June 29, 1948. E. M. ALLEN 2,444,323

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Dec. 23, 1944 3 Sheets-Sheet 1

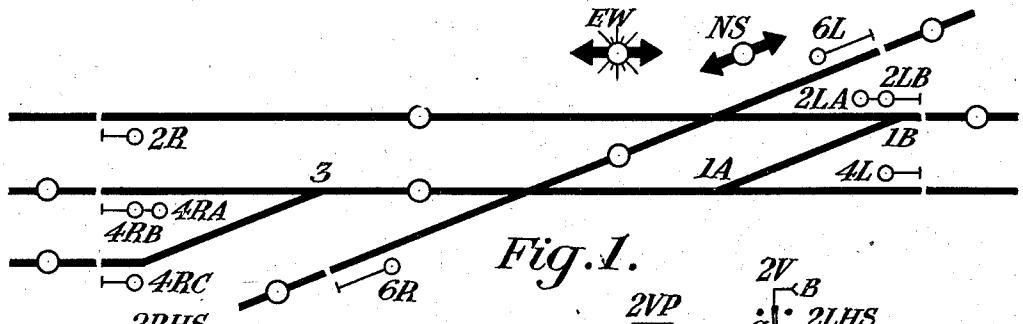


Fig. 1.

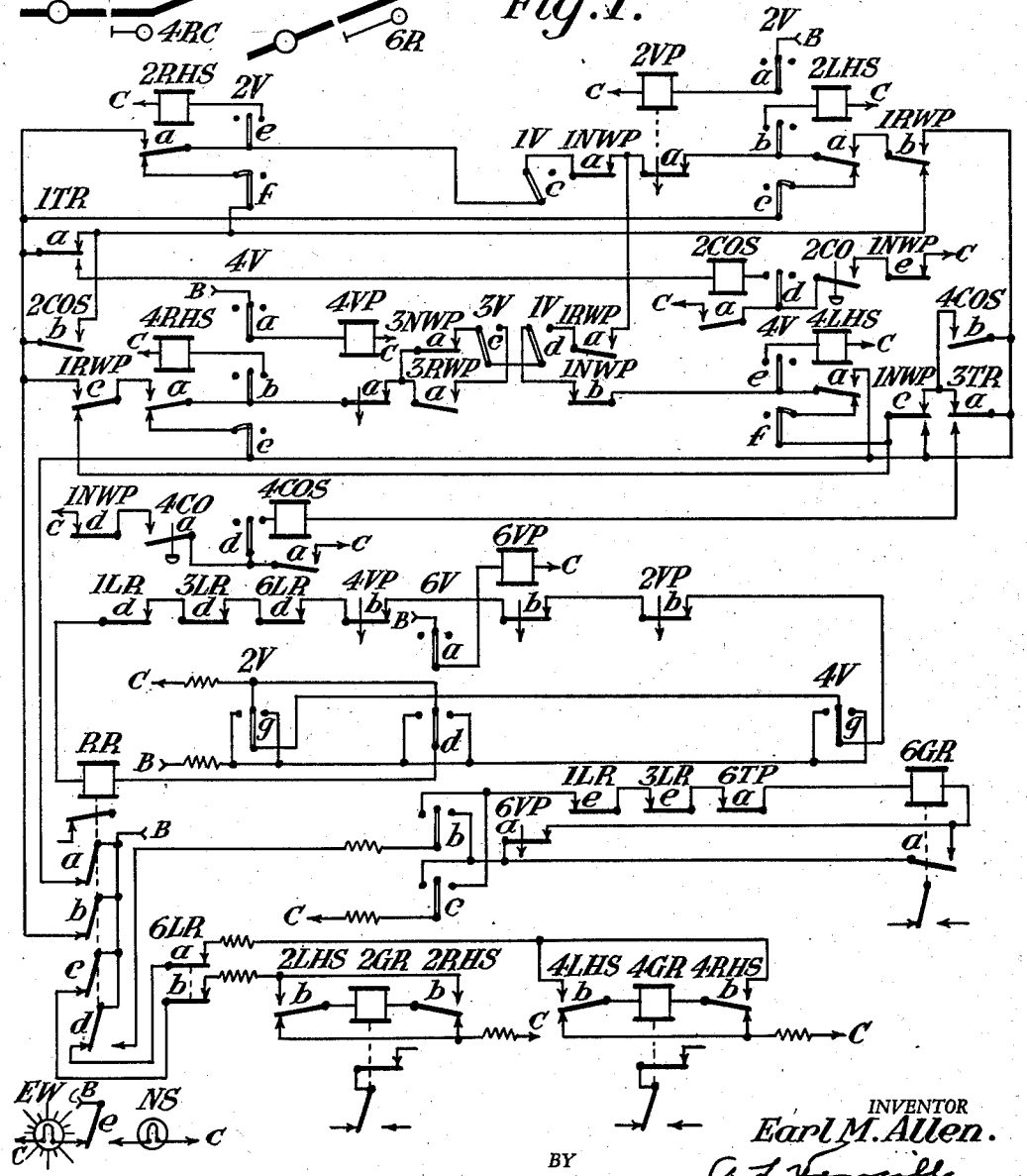


Fig. 2.

INVENTOR
Earl M. Allen.

BY

HIS ATTORNEY

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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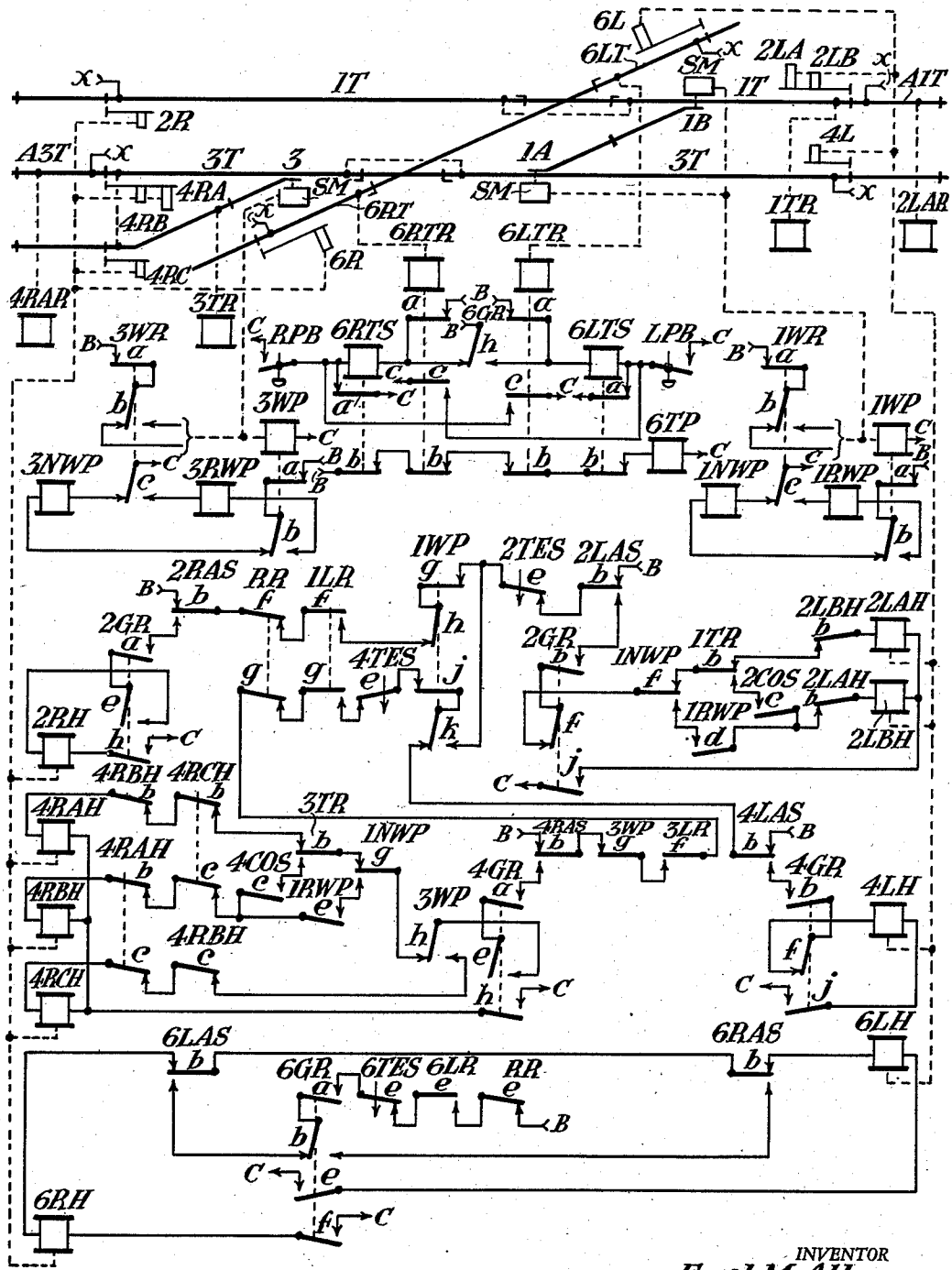


Fig. 3.

INVENTOR
Earl M. Allen.
BY
HIS ATTORNEY

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RAILWAY-TRAFFIC CONTROLLING APPARATUS

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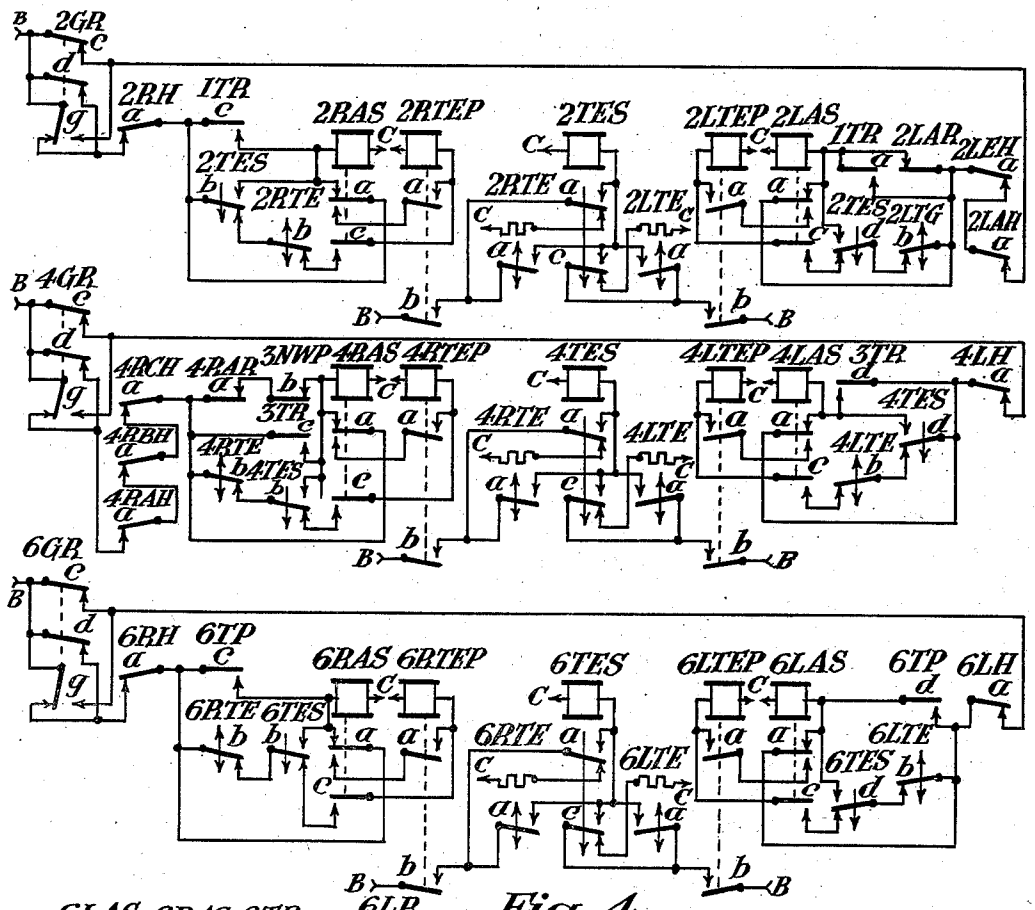


Fig. 4.

Fig. 5.

INVENTOR
Earl M. Allen.
BY
HIS ATTORNEY

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UNITED STATES PATENT OFFICE

2,444,323

RAILWAY TRAFFIC CONTROLLING APPARATUS

Earl M. Allen, Swissvale, Pa., assignor to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

Application December 23, 1944, Serial No. 569,565

7 Claims. (Cl. 246—134)

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My invention relates to railway traffic controlling apparatus, and more particularly to electrically interlocked control apparatus for railway track switches and signals.

One object of my invention is the provision of an improved interlocking system for railroads of the all-relay type, in which the signals may be cleared by the operation of their respective control levers only if free to respond at the time the levers are operated.

Another object of my invention is the provision of an improved system for the control of the track switches and signals of an interlocking plant in which one railroad crosses another, for the protection of traffic movements over the intersecting tracks of a railroad crossing.

A feature of my invention is the provision of a normally deenergized traffic locking relay which is operated to one position or another by the signal levers to give trains of one railroad or the other access to the track section which includes the crossing.

Other objects and features of my invention will be pointed out as the description proceeds.

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

Referring to the accompanying drawings, Fig. 1 comprises a track diagram of a typical track layout which I have chosen to illustrate my invention, while Figs. 2 to 5, inclusive, show the various circuits comprising the relay interlocking system of my invention, as described hereinafter in detail, Fig. 3 also including a plan of the tracks showing the track circuits for detecting the movements of trains through the layout.

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

By reference to Fig. 1, it will be seen that the track layout as shown includes the parallel tracks of a double track railroad extending through an interlocking plant having the crossover switches 1A and 1B and a single switch 3 for establishing different routes over which traffic movements in two directions are governed by the signals 2LA, 2R, etc., and that these tracks are crossed at grade by the single track of another railroad over which traffic movements are governed by the opposing signals 6R and 6L. For the guidance of the operator, it is to be understood that the usual switch, signal and track indication lamps are provided as is customary in systems of this character, although not shown herein. In addition thereto, two traffic indicators designated EW and NS, respectively, are provided on the track diagram, as shown. These indicators are illuminated by lamps controlled as shown in Fig. 2 so as to indicate the position of a polarized traffic locking relay RR controlled by the signal levers 2V, 4V and 6V, which also control the correspondingly numbered signals. When relay RR is in its normal position, as shown, indicator EW is illuminated, and only the signals of the double track railroad controlled by levers 2V and 4V may be cleared, while when relay RR is reversed, this indicator is extinguished and indicator NS is lighted, and then only the signals of the single track railroad controlled by lever 6V may be cleared.

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Fig. 2 shows the circuits controlled directly by the signal levers. Levers 2V and 4V for the signals governing movements over the interlocked track switches of the double track railroad control route relays 2RHS, 2LHS, 4RHS and 4LHS, each of which becomes energized over a route circuit having a portion conforming to a selected route when its lever is moved to a corresponding right or left-hand position, provided relay RR is in its normal position and the route is available, and in turn controls a polarized signal control relay 2GR or 4GR.

The signals for the single track road are controlled by a similar relay 6GR which since no route selection is required is controllable directly by its lever 6V when relay RR is reversed. Each signal lever in its normal position energizes a slow release repeating relay such as relay 2VP, the function of which is to render the relays controlled by the lever responsive to its operation to a reverse position only for the brief period directly following the lever operation. By this means the manually controllable relays are prevented from operating automatically without the knowledge of the operator, as the result of the release of the locking by which at times the relays are prevented from responding to lever operation.

Fig. 3 shows in the upper portion the various track circuits, each identified by the reference character T with a distinguishing numerical prefix, and the track relays TR controlled thereby, together with approach relays 4RAR and 2LAR for indicating the approach of trains running in the normal direction of traffic on the double track railroad. For simplicity the two rails of each track are represented by a single line on the track plan, but it will be understood that each track relay is connected in the usual manner across the rails at one end, and that a suitable source of current x is connected across the rails at the other end, of the corresponding track circuit.

The signals, as shown, may be assumed to be of the two-indication color light type, each having lighting circuits, not shown, controlled by a signal relay such as the relays 2RH, 4RAH, etc., the circuits for which are controlled by the relays GR as shown in the lower portion of Fig. 2, and for an understanding of my invention, it will suffice to assume that each signal indicates proceed when the corresponding signal relay such as relay 2RH is energized and indicates stop when such relay is released.

The high signals 2LA and 4RA govern main line movements over the track switches in their normal positions and are arranged to be restored to stop automatically when a train enters the track section in advance of the signal, likewise signals 6R and 6L, while the remaining signals are slow-speed signals arranged to remain at clear independently of track conditions as long as the controlling lever is reversed. Signals 2LB and 4RB govern slow-speed movements over switches 1A and 1B reversed and also serve as "call on" signals for effecting main line train movements into an occupied section, being cleared under this condition by the operation of a push button such as the button 4CO, Fig. 2, associated with the signal lever 4V, governing a call on stick relay such as the relay 4COS.

Each of the interlocked track switches is operable by a power switch machine SM, controlled by a polarized switch control relay 1WR or 3WR in a well-known manner as indicated diagrammatically in Fig. 3, the circuits for controlling relays 1WR and 3WR being shown in Fig. 5. Switch 3 controls the usual polarized indication relay 3WP and the crossover switches 1A and 1B jointly control a similar relay 1WP. Each relay WP is energized in its normal or reverse position when the corresponding track switch or switches are mechanically locked by the switch machine in a corresponding or reverse position. Each relay WR and the associated indication relay WP jointly control a normal or reverse switch correspondence relay such as the relay 1NWP or 1RWP as shown, having contacts in the route circuits of Fig. 2 and 3.

Due to the fact that it is impracticable to include the tracks at the crossing in the track circuits for both railroads, the track circuits 1T and 3T for the parallel tracks are divided, as shown in Fig. 3, into two sections connected by wires with insulated joints on opposite sides of the crossing track, while the single track includes two track circuits 6RT and 6LT with an intervening non-track circuited section. Train movements over the single track are detected by a "trap circuit" of a well-known type, employing two directionally controlled stick relays 6RTS and 6LTS controlled by the track relays 6RTR and 6LTR, together with a repeating relay 6TP.

Fig. 4 shows various approach and time locking relays controlled by the signal control relays GR of Fig. 2 and by the signal relays H of Fig. 3, by means of which the track switches and signals are electrically interlocked. The approach locking relays LAS and RAS of Fig. 4 control the circuits for the signal relays H of Fig. 3 and together with the track controlled relays 1TR, 3TR and 6TP, control switch locking relays 1LR, 3LR and 6LR, shown in Fig. 5, which relays govern the circuits for the relays GR and relay RR of Fig 2 and those for the signal relays H of Fig. 3, and also govern the circuits for the switch control relays WR of Fig. 5. The latter are controlled by manually operable switch levers 1V and 3V as shown in Fig. 5, the switch levers also having selecting contacts in the circuits for the route relays RHS and LHS of Fig. 2.

To simplify the circuit drawings, only the terminals of the local source of current for energizing the relays are shown, these being designated B and C to identify the positive or supply terminal and the negative or common return terminal, respectively.

Each track relay is normally energized by current from the source *x*, and each of the track repeating relays is normally energized from the local source having terminals B and C, likewise the approach locking relays LAS and RAS, the switch locking relays LR, the switch control and indication relays WR, WP and NWP and the signal lever repeating relays VP, the remaining relays shown being normally deenergized.

Having thus described the various components of the system of my invention, I shall now describe its operation under different assumed conditions, starting with the apparatus in its normal condition, as shown.

Assuming first that a train is approaching from the left in section A3T, for example, and that the operator moves lever 4V to the right with the object of clearing signal 4RA.

In Fig. 2, relay 4VP is deenergized by the reversal of lever 4V and during its release period relay RR is energized normal over the circuit extending from terminal B at the right-hand contact *g* of lever 4V, contacts *b* of relays 2VP 6VP and 4VP, contacts *d* of relays 6LR, 3LR and 1LR through relay RR from left to right to terminal C at the normal or center contact *d* of lever 6V, and with relay RR normal, relay 4RHS is energized over a route circuit extending from terminal B at the normal contact *a* of relay RR over front contact *a* of relay 3TR, front contact *c* of relay 1NWP, contact *f* of lever 4V, back contact *a* of relay 4LHS, contact *b* of relay 1NWP, normal contacts *d* of lever 1V and *c* of lever 3V, contacts *a* of relays 3NWP and 4VP, reverse contact *b* of lever 4V through relay 4RHS to terminal C. Relay 4RHS picks up and completes a stick circuit from terminal B at contact *a* of relay RR over front contact *a* of relay 3TR, front contact *c* of relay 1NWP, back contact *c* of relay 1RWP, front contact *a* of relay 4RHS, contact *b* of lever 4V through relay 4RHS to terminal C, which circuit is independent of the route circuit portion including the switch levers 1V and 3V.

Relay 4RHS energizes relay 4GR reverse over the circuit from terminal B at the normal contact *d* of relay RR over front contact *a* of relay 6LR, front contact *b* of relay 4RHS through relay 4GR to terminal C at back contact *b* of relay 4LHS.

In Fig. 4, relay 4GR opens the stick circuit for relay 4RAS extending from terminal B at the back contact *d* and normal contact *g* of relay 4GR over back contacts *a* of relays 4RAH 4RBH and 4RCH, contact *a* and winding of relay 4RAS to terminal C, so that relay 4RAS releases and by opening its contact *d*, deenergizes relays 1LR and 3LR of Fig. 5, and in Fig. 3, relay 4RAS closes its back contact *b* to prepare a circuit for the signal relay 4RAH.

In Fig. 5, the dropping of contacts *b* and *c* of relays 1LR and 3LR disconnects relays 1WR and 3WR from their respective switch levers 1V and 3V and establishes holding circuits for these relays extending to terminals B and C over the normal contacts *e* and *f* of relays 1WP and 3WP, respectively, thereby locking the track switches

electrically in the normal position as required for the route governed by signal 4RA.

In Fig. 2, relays 1LR and 3LR open their contacts *d* in the circuit for relay RR, and relay 4VP, which is now deenergized, releases to open its contact *b* in that circuit so that relay RR releases and is thereby locked normal. Relays 1LR and 3LR also open their contacts *e* in the circuit for relay 6GR to prevent the clearing of signal 6R or 6L.

In Fig. 3, the signal relay 4RAH becomes energized in response to the release of relays 1LR, 3LR and RR over the circuit extending from terminal B at front contact *b* of relay 4LAS, contacts *k* and *j* of relay 1WP, back contact *e* of relay 4TES of Fig. 4, contacts *g* of relays 1LR and RR, contact *f* of relay 3LR, contact *g* of relay 3WP, back contact *b* of relay 4RAS, contacts *a* and *e* of relay 4GR, normal contact *h* of relay 3WP, front contact *g* of relay 1NWP, front contact *b* of relay 3TR, back contacts *b* of relays 4RCH and 4RBH, through relay 4RAH to terminal C at contact *h* of relay 4GR, thereby clearing signal 4RA.

Assuming now that a train governed by signal 4RA enters section 3T, relay 3TR releases, opening the stick circuit for relay 4RHS and putting signal 4RA to stop, the signal remaining at stop after section 3T is vacated.

In the event the operator desires to admit a following train to section 3T while this section is occupied he will first restore lever 4V to normal to pick up relay 4VP, and then will reverse it again, at the same time operating the call on push button 4CO of Fig. 2 to pick up relay 4COS over back contact *a* of relay 3TR. Relay 4COS when energized completes a stick circuit at its own front contact *a* so that button 4CO may be released, and at its contact *b* relay 4COS completes the route circuit so that relays 4RHS and 4GR become energized. Then in Fig. 3 a signal circuit is completed which extends from terminal B at contact *b* of relay 4LAS over the path already traced to contact *g* of relay 1NWP, from which point it extends over back contact *b* of relay 3TR, front contact *c* of relay 4COS, back contact *c* of relay RCH, back contact *b* of relay 4RAH through relay 4RBH to terminal C at contact *h* of relay 4GR, so that relay 4RBH becomes energized to clear signal 4RB.

If relay 3TR now picks up, relay 4COS will release and signal 4RA will be cleared in place of signal 4RB, as will readily be apparent.

Assuming next that with the apparatus in the normal condition as shown that a slow speed signal such as 4RB or 4RC is to be cleared for a movement over a route different from the one established, the operator will first reverse the switch lever 1V or 3V to set up the required route. The operation of the switch lever opens the route circuit for the old route at the lever contacts *c* or *d*, rendering the signal levers ineffective to control the route relays RHS and LHS until the new route corresponding to the position of the switch levers is established and the corresponding switch indication relays NWP or RWP become energized. To clear signal 4RC, for example, with switches 1 and 3 reversed, and lever 4V in its right hand position, relay 4RHS is energized over the circuit from terminal B at the normal contact *b* of relay RR, contact *c* of lever 2V, contacts *a* of relays 2LHS, 2VP and 1RWP, reverse contact *d* of lever 1V, reverse contact *c* of lever 3V, contacts *a* of relays 3RWP and 4VP, reverse contact *b* of lever 4V through relay 4RHS to terminal C, and the stick circuit for relay 4RHS in this case extends to terminal B at contact *b* of relay RR over front contact *c* of relay 1RWP.

It will be seen that the route circuits for clearing signal 4RC, that for clearing signal 4RB for a movement over the crossover reversed, and those completed by operation of lever 4V to the left for clearing signal 4L, are not controlled by relay 3TR and that these signals are restored to stop only by returning lever 4V to its normal center position. It will also be seen that the circuits for signals 2LA, 2LB and 2R controlled by lever 2V are generally similar to those above described, and a detailed description is therefore deemed unnecessary.

Referring now to Fig. 4, it will be seen that when signal 4RA is put to stop by a train entering section 3T, relays 4GR and 4RAH having released, the approach locking relay 4RAS picks up at once over back contact *c* of relay 3TR, or if signal 4RA or 4RB is put manually to stop and the approach section A3T is unoccupied, over the circuit including contact *a* of relay 4RAR and contact *b* of relay 3NWP. Otherwise, the return of signal 4RA or 4RB, of the return of signal 4RC manually to stop interposes a time delay in the reenergization of relay 4RAS. Relay 4RTEP picks up upon the closing of back contact *a* of the signal relay, when the signal assumes its stop position, over back contacts *b* of relays 4RTE and 4TES and back contact *c* of relay 4RAS, completing a stick circuit at its own front contact *a* over back contact *a* of relay 4RAS. The closing of front contact *b* of relay 4RTP completes a circuit over back contact *a* of relay 4TES, for the thermal relay 4RT, which becomes energized and opens its contact *b* and after a predetermined heating period closes its contact *a* to energize relay 4TS. Relay 4TES completes a stick circuit at its contact *a* and deenergizes relay 4RTE, which after a predetermined cooling period closes its contact *b*, thereby energizing relay 4RAS, over the front contact *b* of relay 4TES, and relay 4RAS then is held energized over its front contact *a* and releases relays 4RTEP and 4TES.

In case signal 4L is put manually to stop, relay 4LAS is energized over generally similar circuits by the operation of relays 4LTEP, 4LTE and 4TES, but in this case a relatively short time interval is interposed, relay 4LAS being energized over front contact *d* of relay 4TES as soon as that relay becomes energized, that is, at the end of the heating period of the thermal relay 4LTE. As to the remaining approach locking relays, it will be noted that the circuits for relays 2RAS and 2LAS controlled by relay 2GR are similar to those controlled by relay 4GR, a short time element being interposed when signal 2R is put to stop and a long time element when signal 2LA or 2LB is put to stop, while the circuits for relays 6RAS and 6LAS controlled by relay 6GR are arranged so that a long time element is interposed when either signal 6R or 6L is manually put to stop.

I shall next assume that the operator moves lever 6V to the right with the object of clearing signal 6R, with the apparatus in the condition shown, relay RR being in its normal position.

The circuit for relay 6VP is opened at contact *a* of lever 6V, and a circuit is closed during the release period of relay 6VP from terminal B at the right-hand contact *d* of lever 6V through relay RR from right to left over contacts *d* of relays 1LR, 3LR and 6LR, contacts *b* of relays

4VP, 6VP and 2VP, and the center contacts *g* of levers 4V and 2V to terminal C, operating relay RR to its reverse position. Relay 6GR then becomes energized in the reserve direction over the circuit from terminal B at the right-hand contacts *d* of relay RR and *b* of lever 6V, contact *a* of relay 6VP through relay 6GR, over contact *a* of relay 6TP, contacts *e* of relays 3LR and 1LR to terminal C at contact *c* of lever 6V. Relay 6GR picks up with its polar contacts reversed and is held energized over a stick circuit including its own front contact *a* after relay 6VP releases.

In Fig. 4, the opening of back contact *d* and normal contact *g* of relay 6GR causes relay 6RAS to release, thereby releasing relay 6LR, which in turn releases relay RR and in Fig. 3, relay 6HR is energized over the circuit from terminal B over contacts *e* of relays RR, 6LR and 6TES, the neutral contact *a* and right-hand polar contact *b* of relay 6GR, back contact *b* of relay 6RAS, front contact *b* of relay 6LAS through relay 6RH to terminal C at contact *f* of relay 6GR thereby clearing signal 6RH. A conflicting signal cannot now be cleared for the reason that contacts *a*, *b* and *d* of relay 6LR in the circuits for relays 4GR, 2GR and RR are now open, and because relay RR is held deenergized in its reverse position, and the opposing signal 6LH cannot be cleared because front contact *b* of relay 6RAS in the circuit for relay 6LH is open.

If now a train governed by signal 6R enters section 6RT, the track relay 6RTR releases and in turn releases relays 6RTS and 6TP, so that relays 6GR and 6RH release to put signal 6R to stop, and relay 6RAS becomes reenergized, but relay 6LR is held deenergized by relay 6TP. When the train, in passing over the crossing, enters section 6LT, the track relay 6LTR releases, but relay 6LTS is held energized over the stick circuit including its own front contact *a* and the reverse contact *h* of relay 6GR. When the train in section 6LT vacates section 6RT, relay 6RTR becomes reenergized and energizes relay 6RTS over the circuit including front contact *a* of relay 6RTR and back contact *c* of relay 6LTR. Relay 6TP becomes reenergized upon the closing of contact *b* of relay 6LTR as the train vacates section 6LT, and then relay 6LR becomes reenergized.

In case signal 6L has been cleared, instead of signal 6R, contact *h* of relay 6GR is in its normal position and retains relay 6RTS energized, but relay 6LTS will release when the train enters section 6LT and pick up when it vacates that section, provided the train is then in section 6RT. In the case of an irregular movement in which the train releases relay 6RTS or 6LTS but does not pass over the crossing, relay 6RTS or 6LTS remains released until picked up by the operator by actuation of an emergency push button RPB or LPB, which buttons are preferably housed at suitable locations on opposite sides of the crossing tracks.

It will be seen that in order to clear signal 6R again, after it has been put to stop as described, or to clear signal 6L, the operator must first restore lever 6V to its normal center position to pick up relay 6VP and then reverse the lever after relay 6TP has been reenergized, and that the signal levers are effective to clear the signals only if operated at a time when the signals are free to respond at once to the lever operation.

Although I have herein shown and described only one form of railway traffic controlling apparatus embodying my invention, it will be 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 combination with a railway track layout, a signal for governing the movement of traffic over a selected route through said layout, a route relay for said signal, a signal lever having a normal position and a reverse position, a slow release relay arranged to be energized only when said lever is in its normal position, a route circuit having a portion conforming to said selected route and including a front contact of said slow release relay, means including a reverse contact of said lever for connecting said route relay to a source of current over said route circuit portion to effect its energization, a stick circuit for said route relay including its own front contact and the reverse contact of said lever for holding said route relay energized irrespective of the condition of said portion of the selected route circuit, and a signal relay having an energizing circuit closed by said route relay when energized for clearing said signal.

2. In combination with a railway track layout, a signal for governing the movement of traffic over a selected route through said layout, a track section in said route having a track relay, a route relay for said signal, a signal lever having a normal and a reverse position, a slow release lever repeating relay which when energized indicates that said lever occupies its normal position, a route circuit conforming to said selected route and having a portion including a front contact of said lever repeating relay, a pick-up circuit for said route relay including a reverse contact of said lever, said route circuit and a front contact of said track relay, a stick circuit including the reverse contact of said lever and the front contact of said track relay for holding said route relay energized irrespective of the condition of said route circuit portion, and a signal relay having an energizing circuit closed by said route relay when energized, for clearing said signal.

3. In combination with a railway track layout, a traffic route in said layout including a track switch, switch control means for operating the track switch, two signals for governing traffic movements in opposite directions over said route, a signal lever, a slow release relay which is energized only when said lever is in its normal position, a route relay for each signal, a route circuit portion including a front contact of said slow release relay and contacts closed by the switch and its control means in the position required for said route and connected at opposite ends to contacts controlled by said lever, pick-up circuits for each route relay closed by said lever contacts in opposite reverse positions, the circuit for each route relay including a back contact of the other, a stick circuit for each route relay independent of said route circuit portion but including its own front contact and the lever contact closed in the corresponding reverse position, and circuits for clearing each signal prepared by the associated route relay when energized and including contacts closed by the switch when in the position required for said route.

4. In combination with a railway track layout including two track sections connected by track switches, switch control means for operating the track switches, two signals for governing traffic

movements in opposite directions over a traffic route including said two track sections, a signal lever for each signal, a slow release relay for each lever which is energized only when such lever is in its normal position, a route relay for each signal, a route circuit portion including contacts closed by the switches and their control means in the position required for said route and connected at opposite ends to contacts controlled by said levers over front contacts of the associated slow release relays, a pick-up circuit for each route relay including said route circuit portion, a reverse contact of the associated signal lever, a normal contact of the other signal lever and a back contact of the other route relay, a stick circuit for each route relay independent of said route circuit portion but including its own front contact and said reverse contact of the associated signal lever, and a circuit controlled by each route relay when energized for clearing the corresponding signal.

5. In an interlocking system for railroads for governing traffic movements over two intersecting track sections, a signal for each section, a signal lever, a signal control relay and a locking relay for each signal, a polarized traffic relay, an energizing circuit for each signal control relay including contacts closed when the corresponding lever is reversed and a front contact of the locking relay for the other signal, one such circuit including a normal polar contact and the other a reverse polar contact of said traffic relay, circuits for energizing said traffic relay in the normal direction when one signal lever is reversed and in the reverse direction when the other signal lever is reversed including front contacts of the locking relays for both signals, an energizing circuit for each locking relay which is opened when the associated signal control relay is energized and is closed following its release provided the associated signal has been at stop for a measured time interval or a train governed thereby has vacated the corresponding track section, and a circuit for clearing each signal including a front contact of the associated signal control relay and back contacts of the associated locking relay and of said traffic relay.

6. In an interlocking system for railroads for governing traffic movements over two intersecting track sections, a signal for each section, a signal lever and a signal control relay for each signal, a polarized traffic relay, an energizing circuit for each signal control relay including contacts closed when the corresponding lever is reversed, said circuits including opposite polar contacts of said traffic relay, an energizing circuit for said traffic relay closed in response to the reversal of either signal lever and arranged to operate such relay to a position to complete the circuit for the signal control relay controlled by the operated lever, provided the other signal lever is in its normal position, means controlled by either signal control relay when energized for opening the circuit for said traffic relay, and a circuit for clearing each signal including a front contact of the associated signal control relay and a back contact of said traffic relay.

7. In an interlocking system for railroads for governing traffic movements over two intersecting track sections, a signal for each section, a signal lever, a slow release relay and a signal control relay for each signal, an energizing circuit for each slow release relay closed only when the associated lever is in its normal position, a polarized traffic relay, energizing circuits for said signal control relays including opposite polar contacts of said traffic relay, the circuit for each signal control relay including a reverse contact of the associated lever and a front contact of the associated slow release relay, an energizing circuit for said traffic relay closed in response to the reversal of either signal lever and arranged to operate such relay to a position to complete the circuit for the signal control relay controlled by the operated lever, said circuit including front contacts of both said slow release relays, and a circuit controlled by each signal control relay when energized for clearing the associated signal.

EARL M. ALLEN.