse winding of relay 1WR will become effective to energize the relay so as to reverse contacts 86 and 190 and to again close contacts 189, 191 and 173, relay 1RC becoming energized when the switch indication relay 1WP becomes energized in the reverse direction as a result of the movement of the track switch to reverse.

It follows that in Fig. 3, relay 1NC or 1RC, depending upon the position of contact 86, is normally energized and these relays by means of contacts 192 and 193 control the usual normal and reverse switch indication lamps 1NE and 1RE which are preferably mounted on the control panel of Fig. 1G above the associated switch lever. The indication repeating relays 1NWK and 1RWK in Fig. 3, however, are normally deenergized as required for the control of the route selecting circuits in the system of my invention. The circuit for relay 1NWK, for example, in Fig. 3, extends from terminal B over front contact 89 of relay 1NC, relay 1NWK, contact 84 of relay 1NR to terminal C, and therefore closes when

a route is set up requiring switch 1A or 1B to be normal as soon as the switches assume the normal position in response to the energization of relay 1NR, and relay 1NC becomes energized. As soon as the route is fully set up, relay 1LS releases, and a connection to terminal C is closed over back contact 83 of relay 1LS so that relay 1NWK remains energized after relay 1NR releases, until relay 1LS is reenergized, precisely as in Fig. 1E. The rectifier 194 functions in an obvious manner to prevent relay 1NWK from being held energized over contact 191 of relay 1WR. The circuit for relay 1RWK is similar to that for 1NWK and it will be seen that these relays arranged as shown in Fig. 3 may be used for the same purposes as the corresponding relays of Fig. 1E.

Referring now to Fig. 4, it is often preferable to use a pair of interlocked neutral relays in place of a polar switch control relay and this view illustrates one manner by which this may be accomplished. In Fig. 4, relay 1WNR is the normal and relay 1WRR the reverse switch control relay, these relays controlling the switch machines in place of relay 1WR by means of contacts 195 and 196. Relay 1WNR is normally energized, as shown, over a circuit from terminal B, contact 197 and winding of relay 1WNR, back contact 198 of relay 1WRR, front contact 199 of relay 1WNR to terminal C. If the route relay 1RR is picked up or lever 1P is moved to the right, a pick-up circuit for relay 1WRR is closed from terminal B, contact 82 of relay 1LS, relay 1WRR, rectifier 200, contact 164 or 184 to terminal C. Relay 1WRR picks up and at back contact 198 breaks the holding circuit for relay 1WNR, and then relay 1WNR releases and at its back contact 199 establishes a holding circuit for relay 1WRR including its own front contacts 201 and 198. If now relay 1NR picks up or lever 1P is moved to the left, a corresponding pick-up circuit for relay 1WNR is closed over contact 83 of relay 1LS and contact 84 or 184 and relay 1WNR picks up and relay 1WRR releases. Relay 1WNR completes the circuit for relay 1NC at contact 202 and relay 1NC picks up to complete the circuit for relay 1NWK at contact 89 and for the normal indication lamp 1NE at contact 192. When relay 1LS releases, relays 1WNR and 1NC remain energized and a holding circuit is closed from terminal B at contact 89 of relay 1NC, the winding and front contact 203 of relay 1NWK, back contact 186 of relay 1LS to terminal C, over which relay 1NWK is held energized after relay 1NR releases until relay 1LS is reenergized. The circuits for relay 1RWK in Fig. 4 are similar to those for relay 1NWK and it is clear that these relays may be used in place of the corresponding relays of Fig. 1E or Fig. 3.

Another novel feature of my invention is included in one form, in the route locking relay circuits of Fig. 1D, and in an alternative form, in the circuits of Figs. 5A and 5B. This feature of my invention is an improvement upon that disclosed in a United States application, Serial No. 286,668 filed July 26, 1939, by G. L. Caille and A. P. Laze, for a Signalling and interlocking system for traffic routes, which corresponds with an application filed in France on January 14, 1939. Heretofore it has been the practice to release the route locking relays for a route only when the route is established, for example, as hereinbefore explained in connection with the description of setting up route 4—12 in which case the series of relays A1ES, 3ES and 7ES release successively in response to the opening of contact 97 of relay 4AS. In other words, it is the usual practice to arrange these relays so that they do not release unless a route is actually set up and often not unless the signal for a route has actually been cleared, and therefore the protection given by these relays is not available in the event a train passes over a route under other circumstances, as for example, with the apparatus in the normal position, as shown, or in fact, in any case when a train passes a signal which is at stop and its approach locking relay AS not deenergized. This limitation is overcome in accordance with my invention, as illustrated in Fig. 1D, by including in the stick circuits for those section locking relays associated with the entrance ends of routes having more than one track section, such as the relay A1ES or 7WS, a back contact such as the contact 204 or 100 of the other relay A1WS or 7ES for the same section. In the layout shown, this arrangement is required in the circuits for relays A1ES, 3ES, 5WS and 7WS only. It will be seen, therefore, that the stick circuits for these relays are normally open and that the section locking relays A1ES, 3ES and 7ES for route 4—12 are released not only by deenergizing relay 4AS as a result of setting up route 4—12 but also in the event a train moving from left to right passes signal 4 at stop and releases the track relay A1TR. Likewise, if a train enters route 4—12, or rather, route 12—4, from the right, the relays 7WS, 3WS and A1WS are released successively by the opening of contact 205 of relay 7TR unless the switches are already locked due to the release of the ES relays. In either case, the relays LS of Fig. 1E will be released to lock the switches for the unoccupied sections in advance of the train to provide the desired protection against operation of these switches. On the other hand, the added back contacts do not interfere in any way with normal operation, for, as already explained, when a train moving from left to right enters route 4—12, the ES relays will be released, relay 7ES closing at contact 100 the stick circuit for relay 7WS to prevent its release by the opening of contact 205 of relay 7TR, and similarly, for route 12—4, the closing of back contact 204 of relay A1WS prevents the release of relay A1ES due to the opening of contact 148 of relay A1TR by a train moving from right to left.

Figs. 5A and 5B illustrate another way by which these desirable results may be obtained. Fig. 5A differs from Fig. 1D in that front contacts of the auxiliary directional relays E and W of Fig. 5B, such as contacts 206 and 207 of relays 4W and 12E, are used in the stick circuits for the entering section relays of Fig. 5A in place of the back contacts 204 and 100 of relays A1WS and 7ES shown in Fig. 1D. This form of my invention differs further in that two of the relays, namely, relays A1WS and 7ES have been omitted. This is in accordance with the usual practice of omitting the section locking relays for the leaving sections of a route. Considering the train moving from left to right through route 4—12, it will be apparent from Fig. 1E that contact 117 of relay 7ES in the circuit for relay 7LS may be replaced by a contact of relay 3ES to lock switch 7B until the train enters section 7T, and that then switch 7B will be locked by contact 208 of the track relay 7TR. Similarly, contact 185 of relay A1WS in the circuit for re-

lay 1LS may be replaced by a contact of relay 3WS.

Referring now to Fig. 5B, it will be seen that an auxiliary relay E or W is picked up when the signal control relay R for the entrance end of a route becomes energized to release the series of section locking relays for the corresponding direction. Thus considering route 4—12, for example, when relay 4R picks up, a circuit is closed from terminal B, front contact 209 of relay 4R, front contacts 210 to 213, inclusive, of the relays NWK for route 4—12, relay 12E to terminal C. When the train passes signal 4 and enters section A1T, relay 4R releases, but relay 12E is held energized over a stick circuit extending from terminal B, back contact 214 of relay A1TR, front contact 215 of relay 1NWK, back contacts 216 and 217 of relays 5RWK and 7RWK, the front contact 218 and winding of relay 12E to terminal C. As the train advances, additional connections from terminal B to the stick circuit for relay 12E are provided at contacts 219 and 220 of relays 3TR and 7TR to hold relay 12E energized, so that contact 207, Fig. 5A, will be held closed as long as the front contact 205 of relay 7TR in the circuit for relay 7WS is open, to prevent the release of relay 7WS by a train moving from left to right. For the opposite direction, relay 4W has a pick-up circuit extending from terminal B at contact 221 of relay 12R over contacts 222 to 225, inclusive, of the NWK relays through relay 4W to terminal C, and a stick circuit extending to terminal B over each of the back contacts 226, 227 and 228 of relays 7TR, 3TR and A1TR, and contact 206 of relay 4W in Fig. 5A therefore functions so as to prevent the release of relay A1ES due to the opening of contact 143 of relay A1TR by a train moving from right to left. It will be seen, therefore, that the circuits of Figs. 5A and 5B function in the desired manner to lock the track switches in sections in advance of a train irrespective of whether the signal control relay R has been picked up or not.

Heretofore in systems of this character, as illustrated for example by the disclosures of each of the patents and applications hereinbefore referred to, it has been customary to employ two normal route relays for each crossover, one for each of the two parallel routes rendered available when the crossover switches are normal, instead of a single relay such as the relay 5NR of Fig. 1B. While the arrangement of Fig. 1B is to be preferred on account of the saving in relays, the older arrangement of the relays may be preferred under certain conditions and may also be used with the circuits of my invention.

Fig. 6 illustrates one manner by which this may be accomplished. It will be seen that in Fig. 6 the contacts and their connections are substantially identical with those of Fig. 1B except that a pair of relays such as the relays 5ANR and 5BNR replaces each normal crossover relay such as relay 5NR, the rectifiers 61 and 61*a* which in Fig. 1B permit relay 5NR to be energized over either of two independent circuits without interference have been omitted, contacts 229 and 230 of relays 5ANR and 5BNR, respectively, replacing contacts 174 and 62 of relay 5NR. The circuit operation in Fig. 6 is identical with that of Fig. 1B, and a detailed explanation appears unnecessary, likewise the manner in which these relays may be employed in connection with the circuits of Figs. 1A and 1E appears to be self evident.

Although I have herein shown and described only one form of apparatus embodying my invention and five modifications of portions 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 track switches adapted to be arranged to form different routes for traffic movements in two directions, route levers for the ends of said routes each having a normal position and two control positions, an entrance relay for each route entrance and an exit relay for each route exit in said layout, normal and reverse route relays for governing the operation of the track switches to their normal and reverse positions, means for energizing the entrance and exit relays for the two ends of a selected route when the route levers for the ends of said route are successively operated to corresponding positions, a single route circuit network comprising conductors arranged to correspond with the tracks of said layout interconnected by movable contacts located at points corresponding to the locations of the track switches, said network comprising a route circuit for each route controlled by the exit relay for one end or the other dependent upon the traffic direction to be established, means controlled by each entrance relay when energized for operating one or more of said movable contacts as required to isolate the route circuits controlled by such relay from those for conflicting routes having different entrance ends, means comprising the route circuit for a selected route having its entrance and exit relays energized for energizing said route relays as required to establish said route for traffic movements in either direction, and means controlled by said energized route relays for operating certain of said movable contacts as required to isolate said energized route circuit from the circuits for conflicting routes having different exit ends.

2. In an interlocking control system, a track layout including track switches adapted to be arranged to form different routes for governing traffic in two directions, an entrance relay and an exit relay for each route end, manually operable means for successively energizing the entrance and exit relays for the opposite ends of a selected route, normal and reverse route relays for governing the operation of the track switches to their normal and reverse positions, a single route circuit network including a circuit for each route through the layout for energizing selected route relays as required to establish such route for traffic movements in either direction, means governed by the entrance relay for a selected route when energized for isolating the route circuit for such route from the circuits for conflicting routes having the same exit end, means governed by the exit relay for the selected route when energized for energizing the route circuit for such route at one end or the other dependent upon which traffic direction is to be established, to operate the route relays as required to establish the selected route, and means governed by said energized route relays for isolating said energized route circuit from the circuits for all conflicting routes.

3. In an interlocking control system, a track layout including track switches arranged to form different routes for governing traffic in two directions, an entrance relay and an exit relay

and a route lever for each route end, means responsive to the operation of the lever for the entrance end of a route for energizing the corresponding entrance relay, a route selecting network for each direction each including a selecting circuit for each route for the corresponding direction prepared by energizing the entrance relay and completed by energizing the exit relay for such route, said network including contacts so controlled by the entrance relays as to prevent the energization of selecting circuits for routes having portions in common, by more than one entrance relay at a time; means responsive to the operation of the lever for the exit end of a route having its selecting circuit prepared for energizing the exit relay for such route, normal and reverse route relays for governing the operation of the track switches to their normal and reverse positions, a non-directional circuit network including a circuit for each route controlled by the exit relays for the opposite ends of such route for energizing selected route relays as required to establish the route for traffic movements in a direction dependent upon which of the two exit relays associated with opposite directions of traffic movements over such route is energized, and means governed by the energized route relays for isolating the circuits for the selected route from the circuits for all conflicting routes.

4. In an interlocking control system, a track layout including track switches arranged to form different routes for governing traffic in two directions, an entrance relay and an exit relay for each route end, manually operable means for successively energizing the entrance and exit relays for the opposite ends of a selected route, a route selecting circuit network for each direction including a selecting circuit for each route for the corresponding direction, means controlled by each entrance relay when energized for preparing the selecting circuit for each route having the corresponding entrance point, means responsive to the energization of an exit relay for the exit end of a route having its selecting circuit prepared for maintaining such exit relay energized over said prepared circuit under the control of the energized entrance relay, normal and reverse route relays for governing the operation of the track switches to their normal and reverse positions, a non-directional circuit network including a circuit for each route controlled by the entrance and exit relays for the opposite ends of such route irrespective of the traffic direction to be established, each such circuit having a branch including the winding of the normal or reverse route relay for each switch of the corresponding route, and means governed by the energized route relays for isolating the circuits for the selected route from the circuits for all conflicting routes.

5. In an interlocking control system, a track layout including track switches arranged to form different routes for governing traffic in two directions, an entrance relay and an exit relay for each route end, manually operable means for successively energizing the entrance and exit relays for the opposite ends of a selected route, a route selecting circuit for each route for the corresponding direction, means controlled by each entrance relay when energized for preparing the selecting circuit for each route having the corresponding entrance point, means responsive to the energization of an exit relay for the exit end of a route having its selecting circuit prepared for maintaining such exit relay energized over said prepared circuit under the control of the energized entrance relay, normal and reverse route relays for governing the operation of the track switches to their normal and reverse positions, a non-directional route circuit network including a route circuit for each route, means controlled by each entrance relay when energized for preparing the route circuit for each route having the corresponding entrance point, means controlled by each exit relay when energized for energizing the prepared route circuit for the route having the corresponding exit point to energize the route relays as required to establish said route, and means governed by the energized route relays for isolating the selecting circuit and the route circuit for the selected route from the circuits for conflicting routes.

6. In an interlocking control system, a track layout including track switches arranged to form different routes for governing traffic in two directions, an entrance relay and an exit relay for each route end, manually operable means for successively energizing the entrance and exit relays for the opposite ends of a selected route, a route selecting circuit network for each direction including a selecting circuit for each route for the corresponding direction, means controlled by each entrance relay when energized for preparing the selecting circuit for each route having the corresponding entrance point, means responsive to the energization of an exit relay for the exit end of a route having its selecting circuit prepared for maintaining such exit relay energized over said prepared circuit under the control of the energized entrance relay, a plurality of selecting relays controlled by said entrance relays over said selecting circuits, contacts controlled by said entrance relays and said selecting relays effective to prevent the control of any exit relay by more than one entrance relay at a time, normal and reverse route relays for governing the operation of the track switches to their normal and reverse positions, a non-directional circuit network including a route circuit for each route, means controlled by each entrance relay when energized and by the selecting relays controlled by such entrance relay for preparing the route circuit for each route having the corresponding entrance point, means controlled by each exit relay when energized for completing the route circuit for the route having the corresponding exit point, means including the completed route circuit for energizing the route relays as required to establish such route, and means governed by the energized route relays for isolating the selecting circuit and the route circuit for the selected route from the circuit for conflicting routes until the exit relay for such route is released.

7. In an interlocking control system, a track layout including track switches adapted to be arranged to form different traffic routes, route levers for the ends of said routes each having a normal position and two control positions, a pair of stick relays for each route including an entrance relay and an exit relay for each route end, means for energizing the entrance relay at one end and the exit relay for the other end of a route when the two levers for the ends of said route are successively operated to one control position, means or energizing the entrance relay for said other end and the exit relay for said one end of said route when the two levers for the end of said route are successively operated to their other position, a stick circuit for each entrance relay including a back contact of the

exit relay for the same route end, a stick circuit for each exit relay controlled by a front contact of the entrance relay for the other end of the same route, switch control means controlled by the exit relays for a route for operating the track switches as required to establish such route, a signal at each end of each route for governing the movement of traffic over the route, a signal control relay for each route end, a circuit including a front contact of the energized exit relay for a route for energizing the signal control relay for the entrance end of such route when the track switches assume the positions required for such route, and means controlled by each switch control relay when energized for first locking each track switch of the route in the required position and for then clearing the signal at the entrance end of such route.

8. In an interlocking control system, a track layout including track switches adapted to form different routes for governing traffic movements in two directions, an entrance relay and an exit relay for each route end, manually operable means for successively energizing the entrance and exit relays for the opposite ends of a selected route, switch control means controlled by the entrance and exit relays for a route for operating the track switches as required to establish such route, signals at the ends of the routes for governing traffic movements over the route in opposite directions, a signal control relay for each route end, a circuit including a front contact of the energized exit relay for energizing the signal control relay for the entrance end of the corresponding route when each track switch of the route assumes the position required to establish the route, and a signal circuit for clearing the signal at the entrance end of said route including front contacts of said signal control relay and contacts controlled by each track switch of the established route.

9. In an interlocking control system, a track layout including a plurality of track sections containing track switches which may be arranged to form different traffic routes, manually operable devices for selecting said routes, a locking relay for each section energized only when conditions are proper for the operation of the switch in such section, normal and reverse route relays for each switch, means controlled by each route relay for operating the corresponding switch to its normal or reverse position effective only when the locking relay for that switch is energized, normally deenergized normal and reverse indication relays for each switch, means for energizing each such normal or reverse indication relay when the normal or reverse route relay for the same switch is energized and the switch assumes the corresponding normal or reverse position, route selecting circuits for governing the operation of said route relays as required to establish the route selected by the operation of said manually operable devices, means for isolating the route selecting circuits for established routes from those for conflicting routes comprising a back contact of each normal indication relay in a circuit governing the associated reverse route relay, and a back contact of each reverse indication relay in a circuit governing the associated normal route relay, means for releasing the locking relay for each switch of a selected route when such route is established, and means controlled by each such locking relay when released for maintaining energized the normal or reverse indication relay for the associated switch to maintain the corresponding route selecting circuit isolated only until such locking relay is again energized.

10. In an interlocking control system, a track layout including a track switch operable to normal and reverse positions to form different traffic routes, route levers for selecting said routes, normal and reverse route relays for governing the operation of the track switch to said normal and reverse positions, normally deenergized normal and reverse indication relays, means for energizing the normal or reverse indication relay when the normal or reverse route relay is energized and the switch assumes the corresponding normal or reverse position, route selecting circuits controlled by said route levers for governing the operation of said route relays to selectively establish said routes, and means controlled by said indication relays for interlocking said selecting circuits comprising a back contact in each selecting circuit which opens when the indication relay controlled by the route relay for the other selecting circuit is energized.

11. In an interlocking control system, a track layout including a track switch operable to normal and reverse positions to form different traffic routes, route levers for selecting said routes, normal and reverse route relays for governing the operation of the track switch to said normal and reverse positions, normal and reverse indication relays, means for energizing the normal or reverse indication relay when the normal or reverse route relay is energized and the switch assumes the corresponding normal or reverse position, route selecting circuits including selecting relays energized in response to the operation of said route levers for governing said route relays to selectively establish said routes, means for interlocking said selecting circuits comprising back contacts of a route relay and of an indication relay in series in each of said selecting circuits, the contacts in each circuit being controlled by the relays governed by the other circuit, and means for deenergizing said energized route and indication relays to permit one selecting circuit or the other to be energized.

12. In an interlocking control system, a track section including a track switch operable to normal and reverse positions to form different traffic routes, route levers for selecting said routes, a locking relay energized only when said track section is unoccupied and conditions are proper for operating the track switch, normal and reverse route relays each effective when said locking relay is energized to govern the operation of the track switch to a corresponding normal or reverse position, normal and reverse indication relays, means for energizing the normal or reverse indication relay when the normal or reverse route relay is energized and the switch assumes the corresponding normal or reverse position, route selecting circuits controlled by said route levers for governing said route relays to selectively establish said routes, each selecting circuit including in series back contacts of the route relay governed by the other selecting circuit and of the indication relay controlled thereby, and means effective when a route has been established and said locking relay has been released to maintain the energized indication relay picked up until said locking relay is again energized, irrespective of the condition of the corresponding route relay.

13. In an interlocking control system, a track layout including a traffic route having a first portion extending from the entrance end of the lay-

out to an intermediate point and a second portion extending from said intermediate point to the exit end of the layout, route levers for the ends of said route and for said intermediate point, an intermediate entrance relay normally responsive to the operation of the lever for said intermediate point, means responsive to the operation of the lever for said exit end when said entrance relay is energized to establish the second portion of said route, a selector relay and an exit relay associated with said intermediate point, a pick-up circuit for said selector relay including a back contact of said exit relay and closed in response to the operation of the lever at the entrance end of the first portion of said route, means effective when said selector relay is energized to render the lever for said intermediate point effective to control said exit relay in place of said intermediate entrance relay, means controlled by said exit relay when energized to establish the first portion of said route, and a stick circuit for said selector relay including its own front contact and a contact closed when said intermediate lever is reversed, whereby said selector relay is released following the energization of said exit relay only upon the return of said intermediate lever to its normal position.

14. In an interlocking control system, a track section including a track switch operable to normal and reverse positions to form different traffic routes, route levers for selecting said routes, a locking relay energized only when said track section is unoccupied and conditions are proper for operating the track switch, normal and reverse route relays each effective when said locking relay is energized to govern the operation of the track switch to a corresponding normal or reverse position, normal and reverse indication relays, a pick-up circuit for each normal or reverse indication relay including a front contact of the normal or reverse control relay, respectively, and a contact controlled by the track switch which is closed only when the switch assumes the corresponding normal or reverse position, a holding circuit for each indication relay including said switch controlled contact and a back contact of said locking relay, and interlocked route selecting circuits for governing said route relays controlled by said route levers, the circuit for governing each route relay including in series back contacts of the other route relay and of the indication relay associated therewith.

15. In an interlocking control system, a track section including a track switch operable to normal and reverse positions to form different traffic routes, route levers for selecting said routes, a locking relay energized only when said track section is unoccupied and conditions are proper for operating the track switch, switch control means effective only when energized to operate the track switch to its normal and reverse positions, normal and reverse route relays for energizing said switch control means effective only when said locking relay is energized, normal and reverse indication relays, means for energizing each normal or reverse indication relay when the track switch occupies a corresponding normal or reverse position in agreement to the condition of its control means provided said control means is energized, means for maintaining said switch control means energized in its last operated condition when said locking relay is deenergized, and interlocked route selecting circuits controlled by said route levers for governing said route relays, the circuit for governing each route relay including back contacts of the other route relay and of the indication relay associated therewith.

16. In an interlocking control system, a track layout including track switches arranged to form different routes for governing traffic in two directions, route levers for the ends of said routes, a route selecting circuit network for each direction including a route selecting circuit for each route for the corresponding direction each said network including selecting relays energized in response to the operation of certain ones of the route levers for the entrance ends of converging routes, normal and reverse route relays for governing the operation of the track switches to their normal and reverse positions, a single non-directional route circuit network comprising a route circuit for each route selected in response to the operation of said selecting relays for controlling said route relays, means responsive to the operation of the route lever for the exit end of a route having its selecting circuit energized for connecting a source of current to the corresponding end of the route circuit for such route to energize in multiple the route relays for the switches of the selected route as required to establish said route, and means controlled by said energized route relays for isolating the energized route circuit from the route circuits for conflicting routes irrespective of the condition of said selecting relays.

17. In an interlocking control system, a track layout including track switches arranged to form different routes for governing traffic in two directions, a route lever, an entrance relay and an exit relay for each route end, means controlled by each route lever for energizing the associated entrance relay, a route selecting circuit network for each direction comprising a route circuit for each route including a front contact of the entrance relay for one end and the winding of the exit relay for the other end of such route each said network including selecting relays energized in response to the energization of the entrance relays for the entrance ends of certain ones of said routes said selecting relays being effective to isolate the corresponding selecting circuits from those for converging routes, normal and reverse route relays for governing the operation of the track switches to their normal and reverse positions, a non-directional route circuit network comprising a route circuit for each route selected in response to the operation of said selecting relays for controlling said route relays, means responsive to the operation of the route lever for the exit end of a route having its selecting circuit energized for energizing the associated exit relay, means controlled by the exit relay for a selected route when energized for connecting a source of current to the corresponding end of the route circuit for such route to energize in multiple selected route relays to operate the track switches as required to establish such route, and means controlled by said energized route relays for isolating the energized route circuit from the route circuits for conflicting routes irrespective of the condition of said selecting relays.

18. In an interlocking control system, a track layout including parallel tracks connected by pairs of track switches adapted when normal to form parallel traffic routes and when reversed to form crossover routes from one track to the other, route levers for the ends of said routes, a single normal route relay and a single reverse route relay for each said pair of track switches for

governing the operation of the switches to their normal and reverse positions, a route circuit network comprising conductors arranged to correspond with said track layout and including a route circuit for each traffic route through the track layout, each such route circuit having a branch including the winding of each route relay for governing a switch of the corresponding route, selecting means for isolating a particular route circuit from the route circuits for conflicting routes having different entrance ends, means for connecting a source of current to the exit end of said particular route circuit to energize the route relays connected thereto, and means controlled by said route relays for isolating said route circuit from the route circuits for conflicting routes having different exit ends.

19. In combination, a track layout including a plurality of track sections containing track switches adapted to be arranged to form different traffic routes, signals for governing traffic movements over said routes in two directions, a track relay for each section, a section locking relay for each direction for each section, means preventing the operation of each track switch when the track relay or either section locking relay for the corresponding section is deenergized, circuits for said section locking relays arranged to provide two series of normally energized tandem connected relays one series for each direction for each route comprising a pick-up circuit for each relay except the first relay of a series including a front contact of the track relay for the same section and a front contact of the next preceding relay of the same series, a pick-up circuit for the first relay of each series including a front contact of the track relay for the first section of the corresponding route and a contact controlled by the signal governing traffic over such route and closed only when such signal is at stop, a stick circuit for each section locking relay except the first relay of a series including its own front contact and a front contact of the next preceding relay of the same series, and a stick circuit for the first relay of each series including its own front contact, said signal controlled contact and a back contact of the last relay of the series for the opposite direction for the same route.

20. In combination, a track layout including a plurality of track sections containing track switches for arranging different traffic routes, signals for governing traffic movements over said routes in two directions, a track relay for each section, a section locking relay for each direction for each section, means preventing the operation of each track switch when the track relay or either section locking relay for the corresponding section is deenergized, circuits for energizing said section locking relays in accordance with the positions of the track switches to provide two series of normally energized tandem connected relays, one series for each direction for each route, the relays of each such series being energized only when the signal governing traffic over the route in a corresponding direction is at stop, means controlled by the track relays and effective when a signal has been cleared in order to permit a train to enter a route and the corresponding series of relays are deenergized for maintaining each relay of said series deenergized only until the train vacates the corresponding section of the route, and means controlled by the track relay for the first section of each route and effective in the event a train enters such route when the entering signal has not been cleared to automatically deenergize the relays of the corresponding series to prevent the operation of the track switches in the sections of said route in advance of said train.

21. In combination, a track layout including a plurality of track sections containing track switches for arranging different traffic routes, signals for governing traffic movements over said routes in two directions, a track relay for each section, a section locking relay for each direction for each section, means preventing the operation of each track switch when the track relay or either locking relay for the corresponding section is deenergized, circuits for energizing said section locking relays in accordance with the positions of the track switches to provide two series of normally energized tandem connected relays, one series for each direction for each route, the relays of each such series being energized only when the signal governing traffic over the route in a corresponding direction is at stop, a signal control relay for each signal, means effective when each signal control relay is energized to successively deenergize the locking relays for the route and direction governed by the corresponding signal and to clear such signal in response to the release of said locking relays, means effective in the event a train enters the first section of such route with said signal control relay not energized to automatically deenergize the corresponding series of relays, and means controlled by each signal control relay when energized to prevent the release of the series of relays controlled by the opposing signal at the opposite end of the same route when a train governed by the signal cleared in response to the operation of said signal control relay occupies the last section of its route.

22. In combination, a track layout including a plurality of track sections containing track switches for arranging different traffic routes, signals for governing traffic movements over said routes in two directions, a section locking relay for each direction for each section, means preventing the operation of each track switch when either section locking relay for the corresponding section is deenergized, circuits for energizing said section locking relays arranged to provide two series of normally energized tandem connected relays one series for each direction of each route, the relays of each such series being energized only when the signal governing traffic over the route in a corresponding direction is at stop, means effective when a signal has been cleared in order to permit a train to enter a route and the corresponding series of relays are deenergized for maintaining each relay of said series deenergized only until the train vacates the corresponding section of the route, and means automatically effective if a train passes a signal which has not been cleared and enters the route governed by such signal to automatically deenergize the series of locking relays for such route and direction.

23. In combination, a track layout including a plurality of track sections containing track switches for arranging different traffic routes, a track relay for each section, a section locking relay for each direction for each section, means preventing the operation of each track switch when either section locking relay for the corresponding section is deenergized, circuits for selectively energizing said section locking relays

in accordance with the positions of the track switches to provide two series of normally energized tandem connected relays, one series for each direction for each route, means automatically responsive to the release of the track relay for the first section of a route by a train entering such route for successively deenergizing the corresponding series of relays, and manually governed directionally controlled means effective to prevent the release of said series of relays by said track relay when a train moving in the opposite direction enters said first section.

24. In combination, a track layout including a plurality of track sections containing track switches for arranging different traffic routes, a track relay for each section, a section locking relay for each direction for each section, means preventing the operation of each track switch when either section locking relay for the corresponding section is deenergized, circuits for selectively energizing said section locking relays in accordance with the positions of the track switches to provide two series of normally energized tandem connected relays, one series for each direction for each route, means automatically responsive to the release of the track relay for the first section of each route by a train entering such route for successively deenergizing the corresponding series of relays, and means controlled by the last relay of said series when deenergized to prevent the deenergization of the locking relays for the opposite direction for the same route when the track relay of the last section of the route is released by said train.

25. In combination, a track layout including a plurality of track switches, a locking relay for each switch effective when deenergized to prevent operation of the switch, a route lever for each route end at each end of the traffic route, an exit indication lamp and an exit relay for the exit end of each route, a route selecting circuit network for each direction of traffic movement through said track layout each including a circuit for the exit lamp for each route extending in the corresponding direction, means responsive to the operation of the route lever for the common entrance end of a plurality of diverging routes for completing the circuit for the lamp for the exit end of each such route having its track switches in the required positions or unlocked as manifested by the energization of the corresponding locking relays, means responsive to the operation of the route lever for the exit end of a route having its exit lamp energized for energizing the corresponding exit relay in multiple with such lamp, route establishing means controlled by each exit relay when energized for operating the track switches as required to establish the corresponding one of said diverging routes and for extinguishing the exit lamps for the remaining diverging routes.

26. In an interlocking control system, a track layout including track switches adapted to form different routes for governing traffic movements in two directions, an entrance relay and an exit relay for each route end, manually operable means for successively energizing the entrance and exit relays for the opposite ends of a selected route, switch control means controlled by the entrance and exit relays for a route for operating the track switches as required to establish such route, signals at the ends of the routes for governing traffic movements over the route in opposite directions, a signal control relay for each route end, a circuit including a front contact of the energized exit relay for energizing the signal control relay for the entrance end of the corresponding route when each track switch of the route assumes the position required to establish the route, and a signal circuit for clearing the signal at the entrance end of said route including front contacts of said signal control relay and contacts controlled by each facing point track switch of the established route.

27. In an interlocking control system, a track layout including track switches arranged to form different routes for governing traffic in two directions, route levers for the ends of said routes, a route selecting circuit network for each direction including a route selecting circuit for each route for the corresponding direction each said network including selecting relays energized in response to the operation of certain ones of the route levers for the entrance ends of converging routes to define the traffic direction to be established, normal and reverse route relays for governing the operation of the track switches to their normal and reverse positions, a non-directional route circuit network comprising a single route circuit for each route selected in response to the operation of said selecting relays so as to prepare the route relays for the corresponding route for energization when a source of current is connected to the circuit at one end or the other according to the traffic direction defined by the energized selecting relays, means responsive to the operation of the route lever for the exit end of a route having its selecting circuit energized for connecting a source of current to the corresponding end of the prepared route circuit for such route to energize in multiple the route relays for the switches of the selected route as required to establish said route, and means controlled by said energized route relays for isolating the energized route circuit from the route circuits for conflicting routes irrespective of the condition of said selecting relays.

28. In an interlocking control system for a track layout including a through route having a first signal at its entrance end for governing traffic movements over a first portion of the route and a second signal at an intermediate point for governing traffic movements over a second portion of the route, a first and a second entrance relay for controlling said first and second signal respectively, a first and a second manually operable device, a selector relay and an exit relay, pick-up and stick circuits for each entrance relay adapted to be closed in response to the momentary operation of the associated manually operable device, the circuits for the second entrance relay becoming closed only if such operation occurs when the selector relay is in its released position, a pick-up circuit for said selector relay closed in response to the energization of said first entrance stick relay and including a back contact of said exit relay, two circuits closed in response to the operation of said second manually operable device if such operation occurs when said selector relay is picked up, one being a pick-up circuit for said exit relay and the other a stick circuit for holding said selector relay picked up only until such manually operable device is restored to normal, a stick circuit for holding said exit relay picked up until said first entrance relay is released, and means for releasing each entrance relay.

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