June 3, 1941. J. M. PELIKAN 2,244,401

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Dec. 31, 1936 6 Sheets-Sheet 1

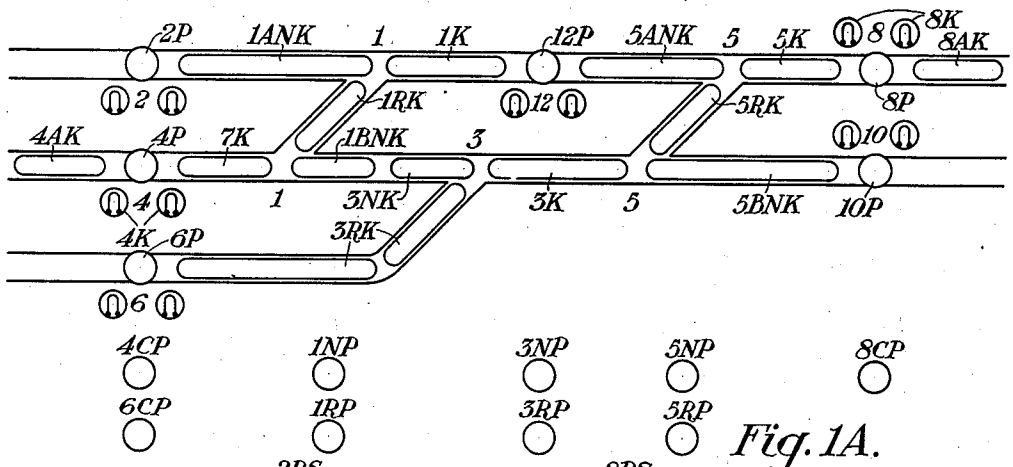


Fig. 1A.

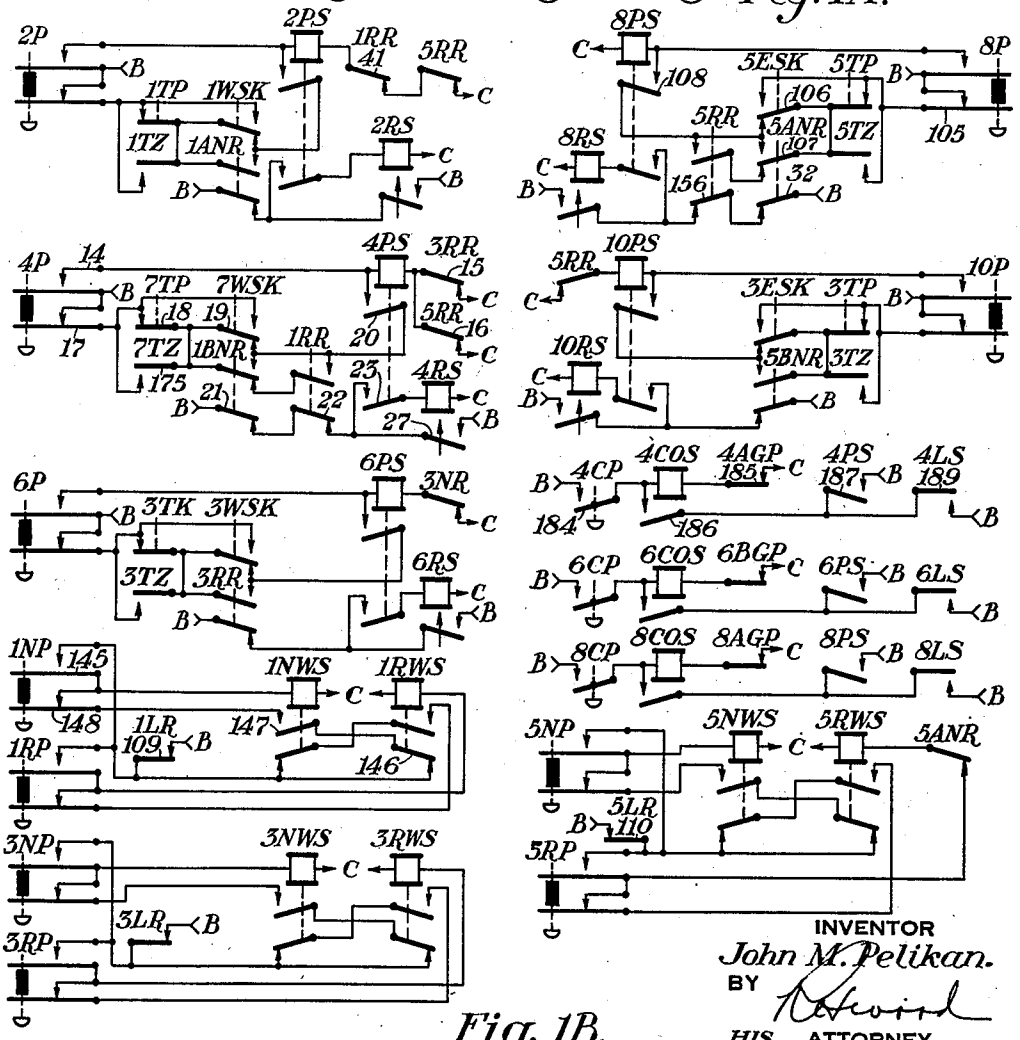


Fig. 1B.

INVENTOR
John M. Pelikan.
BY
HIS ATTORNEY

June 3, 1941. J. M. PELIKAN 2,244,401

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Dec. 31, 1936 6 Sheets-Sheet 2

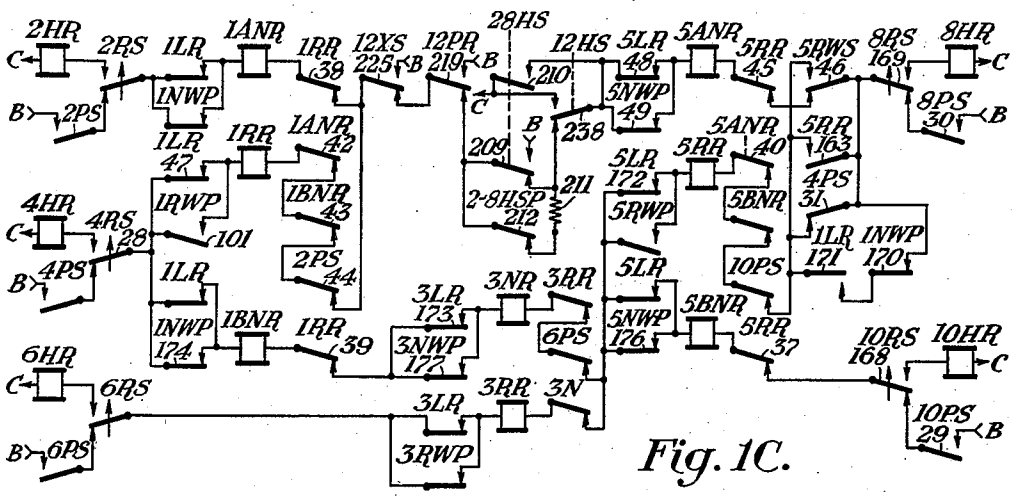


Fig. 1C.

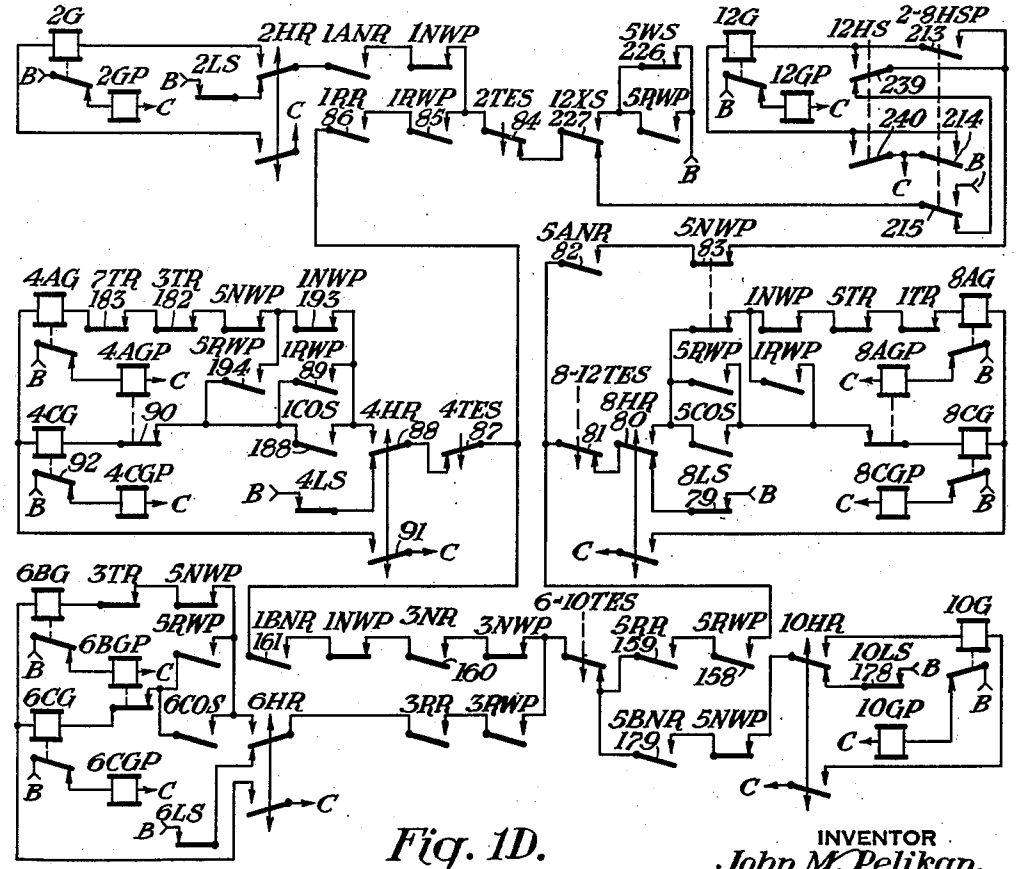


Fig. 1D.

INVENTOR
John M. Pelikan.
BY
Kenwood
HIS ATTORNEY

June 3, 1941. J. M. PELIKAN 2,244,401

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Dec. 31, 1936 6 Sheets-Sheet 3

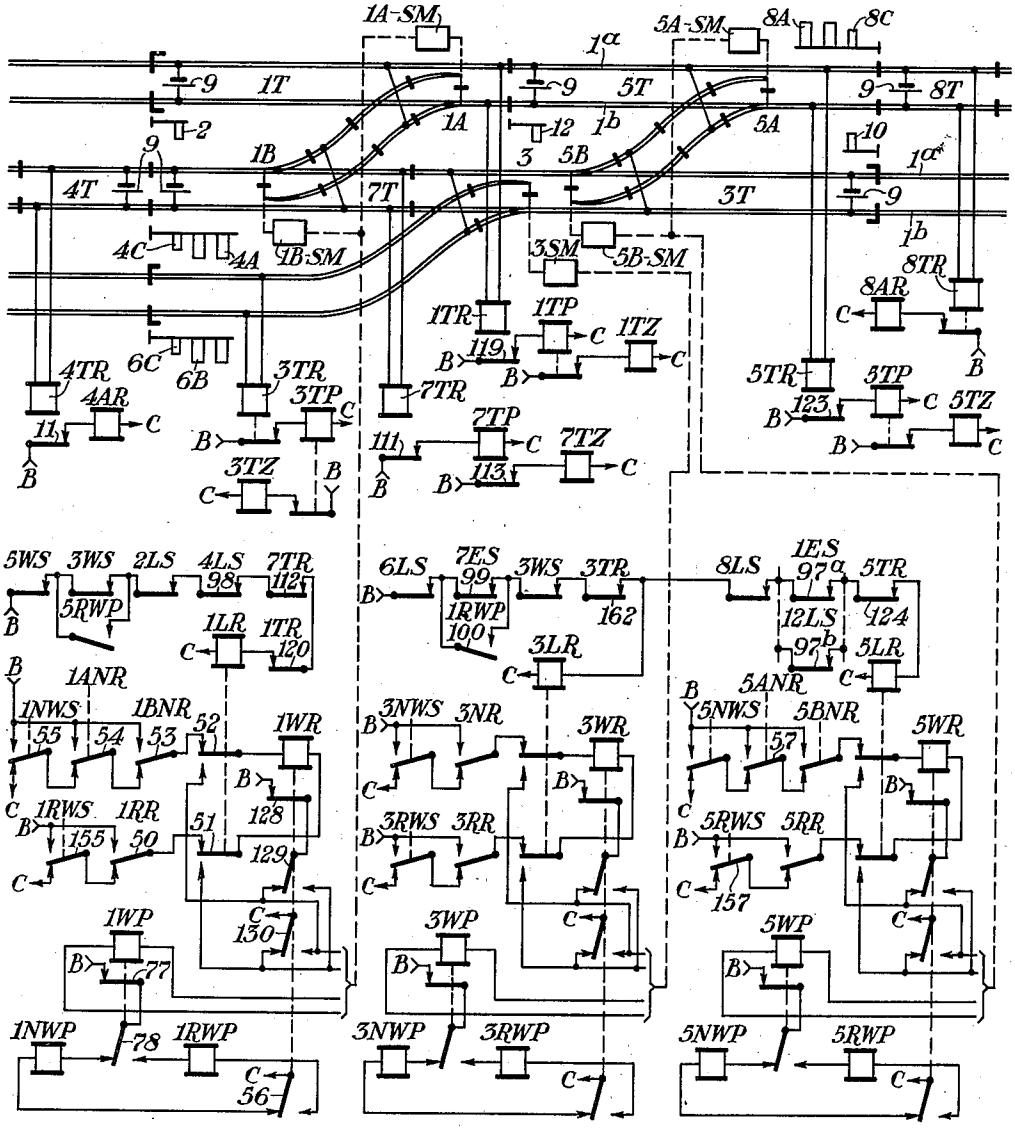


Fig. 1E.

INVENTOR
John M. Pelikan.
BY
HIS ATTORNEY

June 3, 1941. J. M. PELIKAN 2,244,401

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Dec. 31, 1936 6 Sheets-Sheet 4

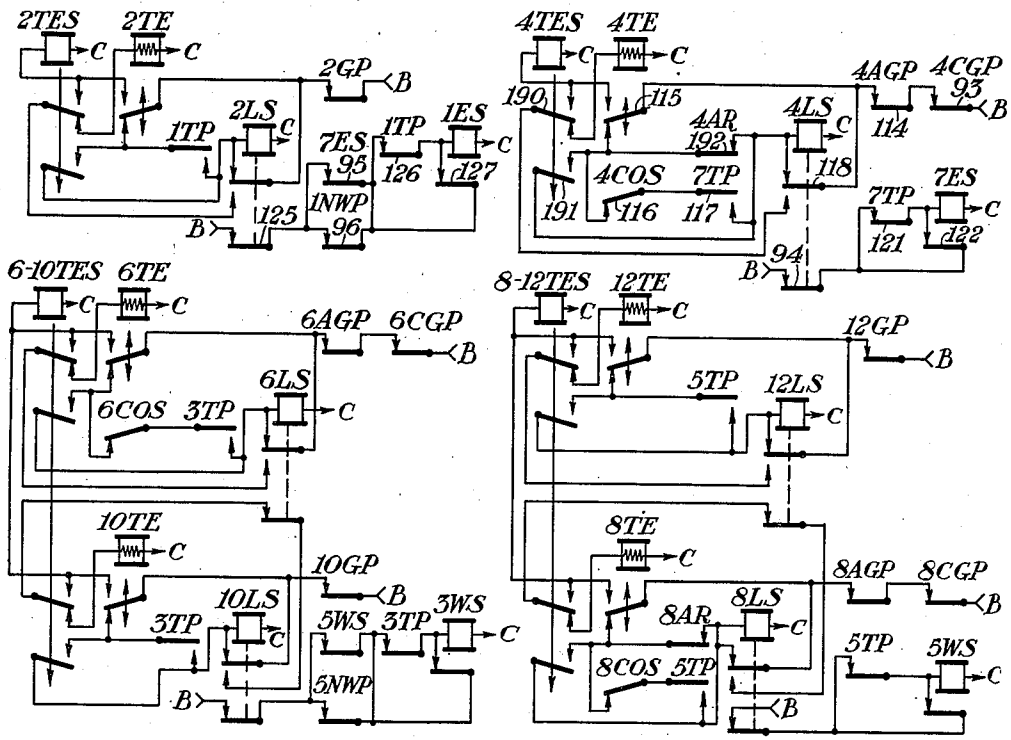


Fig. 1F.

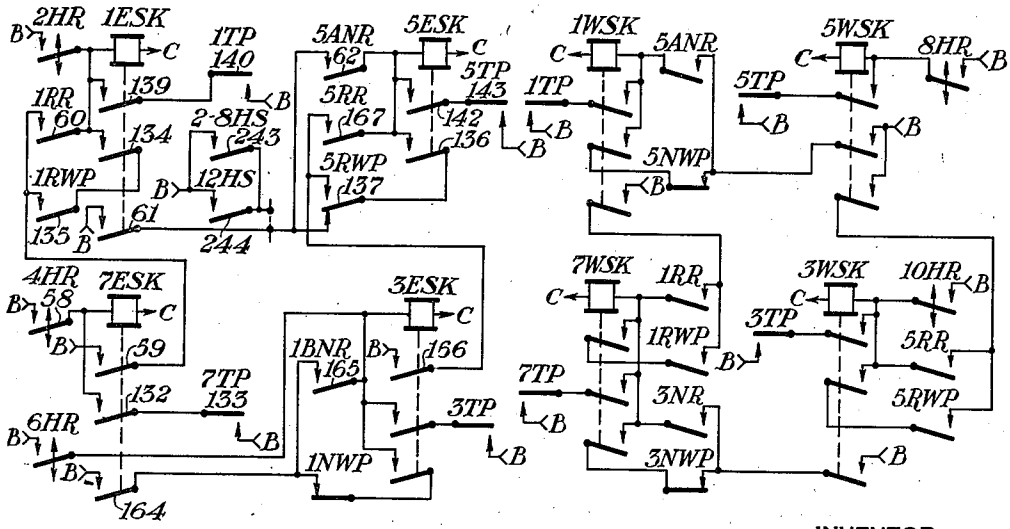


Fig. 1G.

INVENTOR
John M. Pelikan.
BY
HIS ATTORNEY

June 3, 1941. J. M. PELIKAN 2,244,401

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Dec. 31, 1936 6 Sheets-Sheet 5

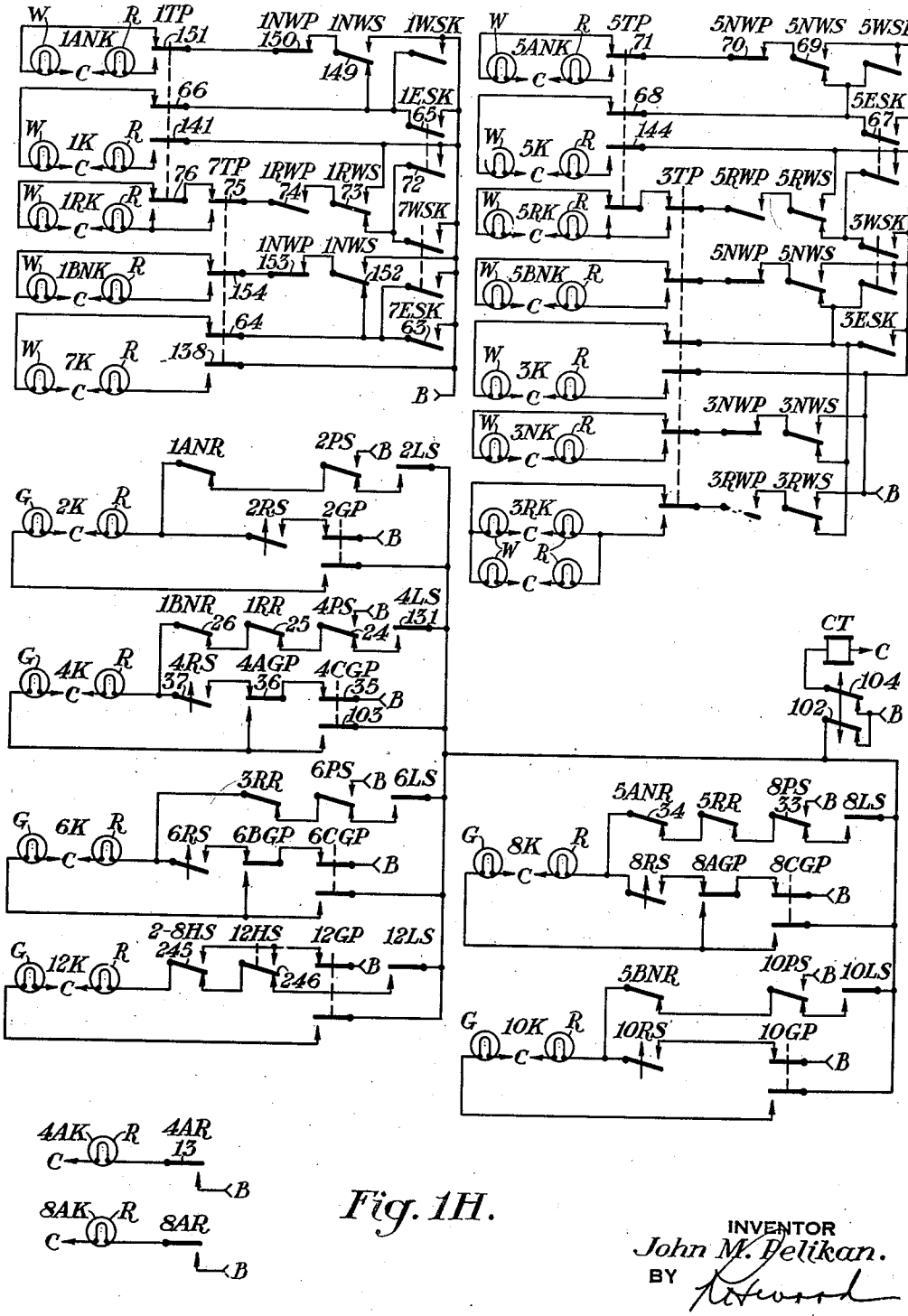


Fig. 1H.

INVENTOR
John M. Pelikan.
BY
HIS ATTORNEY

June 3, 1941. J. M. PELIKAN 2,244,401

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Dec. 31, 1936 6 Sheets-Sheet 6

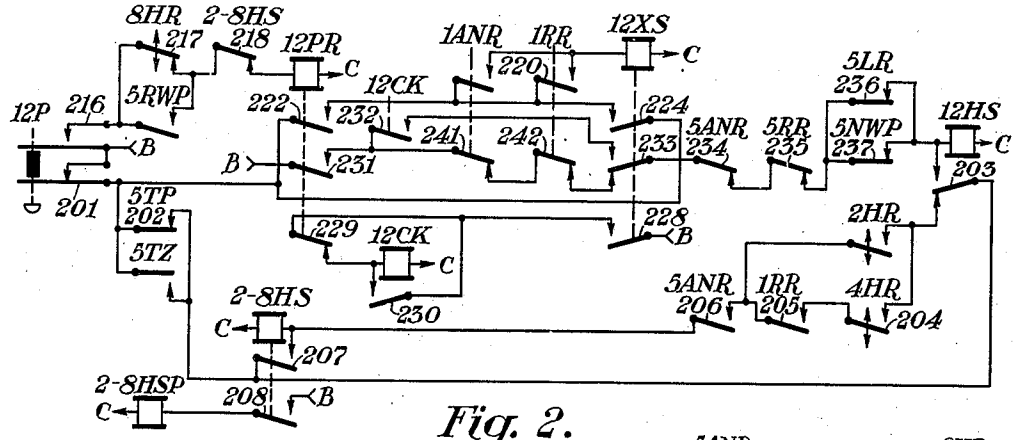


Fig. 2.

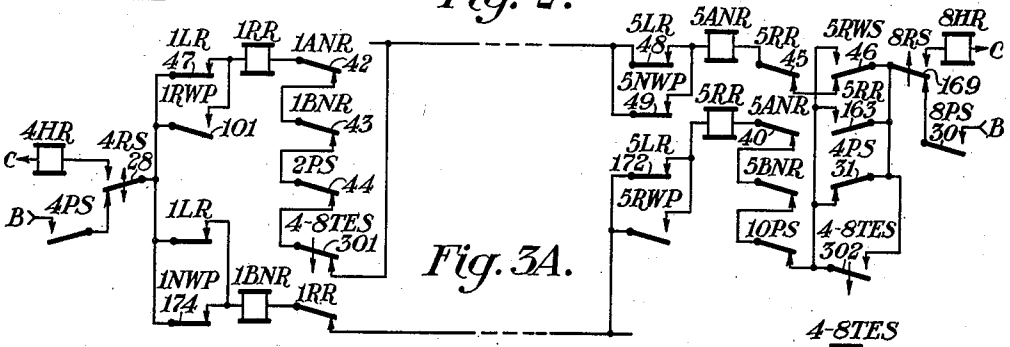


Fig. 3A.

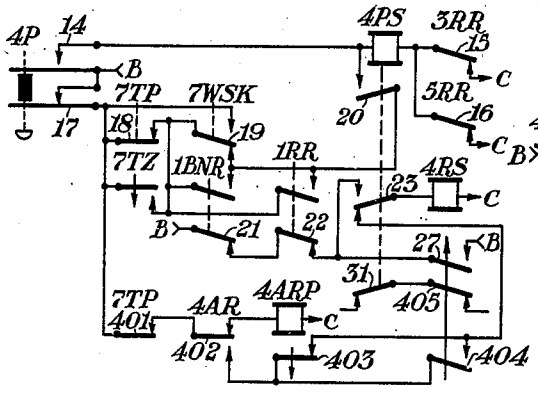


Fig. 4.

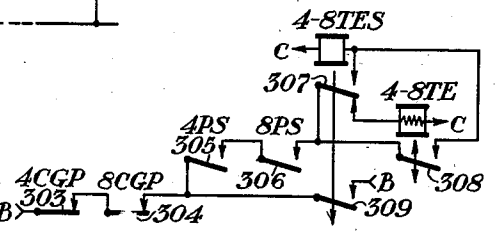


Fig. 3B.

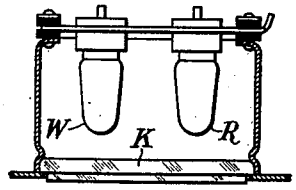


Fig. 5B.

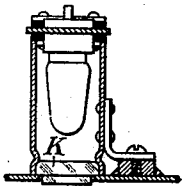


Fig. 5A.

INVENTOR
John M. Pelikan.
BY
HIS ATTORNEY

Patented June 3, 1941 2,244,401

UNITED STATES PATENT OFFICE

2,244,401

RAILWAY TRAFFIC CONTROLLING APPARATUS

John M. Pelikan, Greentree, Pa., assignor to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

Application December 31, 1936, Serial No. 118,609

59 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.

One object of my invention is the provision, in a system of this character, of an illuminated diagram of the track layout in the signal cabin or other point of control, which visually indicates different traffic routes through the track layout as these are established by the operator, and which also indicates the progress of trains over such routes. Another object of my invention is the provision of an "all-relay" route interlocking system for operating the switches and signals for the different traffic routes under the control of manually operable contacts, push buttons or the like, which are preferably mounted on the track diagram in locations corresponding to the ends of the respective routes. A further object of my invention is the provision of means whereby one or more of the track switches may be operated as required to establish a route by operating the two push buttons at the opposite ends of the representation of that route on the track diagram, and in which one or the other of the two signals for governing the movement of traffic over that route will then clear automatically, the traffic direction established being dependent upon the relative order of the operation of two push buttons. Other objects, purposes and features of my invention will be pointed out as the description proceeds.

My invention is an improvement upon that disclosed in a copending application, Serial No. 14,868, for Interlocking control apparatus, filed April 5, 1935, by Earl M. Allen and Howard A. Thompson.

I will describe four forms of apparatus embodying my invention, and will then point out the novel features thereof in claims.

Referring to the accompanying drawings, Figs. 1A to 1H, inclusive, taken together, illustrate diagrammatically the circuits for a route interlocking system embodying one form of my invention, together with a plan of the track layout to be controlled, shown in the upper portion of Fig. 1E, and a suitable control panel, shown in Fig. 1A, which contains a track diagram constituting a miniature representation of the track layout. Fig. 2 shows the additional circuits that are required when an intermediate signal such as signal 12 is included in the track layout. It is to be understood, therefore, that the second form of my invention includes the apparatus of the first form together with that of Fig. 2, and that in the first form the intermediate signal 12 is to be omitted and the relays directly associated therewith are idle and may be omitted as hereinafter pointed out in detail. Figs. 3A and 3B illustrate an alternative method of route selection which may be used when there are two or more different routes between the same route ends. The third form of my invention is illustrated by the drawings for the first form together with Fig. 3B, but with the apparatus of Fig. 3A substituted for the corresponding portion of Fig. 1C. Fig. 4 illustrates a modification of one of the push button circuits of Fig. 1B, whereby the operation of only the push button at the exit end of a route is required to establish a route and to clear the signal for an approaching train. The fourth form of my invention is therefore illustrated by substituting the circuits of Fig. 4 for one or more of the corresponding circuits of Fig. 1B in the first form of the apparatus. Fig. 5A is a side view, in section, and Fig. 5B is a plan view, in section, of a preferred form of the structure for illuminating the unit portions of the track diagram of Fig. 1A.

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

In order to simplify the description, I will first explain the functions of the several parts of the first form of my apparatus, and will then describe its operation under selected conditions in detail, and will then point out the distinguishing features of the other forms of my apparatus.

The track switches shown in the track plan of Fig. 1E, in accordance with the usual notation of the signaling art, are identified by odd numbers, such as 1, 3 and 5, and the wayside signals by even numbers, such as 4 and 8. For the guidance of the control operator, the corresponding numbers are shown on the control panel of Fig. 1A, adjacent the switches of the diagram and the respective control buttons. The two switches of a crossover bear the same number but are distinguished by the suffixes A and B, respectively, and similarly, in case of a multiple arm signal, the suffix A designates the top arm or high speed signal, B designates a medium speed signal, and C a slow speed signal. Each bottom arm C also serves as a "call-on" signal which may be cleared to admit a train to an occupied block. The one arm signals 2, 10 and 12 are slow speed signals governing train movements against the normal direction of traffic.

In the circuit plans, 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. In circuits of this form the relay contacts are not necessarily adjacent the respective relays which operate them, and a contact is identified not only by a number but more particularly 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 source.

The push buttons of the control panel of Fig. 1A bear the reference character P, and the circuits which they control directly are grouped together in Fig. 1B. The even-numbered push buttons 4P, 8P, etc., are the route buttons located in the track diagram at the ends of the different routes, and each is provided with a normally open contact which may be closed by pressing the button, to energize a push button stick relay PS. Each route button also has a normally closed contact which may be opened by operating it in the opposite direction, that is, by "pulling" the button, to effect the manual release of the associated stick relay PS, as required. Each route button therefore constitutes a centrally biased three-position manually operable circuit controller, and these are not necessarily of the push button form, but a "twist key" or centrally biased rotatable lever may also be used. Each stick relay PS controls a directional route stick relay RS, the circuits for which are also shown in Fig. 1B. Each relay RS is of relatively high resistance or its otherwise arranged so as to be of the slow pickup type. Each call-on signal is governed by a call-on stick relay COS shown in Fig. 1B, and each relay COS is controlled by a call-on button CP, mounted in the lower part of the control panel directly below the corresponding route button. The apparatus also includes means for operating the track switches or crossovers individually, comprising normal and reverse switch stick relays NWS and RWS shown in Fig. 1B, which are controlled by the push buttons NP and RP of the control panel. The latter are similar in construction to the route buttons, and each may be pressed to operate a switch or may be pulled to cancel the individual switch control.

Fig. 1C shows circuits controlled by the stick relays PS and the route relays RS, comprising a route network consisting of interconnected circuits so arranged as to include a route circuit for each route through the track layout. Each route circuit includes a switch operating relay NR or RR for each switch of the route which relays when energized cause the operation of the switches to normal or reverse as required for the route. Each route circuit also includes a signal control relay HR at each end, one or the other of which is included in the circuit when energized in order to selectively clear the signal for one direction or the other when the route is established.

One feature of my invention relates to the control of the route circuits of Fig. 1C by the successive operation of the push buttons P for the two ends of a route. When the push button for the entrance end of a route is operated, the corresponding relays PS and RS become successively energized. Relay RS picks up before the operator presses the second button and then connects one terminal of the local source of current through the winding of the associated signal control relay HR to those route circuits which have one end at that point, thereby establishing that end as the entering end of the route. Each route relay RS is energized over a back contact of one or more of the switch operating relays NR or RR which are in series in the route circuits which that relay RS controls, and these series relays are of relatively low resistance and are quick acting in comparison with relays RS. When the push button P at the exit end of any one of the route in question is operated, the corresponding relay PS picks up, thereby completing the selected route circuit to energize the relay HR at the entrance end. Relay RS at the exit end of the route although energized momentarily does not pick up because its circuit is immediately opened by the operation of the adjacent series relay in the energized route circuit, while the relay RS at the entrance end having already completed its stick circuit remains energized. It follows, therefore, that each route is established by the successive operation of the push buttons to energize the relays PS for the two ends of the route, and that the traffic direction is determined by the energization of relay HR at one end or the other in accordance with the relative order in which the two push buttons are operated.

In addition to the manual means for cancelling a route already mentioned, means are provided in accordance with a feature of my invention for deenergizing each route circuit automatically as soon as it is entered by a train, by opening the stick circuit for the relay PS at the entering end. This is accomplished in such a manner that the stick circuit again becomes available after a time sufficient to insure the release of the route relays, so that an occupied route may be reestablished by a second operation of the same push buttons, and then a "call-on" signal may be cleared by operating the corresponding push button CP. This arrangement permits a train to enter, at slow speed, a route already occupied by a preceding train, as is often desirable in practice.

Fig. 1D shows the circuits controlled by the signal control relays HR of Fig. 1C, comprising a network of interconnected circuits for controlling the signals. Each signal arm bearing a reference character in Fig. 1E has an operating mechanism bearing the reference G with identifying prefix in Fig. 1D, those signal arms having no references being fixed markers. Each mechanism G is controlled over a signal circuit which corresponds to the route which such signal governs and which includes contacts of the corresponding switch operating and indication relays as well as a front contact of a locking relay LS controlled by the opposing signal for the same route. 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. Each signal is provided with the usual back lock or signal indication relay GP, which, as shown in Fig. 1D, is energized only when the corresponding signal

indicates stop. For simplicity, each signal is arranged to indicate either clear or stop, and the usual circuits for controlling each signal by the next signal in advance to provide a third indication have been omitted. It is to be understood, however, that the third indication may be provided in the system disclosed by means which are well known and which form no part of the present invention.

Referring now to Fig. 1E, the track plan shown therein represents the tracks rails 1[a] and 1[b] of each of two main tracks interconnected by crossovers 1 and 5, the lower track being also connected to a siding by a single switch 3. While a specific track layout is disclosed, it is to be understood that the apparatus of my invention is adapted to control other track layouts that may involve entirely different combinations of switches and signals, the present layout having been chosen to illustrate the principles of my invention in a simple manner. As indicated in the drawings, the tracks are divided into sections by insulated joints, the detector sections of the upper track which include the track switches being designated by the references 1T and 5T, while those of the lower track bear the references 3T and 7T. The adjacent approach sections of the two main tracks are designated 2T and 4T, respectively. Each track section is provided with the usual closed track circuit including a track battery 9 and a normally energized track relay, each track relay being identified by the reference TR with a numerical prefix identifying the track section to which it corresponds. Each approach section track relay controls an approach relay AR. Each detector section track relay controls a track repeating relay TP, and each relay TP controls a slow release repeating relay TZ.

Relays TP and TZ jointly control the hereinbefore-mentioned circuits for effecting the automatic release of the routes.

Each track switch of Fig. 1E is actuated by a power-operated switch machine SM, which as herein disclosed may be understood to be of the type shown in the Zabel Patents Nos. 1,293,290 and 1,413,280. Each switch machine is provided with the usual motor having its operating circuits controlled by the contacts of a polarized switch control relay WR in the manner illustrated in the Willard Patent No. 1,380,452, as indicated diagrammatically by dotted line connections in the drawings, and it is to be understood that each switch or switches will be operated to normal, as shown, or to reverse, when the control relay WR is energized and its polar contacts are closed to the left or right, respectively. Each relay WR is controlled by the switch operating relays NR and RR of Fig. 1C, when route control is used, or by the switch stick relays NWS and RWS of Fig. 1B, when individual switch control is used. Each relay WR is also controlled by a switch locking relay LR. The locking relays LR are controlled in turn by the detector track relays TR and by the approach locking relays LS and section locking relays ES and WS of Fig. 1F.

Each switch machine is provided with the usual switch circuit controller as disclosed in the Zabel patents hereinbefore referred to, for controlling a polarized switch indication relay WP, as indicated diagrammatically by dotted line connections in the drawings. For an understanding of the present invention it will suffice to point out that when both switch machines SM of the crossover 1 or 5 are locked normal or reverse, the corresponding relay 1WP or 5WP will be energized and its polar contacts closed to the left or right, respectively, and that relay 3WP is similarly controlled by switch machine 3SM for the single switch 3.

Each switch indication relay WP is provided with a pair of repeating relays NWP and RWP each of which is energized only when the polarized relay WP is energized in a position corresponding to that of the associated switch control relay WR.

As will be hereinafter pointed out in detail, the locking relays LR together with the switch indication relays NWP and RWP control the route circuits of Fig. 1C in such a manner that a route circuit cannot be completed unless each switch of a route is either unlocked or already occupies a position in accordance with that route. The indication relays NWP and RWP also control the signal circuits of Fig. 1D.

Referring now to Fig. 1F, an approach locking relay LS is provided for each signal, and each relay LS is so controlled by the indication relay GP for the associated signal that it can be energized only when that signal is at stop. Time release of the locking is provided by means of a time element relay TE for each relay LS, these being of the well-known thermal type, and each relay TE is governed by an associated stick relay TES. The locking relays LS function in a well-known manner to provide the usual time and approach locking of the switches and of opposing signals; thus when a signal is put to stop manually, the energization of the associated relay LS is delayed for a predetermined time interval, or until the associated relay TE completes its cycle of operation; this delay is nullified by the release of the corresponding track relay TR if the signal is put to stop by a passing train, and also, in the case of the high speed signals 4A and 6A, if there is no train approaching and the corresponding approach relay AR is energized. Each relay LS, as shown, controls a section locking relay ES or WS, which relays provide the usual directional control of the switch locking and function 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.

Fig. 1G shows the circuits for a group of directionally controlled stick indication relays ESK and WSK which control lamps for illuminating the tracks of the track diagram of Fig. 1A. The relays ESK and WSK are controlled by the signal control relays HR and function in such a manner that when one of the route circuits of Fig. 1C is energized, a series of these relays for the corresponding direction east or west become energized successively in tandem, including one relay for each track section of the corresponding route. Each route indication relay has a stick circuit controlled by a back contact of the track repeater relay TP for the corresponding track section, so that it will remain energized after a train has entered the route and until that section is vacated.

Referring now to the track diagram of Fig. 1A, it will be seen that the track sections are represented by a plurality of indicators K each comprising a substantially linear portion or strip, which as herein illustrated, is constructed as shown in Figs. 5A and 5B, and consists of a moulded member of clear glass fitting in a slot in the face of the control panel and provided at

the rear with an enclosure which in the case of the detector track indicators contains a white lamp W and a red lamp R, the approach indicators AK being provided with red lamps only. Each of the moulded glasses is provided with a facing of opal glass to render it translucent or semi-opaque so that the track portion will be more readily seen by reflected light when not illuminated, and also to diffuse the transmitted light so as to provide uniform illumination when lamp W or R is lighted.

Fig. 1H shows, in the upper part, the circuits for the lamps of the track diagram, and it will be seen that the white lamps W are controlled by one or more of the indication relays ESK or WSK over front contacts of the track repeater relays TP, while the red lamps R are similarly controlled over back contacts of relays TP. Furthermore, those portions which represent the branch tracks extending in the trailing direction from a track switch are also controlled by the switch indication relays NWP and RWP and by the switch stick relays NWS and RWS, and these portions serve as switch indication lamps when the switches are controlled individually.

The track diagram is normally dark, but when the operator presses the two buttons at the end of a route, the energization of a relay HR which results if the route is available causes the energization in tandem of a corresponding series of relays ESK or WSK, thereby lighting the white lamps for these portions of the diagram corresponding to the parts of the route that are already established. As the operated switches respond, the white lamps for the corresponding switch indicating portions of the track diagram become lighted, so that a substantially continuous illuminated white line corresponding to the established route is displayed as soon as the route is fully established. When a train enters the approach section, the red lamp for that section is lighted, and as the train enters each detector section of the route, the illumination of the corresponding portions of the diagram changes from white to red, and as each section is vacated, the corresponding portions become dark.

The track diagram also includes an indicator K for each signal, each comprising a green lamp G and a red lamp R, which in the form illustrated are located adjacent the push button for the entering end of the route which the signal governs, the circuits for these lamps being shown in the lower part of Fig. 1H. When the push button relay PS for the entering end of a route is operated, the adjacent red lamp is lighted. This lamp remains lighted if the route is not available. When the route becomes established and the corresponding signal has been cleared, the red lamp is extinguished and the corresponding green lamp is lighted.

The signal indication lamps are arranged to be controlled also by an interrupter relay CT, so as to provide additional information by the display of flashing indications. Thus each slow speed signal when clear causes the display of a flashing green light, while each high or medium speed signal when clear causes the display of a steady green light. When a signal is put to stop manually, the switch locking will in some cases remain effective for a predetermined time interval as already explained, and during this interval the operator will be unable to establish a conflicting route. In order to aid the operator in setting up the new route as soon as it becomes unlocked, the circuits are so arranged that the red signal indicating lamp will flash from the time when a route is manually cancelled until the locking is released, and will then become dark.

I will now describe the operation of the first form of my apparatus under different assumed conditions, tracing the circuits in detail. I will first assume that the apparatus is in the condition shown in the drawings, and that the operator desires to pass an approaching train from section 4T, Fig. 1E, over route 4—8 to section 8T. When the train enters section 4T the release of track relay 4TR opens contact 11, deenergizing the approach relay 4AR, which relay releases and closes back contact 13, Fig. 1H, to close a circuit for the red lamp R of the approach indicator 4AK, this portion of the track diagram of Fig. 1A being thereby illuminated to inform the operator of the approach of the train.

To set up route 4—8, the operator will first press button 4P for the entering end and then will press button 8P for the exit end of the route. The momentary operation of button 4P completes a circuit for relay 4PS which may be traced in Fig. 1B from terminal B, contact 14 of button 4P, relay 4PS, back contacts 15 and 16, in multiple, of relays 3RR and 5RR to terminal C. It is to be noted that relay 4PS is non-responsive if route 6—8 is set up and relays 3RR and 5RR are both energized, in which case no route governed by button 4P is available. In the present instance these relays are released and therefore relay 4PS picks up and closes a stick circuit from terminal B, contact 17 of button 4P, front contact 18 of relay 7TP, back contact 19 of relay 7WSK, front contact 20 and winding of relay 4PS, contacts 15 and 16 in multiple to terminal C. This stick circuit serves to hold relay 4PS energized until the train enters the route and contact 18 opens, or until the route is cancelled manually by opening contact 17. Relay 4PS closes a circuit from terminal B, back contacts 21 and 22 of relays 1BNR and 1RR, front contact 23 of relay 4PS, relay 4RS to terminal C. Relay 4PS also closes a circuit for indicator 4K, Fig. 1H, which may be traced from terminal B, front contact 24 of relay 4PS, back contacts 25 and 26 of relays 1RR and 1BNR, red lamp R of indicator 4K to terminal C, for lighting lamp R to display a red light at the entrance to route 4—8 on the track diagram.

Relay 4RS picks up in about one-half second after becoming energized, which it is to be understood is before the exit button 8P is operated, and relay 4RS then closes its stick circuit from terminal B over contact 27, Fig. 1B, and also closes contact 28, Fig. 1C, connecting terminal C through relay 4HR to the left-hand end of three route circuits comprising those for route 4—10, route 4—8 over crossover 5 reversed, and route 4—8 over crossover 1 reversed, respectively. Without tracing these circuits in detail, it will be apparent from the drawings that the first includes relays 1BNR, 3NR, 5BNR and back contact 168 of relay 10RS and is open at front contact 29 of relay 10PS; that the second includes relays 1BNR, 3NR, 5RR, and back contact 169 of relay 8RS and is open at front contact 30 of relay 8PS and also at back contact 31 of relay 4PS, while the third includes relays 1RR and 5ANR and back contact 169 of relay 8RS and is open only at front contact 32 of relay 8PS.

When button 8P for the exit end of route 4—8 is operated, relays 8PS and 8RS will be ener-

gized over circuits shown in Fig. 1B which are similar to those already traced for relays 4PS and 4RS, but as soon as relay 8PS closes its front contact 30 the third of the above-mentioned route circuits is completed to terminal B and relays 1RR and 5ANR pick up quickly in series with relay 4HR. Relay 5ANR opens back contact 32, Fig. 1B, in the pickup circuit for relay 8RS before this relay has time to pick up and relay 8RS therefore remains released and its back contact 169 in the route circuit remains closed. Relay 8PS closes front contact 33, Fig. 1H, in the circuit for lamp R of indicator 8K for the exit end of the route, but back contact 34 of relay 5ANR opens to prevent this lamp from becoming lighted. Back contact 25 of relay 1RR in the circuit for lamp R of indicator 4K for the entrance end of the route also opens, but this lamp is now energized over a branch circuit which extends from terminal B, front contacts 35, 36 and 37 of relays 4CGP, 4AGP, and 4RS through lamp R to terminal C.

It will be noted that the energized route circuit for route 4—8 is now disconnected from the rest of the route network. Relay 1RR, being energized, opens back contacts 38 and 39 in the branches which include relays 1ANR and 1BNR, respectively, while relay 5ANR opens back contact 40 in the branch which includes relay 5RR. Relay 1RR also opens back contact 41, Fig. 1B, in the circuit for relay 2PS. It follows that the energized route circuit can not be interfered with by an attempt to set up a conflicting route, and that back contacts 42, 43, 44 and 45 of relays 1ANR, 1BNR, 2PS and 5RR in the route circuit for route 4—8 are held closed. As hereinbefore stated, it is to be understood that signal 12 is omitted from the first form of the apparatus. The associated relays 12XS, 12PR, 2—8HS and 12HS are therefore idle, and the back contacts of these relays shown in the energized route circuit remain closed, and in practice would be replaced by jumper connections in this form of the apparatus. The energized route circuit also includes back contact 46 of relay 5RWS, the function of which will be described later, and front contacts 47 and 48 of the switch locking relays 1LR and 5LR, the latter contact being bridged by a front contact 49 of relay 5NWP which is closed because crossover 5 is normal. It will be apparent, therefore, that in this instance the route circuit for route 4—8 will become energized in response to the operation of buttons 4P and 8P even though relay 5LR is deenergized because the crossover 1 is not locked and because crossover 5 already occupies a position in accordance with the route.

When the route circuit became energized, relay 1RR closed its front contact 50, Fig. 1E, completing the reverse energizing circuit for relay 1WR from terminal B, front contacts 50 and 51 of relays 1RR and 1LR, relay 1WR, front contact 52 of relay 1LR, back contacts 53, 54 and 55 of relays 1BNR, 1ANR and 1NWS to terminal C. Relay 1WR reverses and operates the switch machines 1A—SM and 1B—SM to reverse crossover 1, and also opens its left-hand polar contact 56 to release relay 1NWP. At the same time, relay 5ANR closes its front contact 57 to complete the normal energizing circuit for relay 5WR, thereby checking the normal position of crossover 5. The signal control relay 4HR being included in the energized route circuit also picks up and closes contact 58, Fig. 1G, to complete a pickup circuit for the indication relay 7ESK. Relay 7ESK upon becoming energized, closes contact 59 to complete a pickup circuit for relay 1ESK from terminal B over front contact 60 of relay 1RR, relay 1ESK to terminal C, and the latter relay picks up and completes a pickup circuit for relay 5ESK from terminal B over its front contact 61 and front contact 62 of relay 5ANR, relay 5ESK to terminal C. Relay 7ESK upon becoming energized closes contact 63, Fig. 1H, to complete a circuit from terminal B over front contact 64 of relay 7TP to light the white lamp W for portion 7K of the track diagram, and similar circuits are closed over contacts 65 and 66 of relays 1ESK and 1TP, and over contacts 67 and 68 of relays 5ESK and 5TP to light the lamps W for portions 1K and 5K, respectively, while lamp W for portion 5ANK is lighted over the circuit from terminal B, front contact 67 of relay 5ESK, back contact 69 of relay 5NWS, front contacts 70 and 71 of relays 5NWP and 5TP, lamp W to terminal C. A circuit is prepared for lamp W of portion 1RK from terminal B, front contact 72 of relay 1ESK, back contact 73 of relay 1RWS, front contacts 74, 75 and 76 of relays 1RWP, 7TP and 1TP, but contact 74 is open and an incomplete route is indicated on the track diagram because portion 1RK remains dark.

When the crossover switches 1A and 1B complete their movement and are locked reverse, the switch indication relay 1WP becomes energized in the reverse direction, completing a circuit shown in Fig. 1E which extends from terminal B over its neutral contact 77 and reverse contact 78, relay 1RWP, reverse contact 56 of relay 1WR to terminal C. Relay 1RWP upon becoming energized closes its contact 74 above mentioned to light lamp W for portion 1RK, thereby completing the route indication so as to display a substantially continuous illuminated white line on the track diagram comprising a representation of route 4—8.

The energization of relays 4HR, 1RR and 5ANR also prepared a circuit for the signal mechanism 4CG, shown in Fig. 1D, which is completed upon the energization of relay 1RWP. This circuit may be traced from terminal B, front contact 79 of relay 8LS, back contacts 80 and 81 of relays 8HR and 8—12TES, front contacts 82 and 83 of relays 5ANR and 5NWP, thence over back contacts of relays 12HS, 2—8HS and 12XS (which contacts in practice are replaced by a jumper when signal 12 is not used), thence over back contact 84 of relay 2TES, front contacts 85 and 86 of relays 1RWP and 1RR, back contact 87 of relay 4TES, front contacts 88, 89 and 90 of relays 4HR, 1RWP and 4AGP, mechanism 4CG, front contact 91 of relay 4HR to terminal C. Mechanism 4CG therefore becomes energized to cause signal 4C to indicate "proceed at slow speed" and its back contact 92 opens to deenergize the back lock relay 4CGP.

Relay 4CGP, upon releasing, opens contact 93, Fig. 1F, to release the approach locking relay 4LS. Relay 4LS upon releasing opens contact 94 to release the section locking relay 7ES, and relay 7ES, by opening contact 95 releases relay 1ES, since contact 96 of relay 1NWP is now open. Relay 1ES is used only when signal 12 is not used, and in the first form of the apparatus it is to be understood that its contact 97a, Fig. 1E, replaces contact 97b of relay 12LS in the circuit for relay 5LR. Relay 1ES upon releasing opens contact 97a to release 5LR, locking crossover 5 normal, while relay 4LS opens contact 98 to release relay 1LR, locking crossover 1 reversed. Switch 3 is

not locked because the open contact 99 of relay 7ES in the circuit for relay 3LR is now bridged by the closed front contact 100 of relay 1RWP. The energized route circuit for route 4—8 remains closed because contact 47 of relay 1LR, Fig. 1C, is now bridged by the closed contact 101 of relay 1RWP.

When relay 4CGP releases, its contact 35, Fig. 1H, opens to extinguish the red lamp for the signal indicator 4K and a circuit is closed from terminal B, back contact 102 of the interrupter relay CT, back contact 103 of relay 4CGP, lamp G of indicator 4K to terminal C. Relay CT has an energizing circuit including its own back contact 104 and operates repeatedly to open its contacts at regularly recurring intervals. Indicator 4K therefore display a flashing green indication when signal 4C is cleared. It will also be noted that if signal 4A had been cleared, 4CGP would have been energized, and relay 4AGP released, and in this case, lamp G of indicator 4K would have been energized from terminal B over front contact 35 and back contact 36 to display a steady green indication.

Referring now to Fig. 1B, it will be seen that a stick circuit for relay 8PS for the exit end of the route is now closed from terminal B, contact 105 of button 8P, front contacts 106 and 107 of relays 5ESK and 4ANR, front contact 108 and winding of relay 8PS to terminal C. Relay 4PS is now held energized over the stick circuit including back contact 19 of relay 7WSK as already described, and may be released manually by opening contact 17 of button 4P. Relay 4PS releases automatically when a train enters the route and contact 18 of relay 7TP opens. It will also be noted that the individual switch control relays 1NWS, 1RWS, 5NWS and 5RWS are now non-responsive to the operation of their respective push buttons, because contacts 109 and 110 of relays 1LR and 5LR are open.

I will now assume that the approaching train passes signal 4C at clear and enters track section 7T. Track relay 7TR releases, opening contacts 111 and 112, Fig. 1E, in the circuits for relays 7TP and 1LR. Relay 7TP releases and opens contact 113, deenergizing the slow release relay 7TZ, and also opens contact 18 to release relay 4PS. Relay 4RS then releases, then relays 1RR, 5ANR and 8PS release, and then the slow acting relays 4HR and 7TZ release. Relay 4HR opens contacts 88 and 91, Fig. 1D, deenergizing mechanism 4CG to restore signal 4C to stop, whereupon contact 92 closes, re-energizing relay 4CGP. Relay 4CGP closes contact 93, Fig. 1F, completing a pickup circuit for relay 4LS which may be traced from terminal B, contacts 93 and 114 of relays 4CGP and 4AGP, back contacts 115, 116 and 117 of relays 4TE, 4COS, and 7TP, relay 4LS to terminal C. Relay 4LS picks up, closing its stick circuit from terminal B over contacts 93 and 114 of relays 4CGP and 4AGP, contact 118 and winding of relay 4LS to terminal C. Relay 4LS closes contact 98 in the circuit for relay 1LR, but relay 1LR is now held released by the open contact 112 of relay 7TR. When the train enters section 1T, relay 1TR releases and opens contacts 119 and 120 in the circuits for relays 1TP and 1LR, and relay 1TP releases and deenergizes relay 1TZ. When the train vacates section 7T, relays 7TR, 7TP and 7TZ pick up. Relay 7ES then picks up over the circuit from terminal B, contacts 94 and 121 of relays 4LS and 7TP, relay 7ES to terminal C and closes its stick circuit from terminal B over contact 94 and its own front contact 122, and contact 95 of relay 7ES in the circuit for relay 1ES becomes closed. When the train enters section 5T, relay 5TR releases and opens contacts 123 and 124 in the circuits for relays 5TP and 5LR, and relay 5TP releases and deenergizes relay 5TZ. When the train vacates section 1T, relays 1TR, 1TP and 1TZ pick up, and the closing of contact 120 of relay 1TR causes relay 1LR to become energized, thereby releasing the locking for switches 1A and 1B as soon as the train passes out of section 1T. Relay 1ES now picks up over the circuit from terminal B, contacts 125, 95 and 126 of relays 2LS, 7ES and 1TP, relay 1ES to terminal C, and closes its stick circuit from terminal B over contacts 125 and 95 of relays 2LS and 7ES and its own front contact 127. Contact 97a of relay 1ES in the circuit for relay 5LR now closes, but relay 5LR does not become re-energized until the train vacates section 5T and contact 124 of relay 5TR closes.

It will be apparent from the foregoing that the apparatus of my invention provides sectional route locking which functions in such a manner that the operator may set up a new route, such as route 4—10, or route 10—4, in the case illustrated, as soon as section 1T is vacated, but that crossover 5 remains locked normal until section 5T is vacated. It is also to be noted that each switch control relay WR is maintained energized while locked by the deenergization of the associated relay LR, for example, relay 1WR has a normal and reverse holding circuit including its front neutral contact 128 and its normal or reverse polar contacts 129 and 130 and back contacts 51 and 52 of relay 1LR, which is effective to maintain relay 1WR energized in its last operated position when relay 1LR is deenergized. It follows that relay 1WR is conditioned to supply current to switch machines 1A—SM and 1B—SM over contacts 128, 129 and 130 to restore the track switches to their last operated position if they should become displaced by a passing train.

Considering now the operation of the indication apparatus in response to a train movement over route 4—8, it will be noted that the signal indicator 4K becomes dark when the train enters section 7T. This is because when relay 4CGP picks up, it opens contact 103, Fig. 1H, to deenergize lamp G, and relay 4RS has released to open contact 37 in one circuit for lamp R, while relay 4PS has released to open front contact 24 in the original energizing circuit for lamp R. Although back contact 24 closes, contact 131 of relay 4LS in series therewith is opened when relay 4LS picks up. The approach indicator 4AK becomes dark when the train vacates section 4T and relay 4AR picks up, as is obvious. The release of relays 4HR, 1RR and 5ANR opens the pickup circuits for the energized indication relays ESK of Fig. 1G, but relay 7ESK is now held energized over a stick circuit from terminal B over back contact 133 of relay 7TP and its own front contact 132. Relay 1ESK is now held energized over a stick circuit from terminal B over contacts 59 and 135 of relays 7ESK and 1RWP and its own front contact 134, while relay 5ESK is held energized over a stick circuit from terminal B over front contact 61 of relay 1ESK, back contact 137 of relay 5RWP and its own front contact 136. The release of relay 7TP also opens front contacts 64 and 75, Fig. 1H, and closes back contacts 75 and 138, energizing the lamps R to cause the indication of the track portions 7K and 1RK to change from white

to red, while the white lamps of the indicators 1K, 5ANK and 5K for the sections ahead of the train remain lighted.

When the train enters section 1T, relay 1TP releases to complete a new stick circuit for relay 1ESK from terminal B over back contact 140 of relay 1TP and its own front contact 139, and relay 1TP opens front contact 66 and closes back contact 141 to change the indication of the track portion 1K from white to red. When the train vacates section 7T, relay 7ESK releases and opens contact 63 to cause portion 7K to become dark. When the train enters section 5T, relay 5TP releases to complete a new stick circuit for relay 5ESK from terminal B over back contact 143 of relay 5TP and its own front contact 142, and relay 5TP opens front contacts 68 and 71 and closes back contacts 71 and 144 to change the indication of track portions 5ANK and 5K from white to red. When the train vacates section 1T, relay 1ESK releases and opens contacts 72 and 65 to cause portions 1RK and 1K to become dark. When the train enters section 8T, lamp R of the indicator 8AK becomes lighted.

Finally, when the train vacates section 5T, contact 67 of relay 5ESK opens to cause portions 5ANK and 5K to become dark, and when it vacates section 8T, portion 8AK becomes dark, thereby restoring the track diagram to its normal dark condition.

It will be noted that at least one red lamp for each track section, such for example, as the one controlled over back contact 138 of relay 7TP, becomes lighted when the corresponding track section is occupied even though no route has been set up. These lamps therefore in addition to indicating the movement of a train over an established route also indicate the release of a track relay and the consequent locking of the switches under other conditions, such for example, as would occur if a car should drift into a detector track section past a stop signal.

It is believed that in view of the foregoing detailed description of the operation of the apparatus under one set of conditions that its operation under other corresponding conditions will be readily apparent without further explanation. It is obvious, for example, that if buttons 4P and 8P are operated in the reverse order, route 8—4 will be set up and signal 8C will clear for a train movement from section 8T to section 4T, and also that, any non-conflicting route such as route 6—10 or route 10—6, may be set up at the same time without interference by the operation of the proper buttons. Furthermore, if buttons 4P and 10P are operated instead of buttons 4P and 8P, route 4—10 will be established and signal 4A will clear, and in this case, indicator 4K will display a steady green indication instead of the flashing indication displayed when the slow speed signal 4C is cleared.

I will next assume that the operator is unable to complete route 4—8 as described, due to failure of one of the switches 1A or 1B to complete its movement to reverse, as would be the case, for example, if there was an obstruction in the switch. In such a case the operator employs the individual switch control buttons, but first pulls buttons 4P to open contact 17 to cancel the route setup, which restores the individual control by releasing relay 1RR to close back contact 50, Fig. 1E. He then presses button 1NP, Fig. 1B, closing a circuit from terminal B, contact 109 of relay 1LR, contact 145 of button 1NP, relay 1NWS to terminal C, energizing relay 1NWS to close its stick circuit from terminal B, contact 109 of relay 1LR, back contact 146 of relay 1RWS, front contact 147 of relay 1NWS, normal contact 148 of button 1NP, relay 1NWS to terminal C. Relay 1NWS upon becoming energized completes the normal energizing circuit for relay 1WR, Fig. 1E, over its front contact 55 and back contacts 50 and 155 of relays 1RR and 1RWS. If switches 1A and 1B respond and become locked normal, relay 1NWP will become energized, completing the normal indication circuits for crossover 1 to illuminate portions 1ANK and 1BNK of the track diagram, the circuit for lamp W of portion 1ANK extending from terminal B, Fig. 1H, over front contacts 149, 150 and 151 of relays 1NWS, 1NWP, and 1TP, lamp W to terminal C, while that for portion 1BNK is similar and includes front contacts 152, 153 and 154 of relays 1NWS, 1NWP and 1TP.

If the operator now presses button 1RP, relay 1RWS will become energized, opening back contact 146 to release relay 1NWS to extinguish the normal indication lamps and closing front contact 155, Fig. 1E, to complete the reverse energizing circuit for relay 1WR. If switches 1A and 1B now fully respond and become locked reverse so that relay 1RWP picks up, a reverse indication circuit is closed over front contact 73 of relay 1RWS to light lamp W of portion 1RK of the track diagram. The operator may now operate buttons 4P and 8P to clear signal 4C as already described, whereupon the remaining lamps W for the route portions of the track diagram will become lighted, and relay 1RWS will be released when contact 109 of relay 1LR opens, cancelling the individual control.

It will be apparent from the foregoing that the two portions of the track diagram which extend in the trailing direction from the representation of the switch serve in place of the usual switch indication lamps when the switch is operated individually. Thus portions 3NK and 3RK serve to indicate the normal and reverse positions of switch 3, respectively, while in the case of crossover 1, as described, the two parallel portions 1ANK and 1BNK provide the normal indication and portion 1RK provides the reverse indication.

I will next assume that the operator wishes to set up the secondary route 4—8, over crossover 5 reversed, as would be the case, for example, if he was unable to complete the route set-up for route 4—8 over crossover 1 reversed but succeeded in restoring crossover 1 to normal. In this case he operates the individual switch control button 5RP, energizing relay 5RWS, to close contact 157, Fig. 1E, to complete the reverse energizing circuit for relay 5WR to reverse crossover 5. Relay 5RWS also opens back contact 46, Fig. 1C, in the route circuit which includes relays 1RR and 5ANR, and closes front contact 46 in the secondary route circuit which includes relays 1BNR, 3NR and 5RR. In this instance the latter circuit will be completed over contacts 28 and 30 of relays 4RS and 8PS, when buttons 4P and 8P are operated, and then relay 5RR will open back contact 156, Fig. 1B, to prevent relay 8RS from picking up. Relay 4HR becomes energized over the secondary route circuit, and when crossover 5 is locked reverse, the energization of relay 5RWP completes the corresponding signal circuit for mechanism 4CG which may be traced in Fig. 1D from terminal B, contacts 79, 80 and 81; thence over the lower branch including contacts 158, 159, 160 and 161 of relays 5RWP, 5RR,

3NR and 1BNR, contacts 87, 88, 193, 194 and 90 of relays 4TES, 4HR, 1NWP, 5RWP and 4AGP, mechanism 4CG, contact 91 to terminal C. Mechanism 4CG upon becoming energized releases relay 4CGP to lock the route. In this case, relay 4LS is released by relay 4CGP to deenergize relays 1LR and 7ES, as before, but since contact 100 of relay 1RWP, Fig. 1E, is now open, the opening of contact 99 of relay 7ES releases both relays 3LR and 5LR. Relay 5LR upon releasing opens contact 110, Fig. 1B, to release relay 5RWS, dropping contact 46, Fig. 1C, but the original or so-called preferred route circuit is now open at back contact 45 of relay 5RR and the new or secondary route circuit is held closed over front contact 163 of relay 5RR.

The locking of crossover 1 is released in the present instance when the train vacates section 7T, and relay 7TR picks up to close contact 112 in the circuit for relay 1LR. When relay 7TP closes its front contact 121, relay 7ES picks up, closing contact 99 in the circuit for relays 3LR and 5LR. Relay 3LR becomes energized when the train vacates section 3T and relay 3TR picks up to close contact 162, while relay 5LR remains deenergized until the train vacates section 5T and contact 124 of relay 5TR closes.

Considering now the operation of the indication apparatus in the case described, relay 4HR upon becoming energized will close contact 58, Fig. 1G, to pick up relay 7ESK. Relay 7ESK then closes a pickup circuit from terminal B over its own contact 164 and contact 165 of relay 1BNR, relay 3ESK to terminal C, and relay 3ESK picks up and closes a pickup circuit from terminal B over its own contact 166 and contact 167 of relay 5RR. relay 5ESK to terminal C. Remembering that relays 1NWP and 3NWP are now energized, it will be clear from Fig. 1H, that the lamps W for portions 7K, 1BNK, 3NK, 3K and 5K of the track diagram will be lighted and that lamp W for portion 5RK will become lighted when relay 5RWP becomes energized, to display a complete route indication, and that the illumination of the successive portions will change from white to red and then become dark as the train moves over the route in the manner hereinbefore described.

The secondary route 4—8 over crossover 5 reversed may also be selected automatically under certain conditions, in accordance with a feature of my invention, as for example, when a westbound train moving over route 8—2 vacates section 5T, but stops in section 1T so that relay 1LR remains deenergized, holding crossover 1 locked normal. In that case relay 5LR picks up when the westbound train vacates section 5T and relay 5TR closes contact 124, Fig. 1E, but the preferred route circuit including relay 1RR, Fig. 1C, is held open at contacts 47 and 101 of relays 1LR and 1RWP. Since switch 3 is not involved, relay 3LR will be energized, and if buttons 4P and 8P are operated, as before, a secondary route circuit will be closed from terminal B, contact 30 of relay 8PS, Fig. 1C, back contact 169 of relay 8RS, front contact 170 of relay 1NWP, back contact 171 of relay 1LR, thence over back contacts of relays 10PS, 5BNR and 5ANR, through relay 5RR, over front contact 172 of relay 5LR, and back contacts of relays 6PS and 3RR, relay 3NR, front contact 173 of relay 3LR. back contact 39 of relay 1RR, relay 1BNR, front contacts 174 and 28 of relays 1NWP and 4RS. relay 4HR to terminal C. It will be seen that this route circuit can not be closed if the train in section 1T is an eastbound train, because relay 1ES and consequently relay 5LR will then be deenergized and its contact 172 will be open, but that if section 1T is occupied by a westbound train, the route circuit for the secondary route over crossover 5 may be closed in response to the operation of route buttons 4 and 8.

I will next assume that buttons 4P and 10P have been operated to clear signal 4A; that a train has passed the signal and is occupying route 4—10, and that the operator wishes to clear the "call-on" signal to permit a following train to enter the same route. Signal 4C not only governs traffic movements over route 4—8 as hereinbefore described but also serves as a call-on signal for routes 4—8 and 4—10, as will be apparent from the signal network circuits of Fig. 1D. As in the case of route 4—8, when the first train entered section 7T, the route circuit was released before relay 7TZ closed its back contact 175, Fig. 1B. When this contact closes it bridges contact 18 of relay 7TP and the operator may then operate button 4P, and after relay 4RS picks up the operator will press button 10P to pick up relay 10PS to re-establish route 4—10. The closing of contact 29 of relay 10PS, Fig. 1C, completes the route circuit from terminal B, contact 29 of relay 10PS, back contacts 168 and 37 of relays 10RS and 5RR, relay 5BNR, front contact 176 of relay 5NWP, back contacts of relays 6PS and 3RR, relay 3NR, front contact 177 of relay 3NWP, back contact 39 of relay 1RR, relay 1BNR, front contacts 174 and 28 of relays 4RS and 4HR to terminal C, so that relays 5BNR, 3NR, 1BNR and 4HR become energized. The corresponding signal circuit, Fig. 1D, is now connected to terminal B over contact 178 of relay 10LS and the closed contacts 179, 180, 181, 86 and 193 of relays 5BNR, 3NR, 1BNR, 4HR, ant 1NWP but is open at contact 182 of relay 3TR or contact 183 of relay 7TR, so that mechanism 4AG remains deenergized, relay 4AGP remains picked up and lamp R of indicator 4K remains lighted.

The operator then pushes button 4CP, Fig. 1B, completing a circuit from terminal B, contact 184 of button 4CP, relay 4COS, contact 185 of relay 4AGP to terminal C, and relay 4COS picks up to complete a stick circuit over its own front contact 186 and contact 187 of relay 4PS. Relay 4COS also completes a branch of the signal circuit just traced which extends from front contact 30 of relay 4HR, Fig. 1D, over contacts 188 and 90 of relays 4COS and 4AGP, mechanism 4CG, contact 91 of relay 4HR to terminal C, thereby clearing signal 4C and releasing relays 4CGP and 4LS.

After the second train has passed the call-on signal 4C. the operator may cancel the route and restore the signal to stop by pulling button 4P to open contact 17, Fig. 1B. Relay 4COS, however, remains energized over a stick circuit including its own front contact 186 and back contact 189 of relay 4LS, and relay 4LS does not pick up when contact 93, Fig. 1F, of relay 4CGP closes, because its pickup circuit over back contact 117 of relay 7TP is now open at back contact 116 of relay COS. The time release of the locking is therefore effective, this feature operating as follows:

When signal 4C is restored to stop, a circuit is closed from terminal B, front contacts 93 and 114 of relays 4CGP and 4AGP, back contact 118 of relay 4LS, back contact 190 of relay 4TES, through the heating element of the thermal relay 4TE to terminal C. After a predetermined time, front contact 115 of relay TE closes to complete a pickup circuit for relay 4TES, which relay picks

up and is held energized over its own front contact 190 and back contact 118 of relay 4LS, deenergizing relay 4TE by opening back contact 190. After a predetermined cooling time, back contact 115 of relay 4TE closes to complete a pickup circuit for relay 4LS over front contact 191 of relay 4TES, as will be apparent from the drawings. Relay 4LS then picks up to complete a stick circuit from terminal B over its own front contact 118, and releases relay 4TES. Relay 4TES upon releasing, closes the check contact 87, Fig. 1D, in the circuits for the signals which control relay 4LS. It is to be noted that this time delay is nullified in case the approach section is unoccupied, because a pickup circuit for relay 4LS is then closed over front contact 192 of relay 4AR. The circuits for the other LS relays of Fig. 1F are generally similar, and it will be evident without further detailed description that they operate in each case in such a manner as to prevent the operator from cancelling a route in the face of an approaching train and then immediately setting up a different route. Since each signal circuit in Fig. 1D includes a front contact such as contact 79 or 178 for the relay LS for the opposing signal, it will be evident that a reversal of traffic direction is also prevented under these conditions.

When a route has been cancelled and the time locking is effective, it is desirable to inform the operator when the time interval ends and the locking becomes released. This is accomplished in accordance with a feature of my invention by causing the signal indicator to display a flashing red indication as long as the time locking is effective, as illustrated by the circuit for lamp R of indicator 4K which includes back contact 131 of relay 4LS, Fig. 1H, which has already been described.

Although I have described but a few of the many possible operations of this form of my apparatus, it is believed that the operation of setting up other routes and also of setting up routes and clearing the signals for the opposite direction will be readily understood from the drawings without further description.

I will next consider the second form of my invention and assume that the intermediate signal 12 is provided in the system disclosed in the drawings of Figs. 1A to 1H, inclusive. The relays of Fig. 2 will now function in response to the operation of button 12P or of the signal control relay 2HR or 4HR, as will be described. Relay 1ES is not required, and it is to be understood that its contact 97a, Fig. 1E, is replaced by contact 97b of relay 12LS, and also that contact 61 of relay 1ESK, Fig. 1G, is omitted, relay 5ESK now being controlled by relays 2—8HS and 12HS, as indicated on the drawings. The back contacts of the relays RR in the crcuits for relays 2PS and 4PS may also be omitted because routes 2—12 and 4—12 in this form do not conflict with route 6—8. Assuming first that buttons 4P and 8P are operated to set up route 4—8 as described in connection with the first form of the apparatus, in this case when relay 4HR picks up a circuit will be closed from terminal B, normal contact 201 of button 12P, Fig. 2, front contact 202 of relay 5TP, back contact 203 of relay 12HS, front contacts 204, 205 and 206 of relays 4HR, 1RR and 5ANR, relay 2—8HS to terminal C. Relay 2—8HS picks up and closes its stick circuit from terminal B over contacts 201 and 202 and its own front contact 207, and also closes contact 208 to pick up relay 2—8HSP.

Referring to Fig. 1C, it will be seen that the route circuit for route 4—8 initially includes back contact 209 of relay 2—8HS but that when this relay picks up the circuit is cut into two portions, the left-hand portion being connected to terminal B over front contact 209 and the right-hand portion to terminal C over contact 210 of relay 2—8HS, the continuity of the circuits being maintained while this relay is picking up because contact 209 is bridged by a circuit portion including resistor 211 and back contact 212 of relay 2—8HSP, which opens as soon as the latter relay picks up. The corresponding signal circuit of Fig. 1D is likewise cut into two portions, the right-hand portion being completed through mechanism 12G over front contacts 213 and 214 of relay 2—8HSP, while the left-hand portion is connected to terminal B over front contact 215 of relay 2—8HSP to energize mechanism 4CG. It follows, therefore, that in this case, signals 4C and 12 are both cleared, while if the same buttons are operated in the reverse order to pick up relay 8HR, signal 8C will clear as in the first form of the apparatus.

I will next assume that with the apparatus as shown, buttons 4P and 12P are operated in that order. Relays 4PS and 4RS pick up as already described, and the operation of button 12P as an exit button completes a circuit from terminal B, contact 216 of button 12P, back contacts 217 and 218 of relays 8HR and 2—8HS, relay 12PR to terminal C. Relay 12PR picks up, closing contact 219, Fig. 1C, connecting terminal B to the left-hand portion of the route circuit to energize relays 1RR and 4HR only, and relay 1RR closes contact 220, Fig. 2, to complete a circuit from terminal B, contact 201 of button 12P, contacts 222 and 220 of relays 12PR and 1RR, relay 12XS to terminal C. Relay 12XS picks up to complete a stick circuit from terminal B over contact 201 and its own front contact 224 and front contact 220 of relay 1RR. Relay 12PR releases when button 12P is released, but relay 12XS closes contact 225, Fig. 1C, to maintain the route circuit closed until contact 28 of relay 4RS opens, as in the first form. Relay 12XS also completes a connection from terminal B, front contact 226 of relay 5WS, Fig. 1D, front contact 227 of relay 12XS, thence as hereinbefore described over contacts 88 and 91 of relay 4HR through mechanism 4CG to terminal C. In this case, signal 4C will clear, but the train passing this signal will be held by signal 12 at stop.

I will next assume that signal 4C has been cleared by an operation of buttons 4P and 12P, and that while signal 4C is at clear, buttons 12P and 8P are operated in that order. It will be noted that when relay 12PR released, after its first operation, a circuit was closed from terminal B, front contact 228 of relay 12XS, back contact 229 of relay 12PR, relay 12CK to terminal C, and that relay 12CK is now energized over a stick circuit from terminal B over contact 228 and its own front contact 230. The second operation of relay 12PR therefore completes a circuit from terminal B, front contacts 231, 232 and 233 of relays 12PR, 12CK and 12XS, back contacts 234 and 235 of relays 5ANR and 5RR, front contact 236 of relay 5LR or front contact 237 of relay 5NWP, relay 12HS to terminal C, so that relay 12HS picks up to complete a stick circuit from terminal B, contact 201 of button 12P, contact 202 of relay 5TP, front contact 203 and winding of relay 12HS to terminal C. Relay 12HS closes contact 238, Fig. 1C, to

complete the route circuit to terminal C for relay 5ANR, and also closes contacts 239 and 240, Fig. 1D, to complete the signal circuit for mechanism 12G, to clear signal 12. It will be apparent, therefore, that signals 4C and 12 may be cleared either by an operation of buttons 4P and 8P or by an operation of buttons 4P and 12P followed by an operation of buttons 12P and 8P.

I will now assume that signal 4C has been cleared by an operation of buttons 4P and 12P and that a train has passed signal 4C and is approaching signal 12. The release of relay 7TR has caused the release of relays 7TP, 4PS, 4RS, 1RR, 12XS, 12CK and 4HR and of mechanism 4CG. If buttons 12P and 8P are now operated in that order, 12PR will become energized to complete a circuit from terminal B, front contact 231 of relay 12PR, back contacts 241, 242, 233, 234, 235 of relays 1ANR, 1RR, 12XS, 5ANR, 5RR, front contact 236 of relay 5LR or front contact 237 of relay 5NWP, relay 12HS to terminal C, so that relay 12HS will pick up to effect the clearing of signal 12 and the operation of crossover 5 if required, as in the preceding example. In either case, when relay 12HS is energized, relay 5ANR will become energized over contact 30 of relay 8PS, and will open back contact 234 in the pick-up circuit of relay 12HS so that the latter relay will release when the train passes signal 12 and causes contact 202 of relay 5TP to open.

It will be apparent from the foregoing that relay 12XS serves solely as an exit relay for the route portions 4—12 or 2—12, while relay 12HS serves solely as an entrance relay for the route portion 12—8, and that relays 2—8HS and 2—8HSP serve to clear signal 12 along with signal 4 or signal 2 when the route buttons 4P and 8P or 2P and 8P are operated. It is also to be understood that similar arrangements may be readily provided for the opposite direction in case it is desired to provide an intermediate signal for governing the movement of traffic from right to left into the route portions 12—2 or 12—4.

Since signal 12 is cleared only in response to the energization of relay 2—8HS or relay 12HS, it will be evident that the front contacts 243 and 244 of these relays shown in Fig. 1G serve to properly control the indication relay 5ESK in place of contact 61 of relay 1ESK, and that contacts 245 and 246 of these relays shown in Fig. 1H serve to properly control the circuits for lamp R of indicator 12K, and that the signal and track indicators will function in the second form of the apparatus in a manner consistent with the operation of the first form, as hereinbefore described.

Considering now the third form of my apparatus, it is to be understood that in this form Fig. 3A replaces the corresponding portion of Fig. 1C, the remaining apparatus of Figs. 1A to 1H being similar to that already described. Fig. 3A illustrates the route circuits for the two alternate routes 4—8 which differ from those of Fig. 1C in that they include contacts 301 and 302 of a stick relay 4—8TES, which relay is controlled by a thermal relay 4—8TE in the manner illustrated in Fig. 3B.

Assuming these relays to have been provided, if buttons 4P and 8P are operated as hereinbefore described, when relays 4PS and 8PS pick up a circuit is closed from terminal B over front contacts 303, 304, 305 and 306 of relays 4CGP, 8CGP, 4PS and 8PS, back contact 307 of relay 4—8TES, through the heating element of the thermal relay 4—8TE to terminal C. Normally signal 4C or 8C will clear before relay 4—8TE closes its front contact 308 and then contact 303 or 304 will open to restore relay 4—8TE to its normal cooled condition, but if for any reason the preferred route 4—8 over crossover 1 fails to be completed within a predetermined time, contact 308 closes completing a pickup circuit through relay 4—8TES to terminal C, whereupon this relay picks up closing a stick circuit from terminal B over its own front contact 309, front contacts 305 and 306 of relays 4PS and 8PS and its own front contact 307, and also opens back contact 301 in the preferred route circuit of Fig. 3A and closes front contact 302 to complete the secondary route circuit. The selection of the secondary route circuit is thereby effected automatically at the end of a predetermined time whenever the preferred route fails to become established, and relay 4—8TES is then held energized until a train enters the route and relays 4PS and 8PS release. This method of selection obviously can be further extended to effect the selection of one or more additional routes one at a time in order when such routes are provided by the track layout, each route being selected in the event the preceding one is not completed within a predetermined time.

In Fig. 4, I have illustrated means whereby the directional route relay RS at the entrance end of a route is operated automatically by an approaching train, so that the operation of the route button at that end of a route is rendered unnecessary in the event a train occupies the corresponding approach section. In the fourth form of my apparatus, which I will now describe, it is to be understood that circuits similar to those of Fig. 4 replace the circuits for controlling one or more of the pairs of relays PS and RS of Fig. 1B in the first form of the apparatus, the circuits of Fig. 4 as shown, being arranged to replace those controlled by button 4P in Fig. 1. Fig. 4 includes circuits for picking up relays 4PS and 4RS successively when button 4P is operated as an entrance button, and circuits for picking up 4PS only when button 4P is operated as an exit button, and also includes circuits for releasing these relays manually or when a train enters the route, which are similar to those of Fig. 1B. In addition, Fig. 4 includes a momentary pickup circuit for relay 4RS which circuit is controlled by the approach relay 4AR and by a slow-acting repeater relay 4ARP. Relay 4ARP is normally energized over a circuit extending from terminal B, contact 17 of button 4P, front contacts 401 and 402 of relays 7TP and 4AR, relay 4ARP to terminal C. When a train moving from left to right enters section 4T, relay 4AR releases, as hereinbefore described, and completes a circuit momentarily from terminal B over the normally closed contact 17 of button 4P, front contact 401 of relay 7TP, back contact 402 of relay 4AR, front contact 403 of relay 4ARP, back contact 23 of relay 4PS, relay 4RS to terminal C. The duration of this impulse is made sufficient to insure that relay 4RS will pick up to close its stick circuit, which includes its own front contact 404 in place of contact 403 but otherwise is the same as the circuit just traced. Contacts 13 and 37 of relays 4AR and 4RS, Fig. 1H, complete the circuits for lamps R of indicators 4AK and 4K, and since front contact 28 of relay 4RS, Fig. 1C, is closed, the route circuits for routes 4—8 and 4—10 are connected to relay 4HR and buttons 8P and 10P are conditioned to function as exit buttons only. It will be clear, therefore, that when section 4T is occupied by an approaching eastbound train

the operation of button 4P as an entrance button is not required, but that the operation of button 8P only or button 10P only will complete the route circuit for route 4—8 or 4—10 and clear the corresponding signal 4C or 4A. If the operator does not wish to set up the route for the train in section 4T at this time, but desires first to use button 8P or 10P as an entrance button to set up route 8—6 or 10—6, for example, he will pull button 4P to open contact 17 momentarily to release relay 4RS before operating button 8P or 10P. It is also to be noted that in Fig. 4 relay 4RS does not pick up when a departing westbound train enters section 4T because in this case contacts 401 and 403 of relays 7TP and 4ARP are opened before back contact 402 of relay 4AR closes. In the particular case illustrated, it is necesasry also to provide auxiliary means for opening the secondary route circuit for route 4—8, when the preferred route 4—8 is set up without operating relay 4PS, which as shown in Fig. 4, comprises a back contact 405 of relay 4RS in series with the back contact 31 of relay 4PS which serves for this purpose in the first form of the apparatus. It is to be understood, therefore, that in the fourth form of the apparatus, contacts 31 and 405 in series replace contact 31 of relay 4PS in Fig. 1C. It will be apparent from the foregoing description that the fourth form of my apparatus provides means whereby an approaching train may be directed over any one of a plurality of diverging routes merely by momentarily operating a single push button associated with the exit end of the desired route.

Although I have herein shown and described but a few forms of apparatus embodying my invention, 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 system for railroads, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a signal for each track at each end of the layout for governing the movement of traffic through the layout, a track diagram comprising a plurality of portions provided with substantially linear light sources and adapted to form an illuminated representation of said track layout, a manually operable contact for each track at each end of the diagram, interlocked route control means responsive to the manual operation of a contact at one end and the subsequent operation of a contact at the opposite end of the diagram to operate the track switches as required to complete a traffic route between the corresponding ends of the track layout, means effective when said route is completed to illuminate certain portions of said diagram to visually indicate said route by a substantially continuous illuminated line, means controlled by said route control means for clearing the signal at one end of the route or the other, depending upon the relative order in which said contacts were closed, track controlled means for illuminating the portions of the diagram corresponding to said route by light of a different color to indicate the movement of a train over the successive track sections of the route, means cancelling the illumination of the corresponding portions of the diagram as each track section is vacated, and track controlled means for releasing said route control means to cancel said route and to restore the cleared signal to stop when the train enters the first track section of the route.

2. In combination, a detector section of railway track including a track switch, a track relay for said section, a track diagram arranged to form a miniature representation of said detector section and provided with two substantially linear translucent portions including one for each branch track extending in the trailing direction from the track switch, means controlled by the track switch and by a front contact of the track relay for at times illuminating a selected one of said portions by light of one color to indicate an available route over the track switch, and means controlled by the track switch and by a back contact of the track relay for at times illuminating said portion by light of a different color to indicate that said route is occupied by a train.

3. In combination, a detector section of railway track including a track switch, a track diagram comprising a plurality of substantially linear translucent portions arranged to form a miniature representation of said track including one portion for each branch track extending in the trailing direction from the track switch and a portion for the single track extending in the facing direction from the track switch, manually controlled means for at times illuminating one or the other of said branch track portions in accordance with the position of the track switch and for also illuminating said single track portion to indicate by a substantially continuous illuminated line the available route through the detector section, means rendered effective when the detector section becomes occupied by a train for changing the character of said illumination to indicate the presence of the train, and means for automatically cancelling said illumination when the detector section becomes vacated.

4. In combination, a detector section of railway track including a track switch, a track diagram comprising a plurality of portions arranged to form a miniature representation of said detector section, two lamps of different colors for each portion for illuminating such portion, manually controlled means effective if operated when the detector section is unoccupied to light one lamp for each portion, and means rendered effective when the detector section becomes occupied to extinguish said one lamp for each portion and to light the other lamp for each portion.

5. In combination, a detector section of railway track including a track switch, a track diagram comprising a plurality of portions arranged to form a miniature representation of said detector section, two lamps of different colors for each portion for illuminating such portion, manually controlled means effective if operated when the detector section is unoccupied to light one lamp for each portion, means effective when the detector section becomes occupied to extinguish said one lamp for each portion and to light the other lamp for each portion, and means effective when the detector section is vacated to extinguish said other lamp for each portion.

6. In combination, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a track diagram comprising a plurality of portions arranged to form a miniature representation of said layout, two lamps of different colors for each portion for illuminating such portion, control means for establishing different traffic routes through said layout, means effective when a route is established through said layout to light

one lamp for each portion of the corresponding route on said diagram, means effective when each track section of said route is occupied to extinguish the lamps for the corresponding portions of the route and to then light the other lamps for such portions, and means effective when each track section of said route is vacated for extinguishing such other lamps.

7. In combination, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a track diagram arranged to form a miniature representation of said layout, lamps of two colors for illuminating the tracks of said diagram, control means for establishing different traffic routes through said layout, means effective when a route is established to light the corresponding lamps of one color to visually indicate such route on said diagram, means effective as each track section of said route becomes occupied to light the lamps of the other color only to illuminate the corresponding section of the diagram, and means effective as each track section is vacated to cause the corresponding section of the diagram to become dark.

8. In combination, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a track diagram composed of strips of translucent material arranged to form a miniature representation of said layout, control means for establishing different traffic routes through said layout, means effective when a route is established to illuminate the strips which form the representation of the corresponding route by light of one color, means effective as each track section of said route becomes occupied to illuminate the strips which form the representation of that section by light of another color, and means effective as each track section is vacated to cause the representation of that section to become dark.

9. In combination, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a signal at each route and at each end of said layout, a track diagram arranged to form a miniature representation of said layout including two indication lamps of different color for each signal in a corresponding location, control means for establishing different traffic routes through said layout and for clearing the signals for such routes, means effective when said control means is operated for clearing a signal to light the corresponding indication lamp of one color only, and means responsive to the clearing of such signal for lighting the corresponding indication lamp of the other color only.

10. In an interlocking system for railroads, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a track relay and a stick relay for each track section, control means for each route effective when energized to operate the track switches as required to establish such route, means for maintaining said control means energized until the entering section of said route becomes occupied, means for energizing the stick relay for said entering section when said control means is operated, means for energizing the stick relays for each of the succeeding sections of said route, each when the stick relay for the next preceding section of said route becomes energized, a holding circuit for each stick relay closed when the track relay for the same section in deenergized, and route indication means controlled by said stick relays.

11. In an interlocking system for railroads, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a track relay and a stick relay for each track section, control means for each route effective when energized to operate the track switches as required to establish such route, means for maintaining said control means energized until the entering section of said route becomes occupied, means for energizing the stick relay for said entering section when said control means is operated, means for energizing the stick relays for each of the succeeding sections of said route, each when the stick relay for the next preceding section of said route becomes energized, a holding circuit for each stick relay closed when the track relay for the same section is deenergized, route indication means controlled by front contacts of said stick relays and of said track relays, and track indication means controlled by front contacts of said stick relays and by back contacts of said track relays.

12. In an interlocking system for railroads, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a track relay and a stick relay for each track section, control means for each route effective when energized to operate the track switches as required to establish such route, means for maintaining said control means energized until the entering section of said route becomes occupied, means for energizing the stick relay for said entering section when said control means is operated, means for energizing the stick relays for each of the succeeding sections of said route, each when the stick relay for the next preceding section of said route becomes energized, a holding circuit for each stick relay closed when the track relay for the same section is deenergized, a track diagram comprising a miniature representation of the track layout, two sets of lamps of different color for illuminating the tracks of said diagram to indicate different traffic routes through said layout including one or more lamps of each set for each track section, means controlled by front contacts of the track relays and of said stick relays to light those lamps of one set which correspond to the route established by the energized control means, and means controlled by back contacts of each track relay for lighting certain lamps of the other set to indicate the occupancy of the corresponding track section.

13. In an interlocking system for railroads, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a track diagram comprising a miniature representation of the track layout, a plurality of lamps included in the tracks of said diagram for displaying illuminated representations of the different routes through said layout, route control means for each route effective when energized to operate one or more of the track switches as required to establish said route, an indication relay for each track section, means controlled by said route control means when energized to successively energize in tandem the indication relays for the successive sections of the corresponding route only, and means controlled by said indication relays and by the track switches for lighting certain of said lamps to indicate the portions of said route that are already established and for lighting the remain-

ing lamps for said route when the operated switches assume their operated positions to thereby indicate a complete route on said diagram as soon as said route is fully established through said track layout.

14. In an interlocking system for railroads, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a track diagram comprising a miniature representation of the track layout, a plurality of lamps included in the tracks of said diagram for displaying illuminated representations of the different routes through said layout, route control means for each route effective when energized to operate one or more of the track switches as required to establish said route, and indication relay for each track section, means controlled by said route control means when energized to successively energize in tandem the indication relays for the successive sections of the corresponding route only, a track relay for each track section, means controlled by each track relay for maintaining the indication relay for the corresponding track section energized until such section is vacated by a train moving over the established route, and means controlled by said indication relays and track relays for controlling the corresponding lamps of said track diagram to indicate the progress of the train over said route.

15. In an interlocking system for railroads, a plurality of traffic routes through a track layout, a manually operable contact for each route end for each end of the layout, means responsive to the successive momentary operation of the contacts for the opposite ends of a route to establish that route through the layout, and means dependent only upon the relative order in which such contacts are operated for determining the direction of traffic movements over that route when established.

16. In combination, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a manually operable contact for each route end for each end of the layout, means responsive to the successive momentary closing of the two contacts for the opposite ends of a route to establish that route through the layout, means dependent only upon the relative order in which said contacts are closed for determining the direction of traffic movements over that route when established, and means for automatically cancelling the established route when a train enters the first track section of that route.

17. In combination, a plurality of traffic routes through a track layout, a centrally biased three-position manually operable circuit controller for each route end for each end of the layout, means responsive to the successive momentary operation of the circuit controllers for the opposite ends of a route to their first operating positions to establish that route through the layout, means dependent only upon the relative order in which said controllers are operated for determining the traffic direction over that route when established, and means for cancelling said route in response to a movement of one controller to its other operating position.

18. In combination, a plurality of traffic routes through a track layout, a push button for each route end for each end of the layout, each provided with a single contact closed when such button is operated, a route relay for each push button, each effective when operated to select the corresponding direction for traffic movements through the layout, means effective if a push button for one end of the layout is operated to operate the associated route relay provided said push button is operated before any push button for the opposite end is operated, and means effective to establish the route connecting the corresponding route ends of the layout if such push button is operated after a push button and route relay for the opposite end of the layout have been operated.

19. In an interlocking system for railroads, a plurality of routes through a track layout, a signal for each track at each end of the layout for governing the movement of traffic over said routes, a single normally open manually operable contact for each route end for each end of the layout, means responsive to the momentary closing in sequence of the two contacts for the opposite ends of a route to establish that route through the layout, and means dependent only upon the relative order in which said contacts are closed and effective when that route is established to selectively clear one or the other of the two opposing signals for governing the movement of traffic over that route.

20. In an interlocking system for railroads, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a signal for each track at each end of the layout for governing the movement of traffic over said routes, a track relay for each section, route control means for each route, a manually operable contact for each route end for each end of the layout, means responsive to the momentary closing in sequence of the two contacts for the opposite ends of a route to energize the route control means for that route, means controlled by said route control means for operating one or more of the track switches as required to establish that route, means dependent only upon the relative order in which said contacts are closed and effective when said route is established to selectively clear one or the other of the two opposing signals for governing the movement of traffic over that route, and means controlled by the track relay for the entering track section of that route for automatically releasing said route control means.

21. In an interlocking system for railroads, a railway track switch operable to normal and reverse positions, signals for governing the movement of traffic over said switch in each of its positions in opposite directions, whereby either of two routes may be set up to permit a train to move in either direction over the switch, a push button for each of said signal locations, means responsive to the operation of the push button for one end of a route followed by the operation of the push button for the opposite end of said route for automatically operating the track switch to a proper normal or reverse position for that route, and means dependent only upon the relative order of operation of said push buttons for clearing the signal at that end of the route which corresponds in location to the push button which was operated first.

22. In an interlocking system for railroads, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a plurality of signals for governing the movement of traffic through said layout in opposite directions, a miniature track diagram corresponding to said track layout, a push button on said track diagram for each of

said signals and in a corresponding position, means responsive to the actuation in sequence of the two push buttons at the opposite ends of a route to operate one or more of the track switches as required to establish that route and to then clear one of the two opposing signals governing the movement of traffic over that route, and means dependent only upon the relative order in which said push buttons were actuated for determining which of said two signals is to be cleared.

23. In an interlocking system, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a normal control relay and a reverse control relay for each switch, a route network comprising a plurality of interconnected circuits each corresponding to one of said routes and each of which includes in series the winding of the normal or reverse control relay for each switch in the corresponding route, a manually controllable contact for each route end for each end of said network, means responsive to the successive operation of the contacts for the opposite ends of a route to energize the network circuit for said route for operating the switch control relays to establish said route, and means dependent only upon the relative order in which said contacts are closed for determining the direction of traffic movements over said route when established.

24. In an interlocking system, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a normal control relay and a reverse control relay for each switch, a route network comprising a plurality of interconnected circuits each corresponding to one of said routes and each of which includes in series the winding of the normal or reverse control relay for each switch in the corresponding route, a stick relay for each route end at each end of said network, a pickup circuit for each stick relay including a manually operable contact, means responsive to the successive energization of the stick relays at the opposite ends of a route to energize the network circuit for said route thereby operating the switch control relays to establish said route, and means controlled by said switch control relays for maintaining said stick relays energized until the entering track section of said route becomes occupied by a train or said route is manually cancelled.

25. In an interlocking system, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a normal control relay and a reverse control relay for each switch, a route circuit network comprising a plurality of interconnected route circuits each corresponding to one of said routes and each of which includes in series the winding of the normal or reverse control relay for each switch in the corresponding route, a manually operable route button for each route end at each end of said network, a stick relay for each route end having a pickup circuit controlled by the associated route button, means responsive to the successive energization of the stick relays at the opposite ends of a route to energize the network circuit for said route thereby operating the switch control relays to establish said route, and means including a back contact of one of said switch control relays for preventing the energization of the stick relay for the end a conflicting route.

26. In an interlocking system for railroads, a plurality of railway tracks interconnected by track switches to form a plurality of traffic routes, a manually controllable contact and a slow pickup route relay for each route end, a route network comprising a plurality of interconnected circuits each corresponding to one of said routes, means for energizing the route relay for one end of a route when the associated manually controllable contact is closed, means responsive to the closing of the manually controllable contact for the other end of said route after said route relay has picked up for energizing the network circuit for said route, means controlled by said network circuit when energized to prevent the pickup of the route relay for said other end even though the associated manually controllable contact is closed and to also operate the track switches as required to establish said route, and means controlled by the energized route relay for for controlling the direction of traffic movements over said route when established.

27. In combination, a plurality of traffic routes through a track layout, a manually controllable relay for each route end for each end of the layout, means rendered effective to select the corresponding direction for traffic movements through the layout if one of said relays becomes energized before any of said relays for the opposite end of the layout is energized, and means rendered effective to establish the route connecting the corresponding route ends of the layout if such relay becomes energized after one of said relays for the opposite end of the layout has been energized.

28. In combination, a plurality of traffic routes through a track layout, a manually controllable stick relay and a route relay for each route end for each end of the layout, means for energizing each route relay when the associated stick relay becomes energized provided no stick relay for the opposite end of the layout is energized, and means responsive to the energization of a stick relay for one end of the layout after a route relay for the opposite end of the layout has been energized for establishing the route connecting the corresponding route ends of the layout to permit a traffic movement in the corresponding direction.

29. In combination, a plurality of traffic routes through a track layout, a manually controllable stick relay and a route relay for each route end for each end of the layout, means for energizing each route relay when the associated stick relay becomes energized provided no stick relay for the opposite end of the layout is energized, means responsive to the energization of a stick relay for one end of the layout after a route relay for the opposite end of the layout has been energized for establishing the route connecting the corresponding route ends of the layout to permit a traffic movement in the corresponding direction, track controlled means for releasing the stick relay which governs the energized route relay, and means controlled by such route relay when released to release the stick relay for the opposite end of the route.

30. In an interlocking system for railroads, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a manually controllable stick relay and a slow pickup route relay for each route end, a route network comprising a plurality of interconnected circuits each corresponding to one of said routes, means for energizing the route relay for one end of a route

when the associated stick relay is energized, means effective if the route relay for one end and the stick relay for the other end of a route are picked up to energize the network circuit for said route, means controlled by said network circuit when energized to prevent the pickup of the route relay for said other end even through the associated stick relay is energized and to also operate the track switches as required to establish said route, means controlled by the energized route relay for controlling the direction of traffic movements over said route when established, and means responsive to the occupancy of the entering track section of said route to release said stick relays to cancel said route.

31. In combination, a plurality of traffic routes through a track layout, a push button for each route end for each end of the layout and one for an intermediate point in said layout each provided with a single contact closed when such button is operated, means effective to select the corresponding direction for traffic movements through the layout if a push button for one end of the layout is operated before any push button for the opposite end is operated, means effective to establish the route connecting the corresponding route ends of the layout if such push button is operated after a push button for the opposite end of the layout is operated, and means effective if the push buttons at one end of the layout and at said intermediate point are operated to establish a route through the corresponding portion of the track layout only.

32. In combination, a plurality of traffic routes through a track layout, said layout including two alternate routes between the same route ends, a push button for each route end for each end of the layout, each provided with a single contact closed when such button is operated, means effective to select the corresponding direction for traffic movements through the layout if a push button at one end of the layout is operated before any push button for the opposite end is operated, means effective to establish the route connecting the corresponding route ends of the layout if such push button is operated after a push button for the opposite end of the layout is operated, means effective when the push buttons for the ends of said alternate routes are operated for normally selecting one of said alternate routes in preference to the other, and means for at times selecting the other alternate route.

33. In an interlocking system for railroads, a track layout for providing different traffic routes leading from a single track section at one end of the layout to any one of a plurality of tracks at the other end of the layout, an approach section of track adjacent said single track section, a track relay for said approach section, a manually operable contact for each of said plurality of tracks, and route control means controlled jointly by said track relay and by said contacts and responsive to the closing of any of said contacts after said approach section has become occupied by a train approaching said track layout for establishing the route leading from said single track to the corresponding one of said plurality of tracks.

34. In an interlocking system for railroads, a track layout for providing different traffic routes leading from a single track section at one end of the layout to any one of a plurality of tracks at the other end of the layout, an approach section of track adjacent said single track section, a track relay for said approach section, a manually operable contact for each of said plurality of tracks, a manually operable contact for said single track, means responsive to the closing of the contact for any one of said plurality of tracks after said track relay has been deenergized by a train approaching said layout for establishing the corresponding route for said train, and means at times responsive to the closing of said contact followed by the closing of the contact for the single track for establishing the same traffic route but for the opposite traffic direction.

35. In an interlocking system for railroads, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, an approach section adjoining a track section of said layout at one end of the layout, a manually operable contact for each route end for each end of the layout, means responsive to the joint operation of the two contacts for the opposite ends of a route to establish that route through the layout, and means effective when the approach section is occupied by an approaching train and only the contact for the exit end of a route for said train is operated to establish that route through the layout.

36. In combination, a plurality of traffic routes through a track layout, a push-pull button for each route end for each end of the layout, each provided with a single normally open contact closed when the button is pushed and with a single normally closed contact opened when the button is pulled, means rendered effective when the two buttons for the opposite ends of a route are pushed to establish that route through the layout, means dependent only upon the relative order in which such buttons are pushed for determining the traffic direction over that route, and means effective when one of such buttons is pulled to cancel the established route.

37. In an interlocking system, a track layout comprising a plurality of track sections interconnected by track switches to form different traffic routes, a route network comprising a plurality of interconnected circuits each corresponding to one of said routes, each including a normal or reverse control relay for each switch of the route in a corresponding position, route control means for each route circuit for at times energizing the switch control relays included therein to establish the corresponding route, a normal and a reverse stick control relay for each switch of the route, a manually operable means for energizing each stick control relay to operate the corresponding switch individually at times, and means controlled by each route control means when operated for releasing the operated stick control relays for the switches of the corresponding route.

38. In combination with a traffic route, a signal for governing the movement of traffic over said route, manually operable control means for clearing the signal, two normally dark indication lamps of different colors associated with said control means, means effective when said control means is operated or clearing said signal to light one of said lamps, and means effective upon the clearing of said signal in response to the operation of said control means for extinguishing said one lamp and lighting the other indication lamp.

39. In combination with a traffic route, a signal for governing the movement of traffic over said route, manually operable control means for clearing the signal, two normally dark indica-

tion lamps of different colors associated with said control means, means effective when said control means is operated for clearing said signal to light one of said lamps, means effective upon the clearing of said signal in response to the operation of said control means for extinguishing said one lamp and lighting the other indication lamp, time locking means controlled by said signal for preventing the setting up of a conflicting route when said signal is at clear and for a predetermined time after said signal is manually restored to stop, and means effective if the signal is manually restored to stop for intermittently lighting one of said lamps to display a flashing indication as long as said time locking is effective.

40. In combination, a track layout adapted to be arranged to form different traffic routes, signals at the ends of said layout for governing traffic movements over said routes, time locking means controlled by each signal for preventing the setting up of any conflicting route when a signal is at clear and for a predetermined time after such signal is manually restored to stop, signal control means including a manually operable control key for each signal operable to a first position to clear the signal and to a second position to manually restore the signal to stop, a normally dark indication lamp for each control key, means responsive to a movement of a control key to its first position to light the associated indication lamp, thereby indicating which key has been operated, and means responsive to a movement of a control key to its second position after the corresponding signal has been cleared to cause the associated indication lamp to display a distinctive flashing indication as long as said time locking remains effective.

41. In combination, a track layout adapted to be arranged to form different traffic routes, signals at the ends of said layout for governing traffic movements over said routes, time locking means controlled by each signal for preventing the setting up of any conflicting route when a signal is at clear and for a predetermined time after such signal is manually restored to stop, signal control means including a manually operable control key for each signal operable to a first position to clear the signal and to a second position to manually restore the signal to stop, two normally dark indication lamps for each control key, means responsive to a movement of a control key to its first position to light one of the associated indication lamps, means responsive to the clearing of the signal which such control key governs for extinguishing said one indication lamp and for lighting the other indication lamp associated with such control key, and means effective if the signal is put to stop by an operation of its control key to extinguish said other indication lamp and to cause said one indication lamp to display a flashing indication as long as said time locking remains effective.

42. In combination with a stretch of railway track, a main signal and a slow speed signal for governing the movement of traffic in one direction into said stretch, manually operable control means for selectively clearing said signals, an indication lamp associated with said control means, means for steadily lighting said lamp to indicate when said main signal clears, and means for intermittently lighting said lamp to display a distinctive flashing indication when said slow speed signal clears.

43. In combination with a stretch of railway track, a main signal and a slow speed signal for governing the movement of traffic in one direction into said stretch, manually operable control means for selectively clearing said signals, two normally dark indication lamps of different colors associated with said control means, means effective when said control means is operated to clear either signal to light one of said lamps, means effective upon the clearing of either signal to extinguish said one lamp and to light the other indication lamp, and means effective only when said slow speed signal is cleared to cause said other indication lamp to display a distinctive flashing indication thereby indicating which signal has been cleared.

44. In combination, a track layout including a plurality of track switches adapted to be arranged to form different traffic routes, signals for governing the movement of traffic over said routes, two normally deenergized stick relays for each switch, including a normal control relay and a reverse control relay each effective when energized to operate the switch to a corresponding position, manually operable means for selectively energizing said stick relays, locking means for each switch rendered effective to prevent its operation when a signal governing the movement of traffic over a route including the switch has been cleared, and means controlled by the locking means for each switch to cause both of the associated stick relays to be deenergized as long as such locking means is effective.

45. In combination, a track layout including a plurality of track switches adapted to be arranged to form different traffic routes, signals for governing the movement of traffic over said routes, two normally deenergized stick relays for each switch, including a normal control relay and a reverse control relay each effective when energized to operate the switch to a corresponding position, a pickup circuit and a stick circuit for each stick relay, manually operable momentary contact means for selectively closing the pickup circuits of said stick relays to effect their energization, locking means for each switch rendered effective to prevent its operation when a signal governing the movement of traffic over a route including the switch has been cleared, and means for opening both the pickup and stick circuits for the stick relays for each switch as long as the associated locking means is effective.

46. In a switch and signal control system for a railway track layout having at least two conflicting routes, control buttons for the ends of said routes, route establishing means appertaining to each of said routes and responsive to only the sequential operation of the control buttons for the ends of its route to set up that route and to clear a signal therefor, and means allowing only one of the route establishing means for said two conflicting routes to be responsive to said control buttons at the same time.

47. In a system of switch and signal control for railroads; a portion of railway track with signals at the opposite ends of such portion to govern traffic in opposite directions and having at least one intervening turnout track switch; a control panel; a single control button on said panel for each end of said track portion; and route establishing means associated with said track portion and responsive to only the sequential operation of said buttons for the two ends of said track portion to control the track switch and to clear one or the other of said signals depending upon the sequence of operation of said control buttons.

48. In a switch and signal control system of the character described, in combination with a miniature track diagram of a railway track layout, a glass strip for each of the various portions of track represented on said track diagram and included in the various routes through the track layout, said glass strip extending for substantially the entire length for the corresponding track portion on the track diagram and being formed with a surface to cause illumination of the strip as a whole by internal reflection of light from a concentrated light source, an indicating lamp location in back of each strip on the track diagram, manually operable buttons on said track diagram for the signal locations represented thereby, and route establishing means responsive to the joint actuation of the buttons for a given route for lighting the lamps for the portions of track included in that route, whereby said route is outlined on said track diagram by a series of illuminated strips of light.

49. In a system of the character described for governing train movement over a track layout providing a number of routes between signal locations over track switches in different positions, certain of such routes being disposed end to end so as to constitute through routes, a manually operable button associated with each signal location, route establishing means for each route between the signal locations at the ends thereof and rendered effective by the joint actuation of the two buttons for the entrance and exit ends of such route, said route establishing means for a route controlling the position of the switch or switches involved in that route and also governing the clearing of a signal at the entrance end of that route, electro-responsive means associated with a certain button for performing the same function in the control of said route establishing means as the manual operation of the corresponding button, and control circuits separate from said route establishing means for said electro-responsive means governed by buttons at the ends of through routes, whereby the actuation of the buttons at the extreme ends of certain through routes will cause operation of the electro-responsive means belonging to the intermediate button and act to control the switch positions and signal clearing throughout such through route the same as if all of the buttons involved in such through route had been operated.

50. A switch and signal control system of the entrance-exit type for governing train movement over various routes between signal locations of a railway track layout, said track layout providing at least one through route which comprises a plurality of adjoining routes each extending between signal locations at their respective ends, said system comprising a single self-restoring push button associated with each signal location, route establishing means for each route operable by the actuation of the two buttons for the ends of that route to govern the position of all of the switches in that route, and to control the clearing of the signal at one end or the other of such route depending upon which of the two buttons was first actuated; electro-responsive means associated with the button for each signal location intermediate to the extreme ends of said through route, and performing the same function in the control of the route establishing means as the manual operation of that button; and circuit means for governing the energization of said electro-responsive means by the operation of the buttons for the extreme ends of said through route.

51. In an interlocking system for railroads, a track layout including a plurality of track switches arranged to form a plurality of different traffic routes including two alternative routes between the same points at the ends of the track layout, manually controlled contacts for the route ends at each end of the layout, a normal and a reverse switch control relay for each switch in said two alternative routes for operating such switch to a corresponding normal or reverse position, a route circuit network including a route circuit for each of said two alternative routes each route circuit including the normal or reverse switch control relay for each switch of such route and also including back contacts of switch control relays included in the route circuit for the other route, selecting means for rendering one or the other of said route circuits energizable in response to the closing of the manually operable contacts for the common ends of said two alternative routes, manual means for controlling said selecting means to govern the energization of said route circuits, and means preventing a change in the condition of energization of said route circuits in response to the operation of said manual means when either route circuit is energized.

52. In an interlocking control system for railroads, a track layout including a plurality of track switches and having signals located at the ends of different traffic routes through said layout formed by the track switches, a control panel having thereon a miniature track diagram of the track layout, lamps associated with the lines of said track diagram adjacent each signal location and at intermediate points, said lamps being adapted when lighted to outline the various routes set up between signal locations, manually operable buttons mounted on said panel adjacent signal locations represented thereon, normal and reverse switch control relays for each switch for governing the operation thereof to the normal or reverse position, route establishing means responsive to the joint actuation of the buttons for any two given signal locations for energizing the normal or reverse switch control relays as required for all of the switches in the route between said signal locations, a detector track section for each switch, a plurality of directional stick relays two for each detector track section, energizing circuits for said stick relays governed by the button for the signal location at the entrance end of the route and the switch control relays of that route, stick circuits for the directional stick relays for each switch closed upon occupancy of its detector track section by a train, and lighting circuits for said lamps governed by said directional stick relays to cause lighting of such lamps as mark out the route established by actuation of buttons and to maintain such lighting of the lamps of that route ahead of a train but not behind it as it passes through the detector track sections of the route.

53. In an interlocking control system for railroads, a track layout including a stretch of main track between two extreme signal locations with an intermediate signal location, there being power-operated track switches in each portion of track between any two signals, a manually operable device for each of the signal locations, route establishing means for each portion of track between two signal locations responsive to the operation of the two manually operable devices

for said two signal locations alone for operating the track switch or switches in such portion to the positions required to allow train movement over such portion and for clearing the signal at the entrance end, electro-responsive means associated with the device for the intermediate signal location for performing the same function in the control of said route establishing means as the manual operation of the corresponding device, and control circuits for said electro-responsive means governed by said manually operable devices for the signal locations at the extreme ends of said stretch of track, whereby the manual actuation of the devices at the extreme ends of said stretch causes the operation of the electro-responsive means belonging to the intermediate signal location to act to control the route establishing means for each portion of track between said extreme signal locations and clearing the intermediate signal the same as if the manually operable devices of all such signal locations had been manually operated.

54. In a switch and signal control system of the entrance-exit type wherein a plurality of interlocked groups are located end-to-end, means for establishing a route in any given interlocked group and clearing the signal at the entrance end thereof by merely designating the entrance and exit ends of such route, and means interconnecting said route establishing means for the several interlocked groups so as to effect the clearing of a signal at the entrance to each of the groups between a designated entrance point in one group and a designated exit point in a subsequent interlocked group to establish a through route, said means requiring that a through route thus established may be manually restored to normal only by the individual restoration of its component parts in the several interlocked groups, and means for automatically restoring a through route to stop as a train passes through its respective component parts.

55. In a switch and signal control system of the character described for governing traffic in a particular direction through a track layout consisting of a first and second track portion adjoining respectively end-to-end to form a composite through route between extreme entrance and exits points, each of such track portions providing in itself a route between an entrance and an exit point; manually operable contact means for each entrance and exit point; an entrance relay for each entrance point; circuit means responsive to the actuation of the contact means for each of the entrance points for energizing an entrance relay for that point; circuit means for maintaining each of said entrance relays energized, dependent for deenergization upon passage of a train past that entrance point; route establishing means for each of the track portions responsive to the combined energization of the entrance relay for that portion and the actuation of the contact means for the exit point for that portion for setting up a route between those designated entrance and exit points, the route establishing means for the second track portion being also responsive to the combined energization of the entrance relay for the first track portion and the actuation of the contact means for the exit point of the second track portion; circuit means rendered effective upon setting up of a route through the second track portion as a result of the combined energization of the entrance relay for the first track portion and the actuation of the contact means for the exit point for the second track portion, for energizing an entrance relay for the second track portion and rendering the route establishing means effective for the first track portion as if the contact means for the exit point of that portion had been actuated in combination with the picking up of the entrance relay for that portion; and circuit means for maintaining said route establishing means for each portion energized dependent upon the energization of the entrance relay for that portion, whereby a through route is set up by actuation of the contact means for the extreme ends of that route, and the route establishing means for each portion is automatically restored to normal upon the passage of a train through that portion.

56. In a switch and signal control system of the entrance-exit type for a track layout including a plurality of interlocked groups adjoining end-to-end, there being entrance and exit points to each interlocked group; manually operable contact means for each entrance point and for each exit point to each route within each interlocked group; route establishing means responsive to the actuation of said contact means for each entrance and each exit point to each interlocked group for setting up an available route extending between the entrance and exit points thus designated; route establishing means responsive to the actuation of said contact means for an entrance point to one interlocked group together with the actuation of said contact means for an exit point to a subsequent interlock group for setting up a route between the entrance and exit points of each interlocked group between the entrance and exit points thus designated, and circuit means for maintaining said route establishing means for each interlocked group effective for each route set up and dependent for restoration to normal upon the manual actuation of said contact means for the entrance to that route within that interlocked group, such restoration being effective by interlocked groups even for through routes set up by end-to-end control.

57. In a switch and signal control system for railroads, a track layout having power-operated track switches for setting up routes between signal locations, normal and reverse switch control relays for each switch for governing the power operation thereof, manually controlled route establishing means for energizing the normal or reverse switch control relay for each of the track switches in any given route to establish that route and to clear a signal for governing traffic thereof, indicating lamps associated with said track diagram adjacent the portions of track corresponding with each signal location and the normal and reverse positions of each of the track switches, lighting circuits for each of said lamps controlled by the energization of said switch control relays, said lighting circuits effecting the illumination of the indicating lamp for the normal or reverse position of each of the track switches in any given route being established only after such track switch has been operated into a position corresponding with its respective normal or reverse switch control relay then energized, and said lighting circuits effecting the energization of the indicating lamps adjacent the signal locations at the ends of any given route being established as soon as the switch control relays for the switches adjacent the ends of that route are energized, whereby a route being established is initially outlined on the miniature track diagram and the complete response of the track switches is subsequently indicated by filling in the outline.

58. In a switch and signal control system, a track layout comprising parallel tracks connected by a crossover with separate track circuit sections for the opposite ends of said crossovers, a track relay for each track circuit section, switch position contacts respectively closed when said crossover is operated to the normal and reverse position, a miniature track diagram of said track layout, indicating means including lamps for illuminating linear portions of said track diagram representing the different positions of said crossover and the portions of each track common to both positions, circuits closed when a given one of said track relays is deenergized for lighting the lamp for the common portion of the corresponding track and the lamp for the normal position of the corresponding end of said crossover, said circuit for said normal position lamp including a switch position contact open when the crossover is in the reverse position, and a circuit including another contact closed when said track relay is deenergized and a switch position contact open when said crossover is in the normal position for lighting the lamp of the indicating means for the reverse position of said crossover.

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

JOHN M. PELIKAN.