Aug. 21, 1945. H. L. BONE ET AL 2,383,037

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed April 15, 1944 4 Sheets-Sheet 1

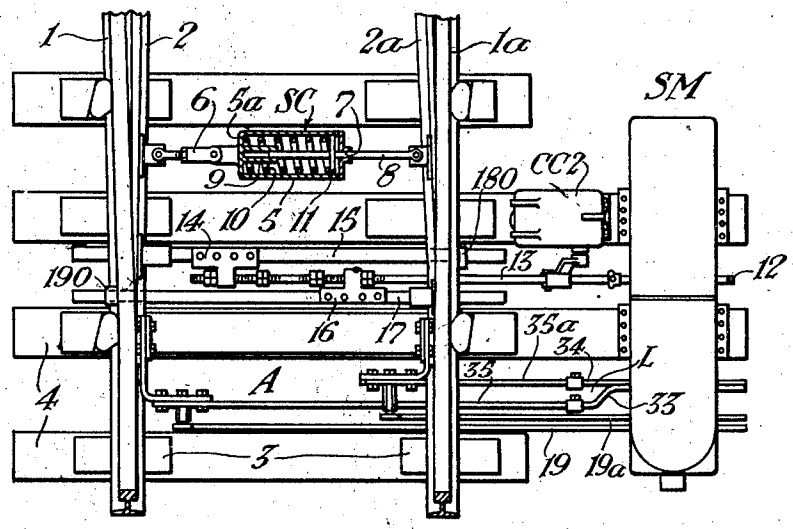


Fig. 1.

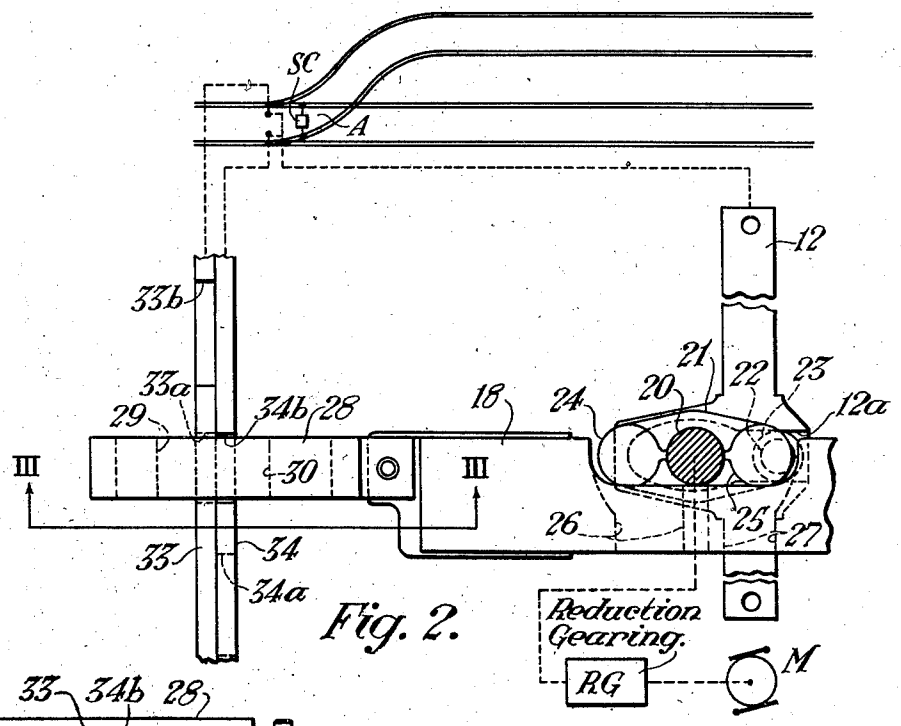


Fig. 2.

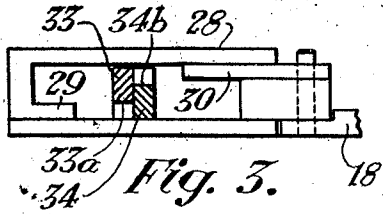


Fig. 3.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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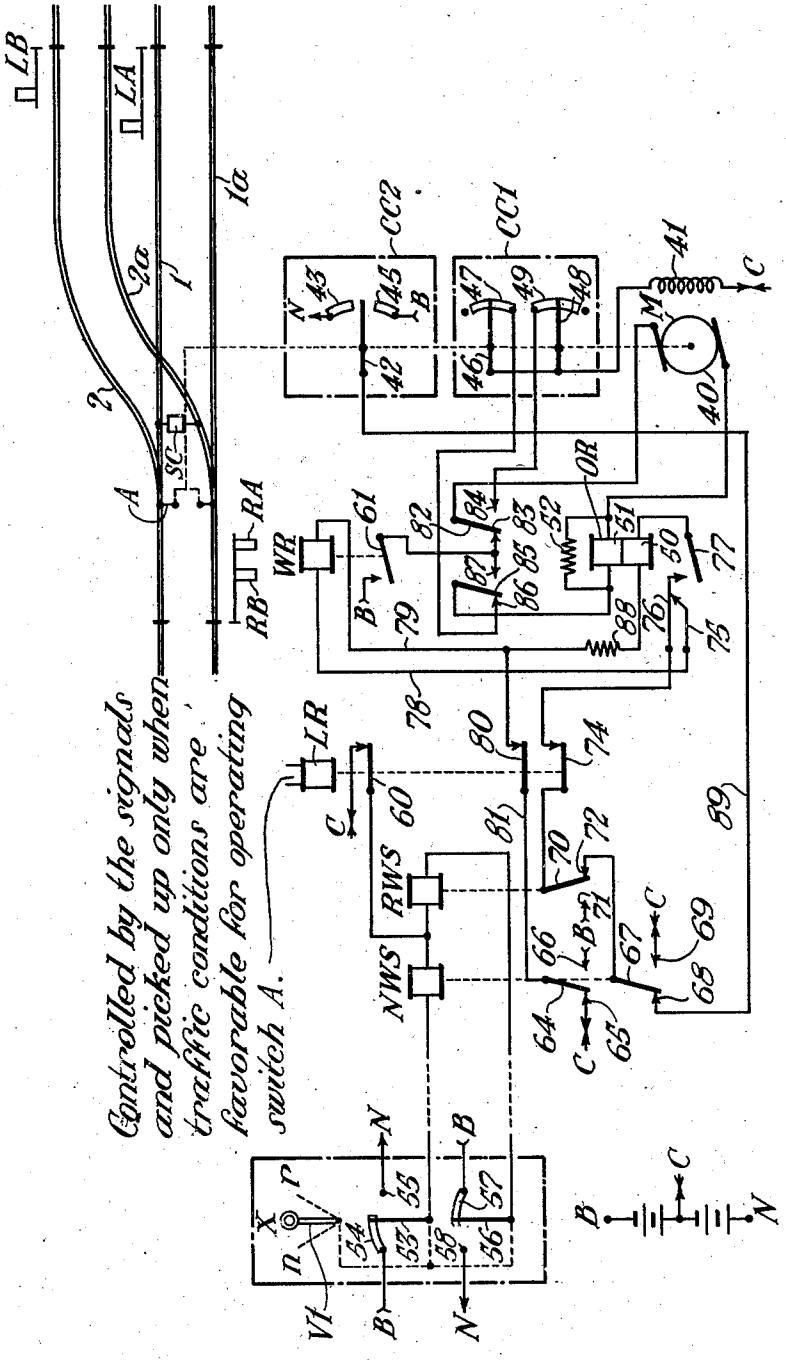


Fig. 4.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed April 15, 1944 4 Sheets-Sheet 3

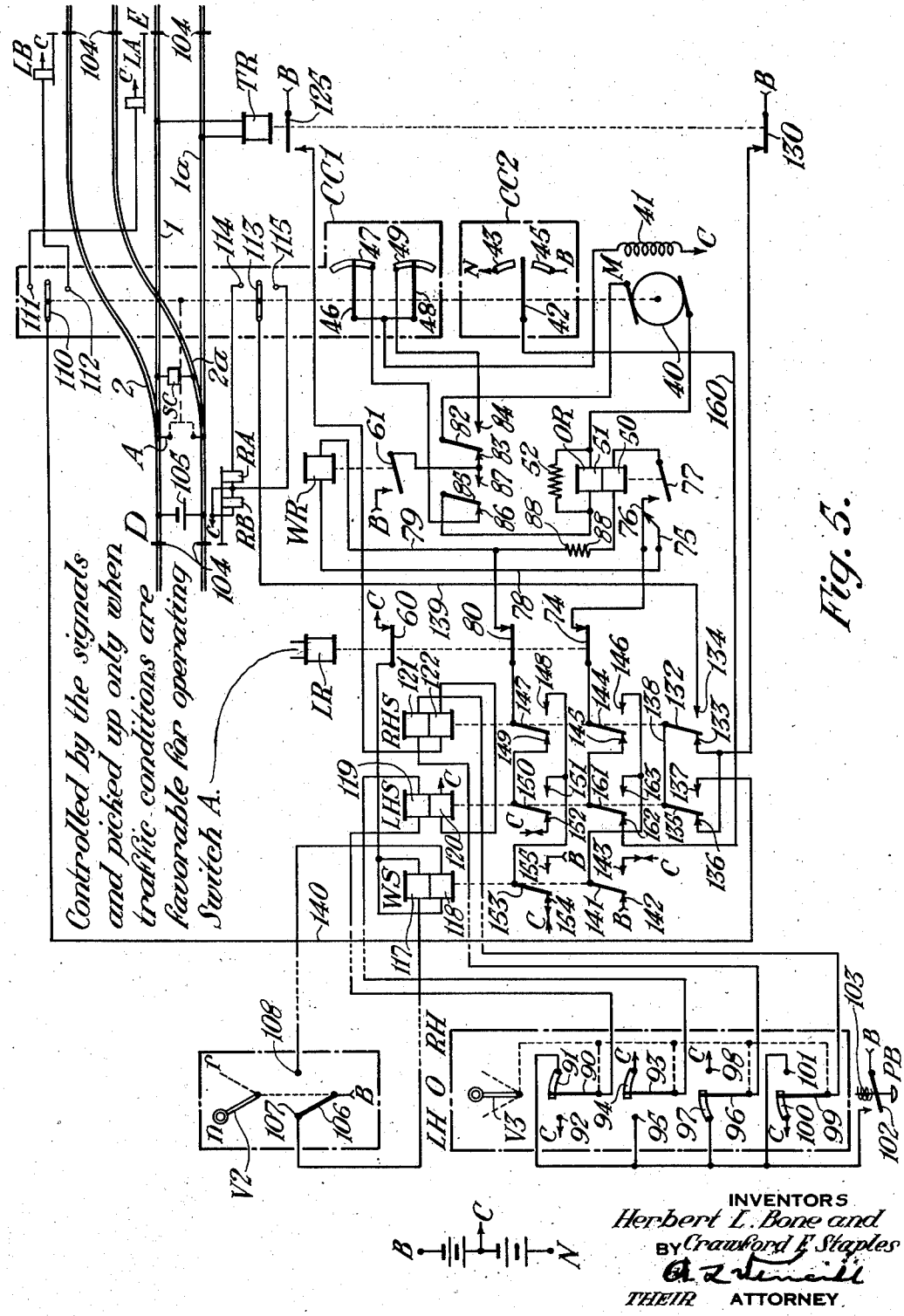


Fig. 5.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed April 15, 1944 4 Sheets-Sheet 4

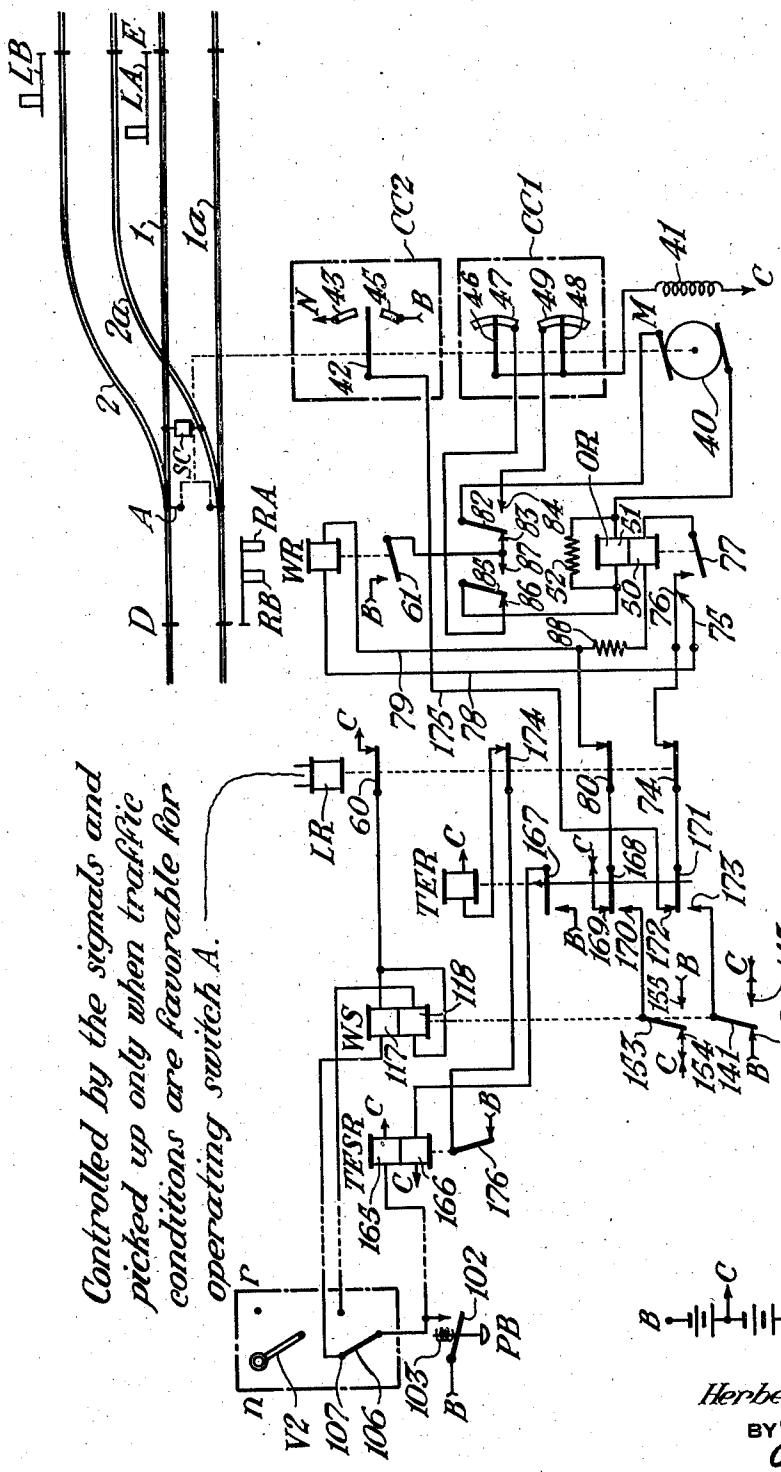


Fig. 6.

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UNITED STATES PATENT OFFICE

2,383,037

RAILWAY TRAFFIC CONTROLLING APPARATUS

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Application April 15, 1944, Serial No. 531,212

12 Claims. (Cl. 246—219)

Our invention relates to railway traffic controlling apparatus, and particularly to apparatus for controlling railway switches.

With the conventional type of railway switch in which the switch points normally stand in one extreme position or the other, it sometimes happens during heavy snow storms that snow becomes packed between the open switch point and the adjacent stock rail to such an extent that the switch cannot be reversed until someone is sent to the switch location to remove the packed snow. This is undesirable particularly where the switch is located at an outlying location, and frequently results in train delays.

In a copending application for Letters Patent of the United States, Serial No. 513,931, filed on December 11, 1943, by Harry L. Black, and assigned to the same assignee as the present application, there is disclosed a switch arrangement for preventing switch failures of the type just described. According to this arrangement, the movable switch points are individually connected through separate lost motion connections to an operating rod, which latter, in turn, is connected to a conventional switch and lock movement equipped with a circuit controller of the type which is provided when the switch and lock movement is to be used to operate a movable point frog. The switch and lock movement normally stands in its mid stroke position, and the movable switch rails are both held closed under these conditions by a spring rod which biases them to their closed positions, the necessary movements of the points to their closed positions being permitted by the lost motion connections between the movable points and the operating rod. When it is desired to line up a traffic route over the switch, the switch and lock movement is operated from its mid stroke position to one extreme position or the other depending upon which one of the two possible traffic routes is desired, and this operation of the switch and lock movement causes the operating rod to open the one point or the other as the case may be against the effect of the spring rod, and to positively hold the point which is not opened in its fully closed position against the associated stock rail. In either extreme position of the switch and lock movement, the locking plunger cooperates with the usual lock rod to lock the points in their corresponding positions, and the usual point detector mechanism provides an indication that the points are in the proper positions for traffic movements over the switch.

One object of our invention is to provide the necessary circuits for controlling the switch and lock movement in a switch arrangement of the type just described to obtain the desired switch operation.

Another object of our invention is to use a combination of contacts on the switch machine and on the usual switch stick relays to so energize the usual switch control relays as to cause the switch machine to move to the mid position and there stop when use of the switch is not required, and at the same time retain all of the safety features of the switch being locked in either the normal or reverse position when the switch points are in the positions for train movements over the switch.

According to our invention, the switch and lock movement is controllel by the usual switch stick relays which, in turn, may be remotely controlled by a three position lever either through direct wire connections or by code over a line circuit. When no train is approaching, the lever normally stands in the mid position, and under these conditions the switch machine moves to its mid position and there stops as a result of the opening of contacts operated by the switch movement circuit controller. When a train approaches, the lever operator moves the lever to its normal or its reverse position depending upon whether he wishes to move the switch to its normal or reverse position, and this causes the switch movement to move to a corresponding extreme position. The operation of the switch movement to an extreme position causes the operating rod to open the one point against the effect of the spring rod and positively hold the other point in the closed position. The locking plunger cooperates with the usual lock rods to lock the points in their extreme position and the usual point detector mechanism provides an indication when the points assume the proper extreme positions. Signals governing train movements over the switch cannot be cleared unless the switch movement occupies the proper extreme position, the switch is locked, and the point detector indicates that the parts are in their proper locked positions.

Other objects and characteristic features of our invention will become apparent as the description proceeds.

We shall describe several forms of railway traffic controlling apparatus embodying our invention, and shall then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a top plan view partly in cross section showing a railway switch A provided with one form of switch

operating mechanism to be controlled by means of control circuits embodying our invention. Fig. 2 is a top plan view, partly diagrammatic, and partly in section showing on an enlarged scale certain of the parts of the switch and lock movement illustrated in Fig. 1. Fig. 3 is a sectional view taken on the line III—III of Fig. 1. Figs. 4, 5 and 6 are diagrammatic views showing different circuit arrangements for controlling the apparatus illustrated in Fig. 1, and embodying our invention.

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

Referring first to Fig. 1, the reference character A designates a railway switch comprising, as usual, two fixed or stock rails 1 and 1*a* and two movable rails or switch points 2 and 2*a*. The fixed rails 1 and 1*a* are laid on tie plates 3 and are secured to cross ties 4 in the usual manner. The movable rails are individually movable, and are both biased to closed positions in which they engage the associated stock rail by means of a spring connecting rod SC.

The spring connecting rod SC may have any suitable form, and as here shown comprises a tubular casing 5 secured at one end by means of a supporting rod 6 to the switch point 2, and provided at the other end with an axial opening 7 which slidably receives another supporting rod 8 secured to the other switch point 2*a*. The supporting rod 8 is guided at its inner end by a tubular projection 9 formed on one end of the casing 5 and is surrounded by a compressed coil spring 10, one end of which abuts against the one end wall 5*a* of the casing 5, and the other end of which abuts against a circular plate 11 secured to the supporting rod 8. The spring 10 is provided with sufficient compression to normally yieldably hold both switch points in closed positions against the adjacent stock rails.

The switch points are arranged to be individually moved from the normally closed position to an open position to line up a traffic route over the switch by means of a switch and lock movement SM, the throw bar 12 of which is connected with the switch point 2 through the medium of the operating rod 13, a switch basket 14, and a throw rod 15, and with the switch point 2*a* through the medium of the operating rod 13, a switch basket 16, and a throw rod 17. The throw rod 15 is secured adjacent one end to the switch point 2 and is slidably supported at the other end underneath the stock rail 1*a* by a bracket 180 secured to the rail 1*a*. The throw rod 17 is similarly secured at one end to the switch point 2*a* and is slidably supported at the opposite end by a bracket 190 secured to the rail 1.

The switch and lock movement may be of any of the usual types, but as here shown it is of the type described and claimed in Letters Patent of the United States No. 1,293,290, granted to W. Zabel on February 4, 1919, for Railway traffic controlling apparatus. Inasmuch as the switch and lock movement is similar to that shown in the said Zabel patent it is believed that for purposes of the present invention it is sufficient to point out that this switch and lock movement includes a main operating shaft 20, the lower end of which terminates in a crank 21. This crank extends in opposite directions from the shaft, and is provided on its lower side with a depending crank pin 22 carrying a roller 23, and on its upper side with rounded upstanding projections 24 and 25 disposed on opposite sides of the shaft 20. The roller 23 cooperates with a cam slot 12*a* formed in the throw bar 12, while the projections 24 and 25 cooperate, respectively, with spaced recesses 26 and 27 formed in the underside of a slide bar 18. The throw bar 12 is slidably mounted in the bottom of the mechanism casing at one side of the axis of the shaft 20, and is operatively connected at one end with one end of the operating rod 13. The slide bar 18 is slidably mounted in the bottom of the mechanism casing in a position in which it overlies the throw bar 12 at right angles, and is provided at its left-hand end with a lock box provided with vertically offset and longitudinally spaced locking dogs 29 and 30. The lock dog 29 cooperates with notches 33*a* and 34*a* provided in the lower edges of a pair of lock bars 33 and 34 slidably mounted in the mechanism casing parallel to the throw bar 12, while the dog 30 cooperates with other notches 33*b* and 34*b* provided in the upper edges of the lock bars 33 and 34. The lock bars are adjustably attached to the switch points 2 and 2*a*, respectively, by means of connecting rods 35 and 35*a*, and are so adjusted that the notches 33*a* and 34*a* will align with the dog 29 when and only when the switch points 2 and 2*a* occupy the positions to permit traffic to move over the main track past the switch, and that the notches 33*b* and 34*b* will align with the dog 30 when and only when the switch points occupy the proper positions to permit traffic to move into or out of the siding or branch track over the switch.

The shaft 20 is arranged to be operated between its two extreme positions by means of an electric motor M, which is connected with the shaft through suitable reduction gearing designated RG in Fig. 2.

Sufficient lost motion is provided between the operating rod 13 and the switch baskets 14 and 16 so that when the throw bar 12 of the switch and lock movement is in its mid stroke position as shown in Fig. 2, the switch points will each be held in engagement with the associated stock rail by the spring connecting rod SC, as shown in Fig. 1. When the throw bar 12 occupies its mid stroke position, the roller 23 engages the cam slot 12*a* adjacent its right-hand end within the straight walled portion thereof, and the slide bar 18 is held in its mid stroke position by engagement of the projections 24 and 25 with the curved flanges which form continuations of the outer sides of the recesses 26 and 27 in the slide bar. With the slide bar 18 in its mid stroke position, the locking dogs 29 and 30 are disposed on opposite sides of the lock bars 33 and 34 so that both switch points are unlocked, and since the switch points are unlocked they can be trailed by a train approaching the switch in a trailing direction either on the siding or on the main track, the necessary movement of the points during the trailing being permitted by the above referred to lost motion connections between the operating rod 13 and the switch baskets 14 and 16.

When it is desired to set the switch for main line traffic over the switch the motor M is energized over circuits which we will describe presently, in the direction to rotate the shaft 20 in a counterclockwise direction to its one extreme position. In response to the rotation of the shaft 20, the roller 23 on the crank 21 engages the upper straight side of the cam slot 12*a* in the throw bar 12, and imparts an upward movement to the throw bar as viewed in Fig. 2, which movement is transmitted through the operating rod 13, switch basket 16, and throw rod 17 to the switch point 2*a* to thereby move the switch point 2*a* to its open

position in opposition to the bias of the spring 10 of the spring connecting rod SC. During the greater part of this rotation of the crank the projections 24 and 25 continue to engage the curved flanges which form continuations of the outer sides of the recesses 26 and 27 so that longitudinal movement of the slide bar 18 is prevented. However, prior to the completion of the rotation of the crank projection 24 enters the recess 26 and causes it to move to the right to its right-hand extreme position. When this latter movement takes place, the lower notches 33*a* and 34*a* in the lock bars 33 and 34 will be in alignment with the dog 29, and this dog will therefore enter these notches to lock the switch points in their normal positions.

When the parts occupy their normal positions as shown in Fig. 2 and it is desired to set the switch for traffic from the main track into the siding or from the siding into the main track the motor M is then energized over other circuits which we will describe presently in the direction to cause the shaft 20 to rotate in a clockwise direction to its other extreme position. The operation of the parts under these conditions is similar to that just described except for the fact that the direction of motion of the parts is reversed, and it is thought that this operation will be apparent from the foregoing and from an inspection of the drawings without further description. It should be noted, however, that when the shaft 20 reaches its other extreme position the switch point 2 will be moved away from the stock rail 1 to its open position and will be locked in this position by virtue of the locking dog 30 entering the notches 33*b* and 34*b* in the tops of the lock bars 33 and 34.

It should be particularly pointed out that when either the switch point 2 or the switch point 2*a* is moved to its open position, the operating rod 13 acts through the switch basket 14 or 16 as the case may be to force the other switch point to, and hold it in, its closed position.

The switch and lock movement includes a circuit controller operated in accordance with the position of the slide bar 18 and the position of two separate point detector rods 19 and 19*a*. This circuit controller may be similar in all respects to that described in the previously identified Zabel patent, and it is believed to be unnecessary to discuss the construction of this circuit controller in detail herein beyond the discussion which will appear hereinafter in connection with the various circuits for controlling the motor M presently to be described. The detector rods 19 and 19*a* are separately connected to the switch points 2 and 2*a* for individual operation thereby, as shown in Fig. 1.

Referring now to Fig. 4, as here shown the motor M is controlled by a switch operating relay WR and a circuit controller CC1. The switch control relay WR is of a well-known polar stick type which retains its polar contacts in their last operated positions when the relay becomes deenergized. That is to say, the relay requires a reversal in the polarity of the current supplied thereto to effect a reversal in the positions of its polar contacts.

The circuit controller CC1 comprises two contacts 46—47 and 48—49 which may be the usual motor cut-out contacts of the circuit controller of the switch and lock movement referred to hereinbefore. The contact 46—47 is closed in all positions of the switch and lock movement except the extreme position in which it locks the switch point 2*a* in its open position, and the contact 48—49 is closed in all positions of the switch and lock movement except the extreme position in which it locks the switch point 2 in its open position.

The relay WR is controlled in part by another circuit controller CC2, the contacts of which are operated in accordance with the position of the operating rod 13. This circuit controller may be separate from the switch and lock movement as indicated diagrammatically in Fig. 1, or it may be built into the switch and lock movement. As shown, this controller comprises a contact 42—43 which is closed when the operating rod 13 occupies its upper extreme position, as viewed in Fig. 1, or any position between its upper extreme position and its mid stroke position, but which is open in the mid stroke position of the operating rod, and a contact 42—45 which is closed when the operating rod occupies its lower extreme position as viewed in Fig. 1, or any posititon between its lower extreme position and its mid stroke position, but which is open in the mid stroke position of the operating rod.

Associated with the motor M is an overload device OR, the function of which is to interrupt the circuit for relay WR and thus effect deenergization of the motor M to prevent damage to the motor in the event that excess current is supplied to the motor for a time sufficient to damage the motor. This device is here shown as a relay having two windings 50 and 51. The winding 51 is generally referred to as an overload winding, and as will be explained more in detail hereinafter, this winding is supplied with the motor current. The other winding 50 is generally referred to as a holding winding and becomes energized whenever relay WR becomes energized over circuits which will become apparent as the description proceeds. Winding 51 is connected in multiple with a thermal resistor 52 which under normal conditions carries the major portion of the motor current. When the motor is overloaded this resistor heats up and thereby increases its resistance. This increase in resistance causes a larger voltage drop across winding 51, thus causing sufficient current to flow in the winding to cause relay OR to close its armature.

The relay WR is also controlled in part by normal and reverse switch control relays NWS and RWS and in part by a lock relay LR, and the relays NWS and RWS, in turn, are controlled in part by the relay LR and in part by a lever V1.

The lever V1 as here shown is a three position lever movable between an intermediate or central position *x* and normal and reverse extreme positions *n* and *r*. It is provided with a contact 53—54 which is closed in its *x* position, its *n* position or any position intermediate these two position; with a contact 53—55 closed only in its *r* position; a contact 56—58 closed only in its *n* position, and a contact 56—57 closed in its *x* position, its *r* position or any position intermediate these two positions. This lever will usually be located at a point remote from the switch such as the dispatcher's office in a centralized traffic controlling system.

The circuits for controlling the lock relay LR form no part of our present invention and are well known. It is believed therefore that for purposes of our present invention it is sufficient to point out that this relay will be energized to cause it to pick up its armature only when traffic conditions are favorable for operating switch S.

The relays NWS and RWS may be controlled by the lever V1 in any suitable manner which

will cause these relays to both close their normal contacts when lever V1 occupies its normal position, to both close their reverse contacts when lever V1 occupies its reverse position, and the one relay to close its normal contacts and the other its reverse contacts when lever V1 occupies its central position. For simplicity in illustrating our invention we have shown direct wire control for these relays, but it should be particularly pointed out that these relays may for example comprise the normal and reverse code switch control relays of a field storage unit in which event these relays would respond to the proper control code.

The apparatus also includes a center tapped battery shown in the lower left-hand corner of Fig. 4. The end terminals of this battery are designated B and N while the center tap is designated C.

As shown in Fig. 4, lever V1 occupies its mid stroke position, and under these conditions a normal energizing circuit for relay NWS is closed at contact 53—54 of lever V1 and a reverse energizing circuit for relay RWS is closed at contact 56—57 of lever V1. These circuits each include a front contact 60 of relay LR, and will be obvious from an inspection of the drawings. By virtue of these circuits relay NWS is energized in its normal direction so that its normal contacts are closed, and relay RWS is energized in its reverse direction so that its reverse contacts are closed. With relay NWS energized in its normal direction and relay RWS energized in its reverse direction, all circuits for relay WR are open and this relay is therefore deenergized. All energizing circuits for motor M are open at front contact 61 of relay WR, and motor M is therefore also deenergized. All parts of the switch and lock movement of which motor M forms a part occupy the positions in which they are shown in Fig. 2, and both switch points 2 and 2a of switch A are held closed by spring connecting rod SC. Both windings of overload relay OR are deenergized.

We shall now assume that with all parts in their normal positions as shown in Fig. 4, the operator desires to condition the switch for main line traffic movements over it. To do this, he moves lever V1 from its central or *x* position to its normal position *n*. As soon as lever V1 is moved away from its *x* position, the reverse energizing circuit which was previously closed for relay RWS at contact 56—57 of lever V1 becomes opened, and when the lever reaches its normal position a normal energizing circuit for this relay becomes closed over which current will flow from tap C through front contact 60 of relay LR, the winding of relay RWS and contact 56—58 of lever V1 to terminal N. Relay RWS therefore becomes energized in its normal direction and closes its normal contact 70—71. As soon as normal contact 70—71 becomes closed, a normal energizing circuit for relay WR is completed and current flows from terminal B through normal contact 70—71 of relay RWS, front contact 74 of relay LR, contact 75—76 of overload relay OR, wire 78, the winding of relay WR, wire 79, front contact 80 of relay LR, wire 81, and normal contact 64 of relay NWS to terminal C. Since the normal contacts of relay WR are already closed when this circuit becomes closed the closing of this circuit merely causes relay WR to close its front neutral contact 61. The closing of this latter contact establishes a circuit to operate motor M to its normal extreme position passing from terminal B through front contact 61 of relay WR, normal contact 82—83 of relay WR, armature 40 of motor M, the winding 51 of overload relay OR in multiple with resistance 52, normal contact 85—86 of relay WR, contact 46—47 of circuit controller CC1 and the field winding 41 of motor M to terminal C. The current which normally flows in winding 51 of relay OR under these conditions is insufficient to pick up the armature of this relay and the armature of this relay therefore remains in its released position. The operation of the motor M under these conditions operates the switch and lock movement from its mid stroke position to its one extreme position, thereby opening point 2a and locking it in its open position. When the locking stroke of the slide bar 18 is completed contact 46—47 opens and deenergizes motor M.

If motor M should become stalled for any reason during the operation of the switch and lock movement, then the resulting increase in the motor current would cause resistor 52 to heat and thereby increase its resistance to the point where the current flowing in winding 51 of relay OR is sufficient to cause it to close its contact 77—76 and open its contact 75—76. The closing of contact 77—76 completes a holding circuit for relay OR which maintains this relay in its energized condition while the opening of contact 75—76 interrupts the energizing circuit for relay WR so that this latter relay now becomes deenergized and interrupts the motor circuit at its front contact 61 to thereby prevent damage to the motor due to the overload. The holding circuit for relay OR may be traced from terminal B through normal contact 70—71 of relay RWS, front contact 74 of lock relay LR, contact 77—76 of relay OR, winding 50 of relay OR, a current limiting resistance 88, front contact 80 of relay LR, wire 81, and normal contact 64—65 of relay NWS to terminal C. By virtue of this holding circuit, relay OR will remain energized until lever N1 is moved away from its normal position to interrupt the normal energizing circuit for relay RWS and complete the reverse energizing circuit for this relay.

When the switch has been positioned for main line traffic in the manner described above, and it is desired to restore it to the position shown in Fig. 4, lever V1 is returned to its central position *x*. This causes relay RWS to again become energized in the reverse direction, and when this happens a reverse energizing circuit becomes completed for relay WR at reverse contact 70—72 of relay RWS which circuit may be traced trom tap C through normal contact 64—65 of relay NWS, wire 81, front contact 80 of relay LR, wire 79, the winding of relay WR, wire 78, contact 75—76 of relay OR, front contact 74 of relay LR, reverse contact 70—72 of relay RWS, normal contact 67—68 of relay NWS, wire 89 and contact 42—43 of circuit controller CC2 to terminal N. Relay WR therefore reverses its polar contacts and closes neutral contact 61, whereupon motor M becomes energized over a circuit passing from terminal B through front contact 61 of relay WR, reverse contact 85—87 of relay WR, winding 51 of relay OR in multiple with resistor 52, armature 40 of motor M, reverse contact 82—84 of relay WR, contact 48—49 of circuit controller CC1, and field winding 41 of motor M to tap C. The direction of current flow through the armature 40 when this latter circuit is closed is such that motor M now operates in the opposite direction from the direction in which it operated to position the switch for main line traffic, and the

switch and lock movement therefore operates the operating rod 13 in the direction to permit point 2a to close under the bias of spring connecting rod SC. When the switch and lock movement reaches its mid stroke position contact 42—43 of circuit controller CC2 opens and deenergizes relay WR. The deenergization of relay WR in turn deenergizes motor M, and when motor M becomes deenergized all parts are restored to the position shown in Fig. 4 except for the polar contacts of relay WR which remain closed in their reverse position.

We will now assume that the parts are in their normal positions, as shown in Fig. 4, and that it is desired to posititon the switch for movement from the main line into the siding or branch track. To do this the operator will move lever V1 from its central position to its right-hand or reverse position *r*. This movement will interrupt the normal energizing circuit for relay NWS and will close a reverse energizing circuit for this relay including contact 53—55 of lever V1. Relay NWS will therefore open its normal contact 64—65 and close its reverse contact 64—66. When reverse contact 64—66 becomes closed, a reversing energizing circuit for relay WR is completed at this contact and current flows from terminal B through contact 64—66 of relay NWS, wire 81, front contact 80 of relay LR, wire 79, the winding of relay WR, wire 78, contact 75—76 of relay OR, front contact 74 of relay LR, reverse contact 70—72 of relay RWS, and reverse contact 67—69 of relay NWS to terminal C. Relay WR thereupon closes its reverse contacts 85—87 and 82—84, as well as its neutral front contact 61, and thus completes the circuit previously traced for motor M including these contacts. Motor M therefore becomes energized and operates the switch and lock movement to the extreme position in which it opens the switch point 2 and locks it in its open position. As soon as the switch and lock movement reaches this extreme position contact 48—49 of circuit controller CC1 opens and deenergizes motor M.

It should be pointed out that while the motor is operating under the conditions just described, the motor current will of course flow through the winding 51 of relay OR in multiple with resistor 52, but unless the motor current increases above its normal operating value, the current flowing in winding 51 will be insufficient to operate this relay. However, if the motor current increases more than a predetermined amount above the normal value relay OR will then pick up for the reasons pointed out hereinbefore. The picking up of the relay under these conditions will deenergize relay WR at contact 75—76 of relay OR, and will complete another holding circuit for this relay passing from terminal B through reverse contacts 64—66 of relay NWS, wire 81, front contact 80 of relay LR, resistance 88, winding 50 of relay OR, contacts 77—76 of relay OR, front contact 74 of relay LR, reverse contact 70—72 of relay RWS, and reverse contact 67—69 of relay NWS to terminal C. Relay OR will therefore remain energized until lever V1 is subsequently moved away from its reverse position.

We will now assume that switch S has been operated to the position to permit traffic to move over the switch into or out of the siding and it is desired to restore the switch to its normal position as shown in Figs. 1 and 4. To do this lever V1 is restored to its central position *x*. This movement of the lever causes relay NWS to again become energized in its normal direction, and as soon as this relay closes its normal contacts, a normal energizing circuit for relay WR becomes closed passing from terminal B through contact 42—45 of circuit controller CC2, wire 89, normal contact 67—68 of relay NWS, reverse contact 70—72 of relay RWS, front contact 74 of relay LR, contact 75—76 of overload relay OR, wire 78, the winding of relay WR, wire 79, front contact 80 of relay LR, wire 81, and front contact 64—65 of relay NWS to terminal C. Relay WR will therefore become energized in the normal direction, and will cause motor M to operate in the direction to restore the parts of the switch and lock movement to their central positions. When they reach these positions contact 42—45 of circuit controller CC2 will open and will deenergize relay WR which, in turn, will deenergize motor M. The movement of the parts of the switch and lock movement to their mid stroke position will permit the spring connecting rod SC to close both switch points, and all parts will then be restored to the positions in which they are shown in Fig. 4.

It will be seen therefore that with the control apparatus for switch S arranged as shown in Figs. 1 to 4, the switch points will both be closed, or the point 2a will become opened to condition the switch for main line traffic over the switch, or the point 2 will become opened to condition the switch for traffic into and out of the siding or branch track according as lever V1 occupies its central, its normal or its reverse position.

The movement of traffic over the switch is controlled by signals RA, RB, LA, and LB. The signals may be controlled by any suitable circuits forming no part of our invention and therefore not shown in the drawings. It should be pointed out, however, that these signals would be controlled in part by the point detector contacts of the circuit controller of the switch and lock movement in such manner that these signals could not be cleared unless one switch point or the other is moved to its proper open position and is fully locked in this position so that conditions are safe for traffic to move over the switch.

Referring next to Fig. 5, we have here illustrated an arrangement of circuits for controlling the motor M of the switch and lock movement SM whereby the switch points are automatically set to the closed point position when the signals which govern traffic movements over the switch are set to their "stop" positions.

As here shown, the supply of current to the motor M is controlled by the relay WR and by the circuit controller CC1 in the manner described in connection with Fig. 4, but the relay WR instead of being controlled by normal and reverse switch control relays as shown in Fig. 4, is controlled by left and right-hand signal control relays LHS and RHS, and by a switch control relay WS.

The signal control relays LHS and RHS are of the two winding magnetic stick type polar relays which retain their polar contacts in their last operated positions when deenergized, and are controlled by a signal lever V3, a push button PB, and a track relay TR.

The lever V3 is movable between a central position O and left-hand and right-hand positions LH and RH, and is provided with a plurality of contacts 90—91, 90—92, 93—94, 93—95, 96—97, 96—98, 99—100, and 99—101. Contacts 90—91 and 93—94 are closed when lever V3 occupies its O position, its RH position or any position intermediate these two positions; contacts 96—97 and

99—100 are closed when lever V3 occupies its O position, its LH position or any position intermediate these two positions; contacts 90—92 and 93—95 are closed only when lever V3 occupies its LH position, and contacts 96—98 and 99—101 are closed only when lever V3 occupies its RH position.

The push button PB comprises a contact 102 biased to an open position by a spring 103.

The track relay TR is included in a detector track circuit which is formed by dividing the track rails 1 and 1a on opposite sides of the switch S into a track section DE by means of insulated joints 104, and which circuit includes the rails 1 and 1a of the section DE, the winding of the track relay TR connected between the rails adjacent one end of the section, and a track battery 105 connected between the rails adjacent the other end of the section.

The relays WS is also of the two winding magnetic stick polar type which retains the polar contacts closed in their last operated position when the relay becomes deenergized, and is controlled by the lock relay LR and by a switch lever V2. The switch lever V2 has normal and reverse positions *n* and *r* and a contact 106—107 closed only in the normal position of the lever and a contact 106—108 closed only in the reverse position of the lever.

The circuit controller CC1 as shown in Fig. 5 includes the usual point detector contacts 110—111, 110—112, 113—114, and 113—115. Contacts 110—111 and 113—114 are closed only when the switch points are properly locked in the position for main line traffic over the switch A, while contacts 110—112 and 113—115 are closed only when the switch points are properly locked in the position for traffic movements over the switch into or out of the branch track or siding.

The winding 117 of relay WS is provided with an energizing circuit which is closed only when lever V2 occupies its *n* position, and which passes from terminal B of a suitable source of current through contact 106—107 of lever V2, winding 117 of relay WS, and front contact 60 of relay LR to terminal C. When this circuit is closed winding 117 is supplied with current of such polarity that the polar contacts of relay WS move to their normal positions in which they are shown in Fig. 5.

The winding 118 of relay WS is similarly provided with an energizing circuit which is closed only when lever V2 occupies its *r* position, and which passes from terminal B through contact 106—108 of lever L, winding 118 of relay WS, and front contact 60 of relay LR. When this circuit is closed winding 118 is supplied with current of such polarity that the polar contacts of relay WS move to their reverse positions.

It will be seen, therefore, that when the lock relay LR is energized, relay WS will close its normal or its reverse contacts according as lever V2 occupies its *n* or its *r* position.

The winding 119 of relay LHS is provided with an energizing circuit which passes from terminal B through contact 102 of push button PB, contact 90—91 of lever V3, winding 119, and contact 93—94 of lever V3 to terminal C. This circuit may be closed by operating push button PB when lever V3 occupies its O position or its RH position, and when closed causes winding 119 to be supplied with current of such polarity that if winding 120 is then deenergized and the normal contacts of the relay are not already closed they will become closed as shown.

The winding 119 of relay LHS is also provided with another energizing circuit which passes from terminal B through contact 102 of push button PB, contact 93—95 of lever V3, the winding 119 of relay LHS and contact 90—92 of lever V3 to terminal C. This latter circuit may be closed by pushing push button PB only when lever V3 occupies its LH position, and when closed causes winding 119 to be supplied with current of such polarity that relay LHS will close its reverse contacts.

The winding 120 of relay LHS is provided with an energizing circuit which includes the winding 122 of relay RHS in series, and which passes from terminal B through back contact 125 of track relay TR, winding 122 of relay RHS, and winding 120 of relay LHS to terminal C. This circuit becomes closed whenever track relay TR becomes deenergized due to the presence of a train in section DE, and when closed causes the windings 120 and 122 of relays LHS and RHS to be supplied with current of such magnitude and polarity that if the other windings of these relays are then deenergized, these relays will both operate their polar contacts to the normal positions shown.

Winding 121 of relay RHS is provided with an energizing circuit which passes from terminal B through contact 102 of push button PB, contact 96—97 of lever V3, winding 121, and contact 99—100 of lever V3 to terminal C. This circuit may be closed by actuating push button PB whenever lever V3 occupies its O or its LH position and when closed causes winding 121 to be supplied with current of such polarity that it will close its normal contacts if they are not already closed and if winding 122 is not simultaneously energized.

Winding 121 of relay RHS is also provided with a second circuit which may be traced from terminal B through contact 102 of push button PB, contact 99—101 of lever V3, winding 121, and contact 96—98 of lever V3 to terminal C. This circuit may be closed by operating push button PB when and only when lever V3 occupies its RH position and when closed causes winding 121 of relay RHS to be supplied with current of such polarity that this relay will close its reverse contacts if these contacts are not already closed.

Signal RA is provided with an energizing circuit which is closed when and only when track relay TR is energized, the switch points are locked in the proper position for main line traffic over the switch, the contacts of relay LHS occupy their normal positions, and the contacts of relay RHS occupy their reverse positions. This circuit passes from terminal B through front contact 130 of track relay TR, normal contact 135—136 of relay LHS, reverse contact 132—134 of relay RHS, wire 139, contact 113—114 of circuit controller CC1, and the winding of signal RA to terminal C.

Signal RB is provided with an energizing circuit which is similar to that just described with the single exception that this latter circuit becomes closed only when the switch points are locked in the positions for traffic movements over the switch into or out of the branch track siding and which includes contact 113—115 of circuit controller CC1 in place of contact 113—114 of circuit controller CC1.

Signal LA is provided wtih an energizing circuit which is closed when and only when track relay TR is energized, the switch points are properly positioned for main line traffic over the

switch, the contacts of relay LHS occupy their reverse positions, and the contacts of relay RHS occupy their normal positions. This circuit passes from terminal B through front contact 130 of track relay TR, normal contact 132—133 of relay RHS, wire 138, reverse contact 135—137 of relay LHS, wire 140, contact 110—111 of circuit controller CC1, and the winding of signal LA to terminal C.

Signal LB is provided with a circuit which is similar to that just traced except that this circuit includes contact 110—112 of circuit controller CC1 in place of contact 110—111 so that this circuit can only be closed when the switch is set for traffic out of the branch track or siding.

In explaining the operation of the apparatus shown in Fig. 5 as a whole, we will assume that the parts are all in the positions illustrated and that the operator wishes to permit a train approaching section DE from the left to proceed along the train track over the switch. To do this he will move lever V3 to its RH position and actuate push button PB. This will complete the reverse energizing circuit for relay RHS so that this relay will open its normal contacts and close its reverse contacts. As soon as the reverse contacts of relay RHS become closed, a normal energizing circuit becomes completed for relay WR and current flows from terminal B through normal contact 141—142 of relay WS, reverse contact 144—146 of relay RHS, front contact 74 of relay LR, contact 75—76 of overload relay OR, wire 78, the winding of relay WR, wire 79, front contact 80 of relay LR, reverse contact 147—148 of relay RHS, and normal contact 153—154 of relay WS to terminal C. Relay WR therefore becomes energized by current of normal polarity and completes an energizing circuit for motor M identical with that described in connection with Fig. 4. Motor M thereupon becomes energized and operates the switch and lock movement to its one extreme position to open the switch point 2*a*, and to lock this switch point in its open position and the switch point 2 in its closed position. When the switch and lock movement has completed the locking of the switch points, contact 46—47 of circuit controller CC1 opens and deenergizes motor M and contact 113—114 of circuit controller CC1 becomes closed and completes the energizing circuit for signal RA. This signal therefore clears, and when it clears the lock relay LR becomes deenergized and deenergizes relay WR. With signal RA cleared, the train may enter section DE, whereupon track relay TR will become deenergized and will interrupt at its front contact 130 the circuit for signal RA so that this signal will now return to its stop position. The deenergization of track relay TR also causes the previously traced energizing circuit for the windings 120 and 122 of relay LHS and RHS to become closed at contact 125 of the track relay, and relay RHS therefore immediately becomes energized in the normal direction and restores its normal contacts to the positions shown. When the train vacates section DE, the lock relay again becomes energized and completes another energizing circuit for relay WR passing from terminal C, through contact 150—152 of relay LHS, contact 147—149 of relay RHS, front contact 80 of relay LR, wire 79, the winding of relay WR, wire 78, contact 75—76 of relay OR, front contact 74 of relay LR, normal contact 144—145 of relay RHS, normal contact 161—162 of relay LHS, wire 160, and contact 42—43 of circuit controller CC1 to terminal N. Relay WR therefore becomes energized in the reverse direction and completes a circuit for motor M which causes the parts of the switch and lock movement to return to their mid stroke positions, whereupon contact 42—43 of circuit controller CC1 opens and interrupts the circuit for relay WR. Relay WR then again becomes deenergized and stops the motor. The movement of the parts of the switch and lock movement to their mid stroke positions causes contact 113—114 of circuit controller CC2 to open, and as a result signal RA returns to its stop position.

If when motor M was moving the switch point 2*a* to its open position under the conditions just described, the motor current had exceeded the value necessary to cause the OR relay to pick up its armature, the resultant closing of contact 76—77 would have completed a holding circuit for winding 50, while the resultant opening of contact 75—76 would have interrupted the circuit for relay WR and would then have caused this relay to become deenergized and deenergize motor M. The holding circuit for winding 50 which becomes closed under those conditions may be traced from terminal B through contact 141—142 of relay WS, reverse contact 144—146 of relay RHS, front contact 74 of relay LR, contact 76—77 of relay OR, winding 50 of relay OR, resistance 88, front contact 80 of relay LR, reverse contact 147—148 of relay RHS, and normal contact 153—154 of relay WS to terminal C. By virtue of this circuit relay OR will remain energized until lever V3 is operated to another position and push button PB is operated to reverse relays RHS or lever V2 is operated to reverse relay WS.

We will now assume that with the parts in the positions shown in Fig. 5, the operator wishes to permit a train approaching section DE from the left to enter the branch track or siding. To do this, he will move the switch lever V2 to its reverse position prior to moving lever V3 to its RH position and operating push button PB. The movement of lever V2 to its reverse position will cause relay WS to operate its polar contacts to their reverse positions and as a result when relay RHS reverses its contacts due to the operation of push button PB, a reverse energizing circuit for relay WR will become completed passing from terminal B through reverse contact 153—155 of relay WS, reverse contact 147—148 of relay RHS, front contact 80 of relay LR, wire 79, the winding of relay WR, wire 78, contact 75—76 of relay OR, front contact 74 of relay LR, reverse contact 144—146 of relay RHS and reverse contact 141—143 of relay WS to terminal C. Relay WR will therefore become energized in the reverse direction and will complete an energizing circuit for motor M similar to that described in connection with Fig. 4, so that motor M will now operate the switch and lock movement from its mid stroke position to the extreme position in which the switch point 2 becomes opened. When the switch and lock movement reaches this extreme position and has locked the switch points in the corresponding positions, contact 46—49 of circuit controller CC1 will open and will deenergize motor M. Furthermore contact 113—115 of circuit controller CC1 will become closed and will complete the previously traced circuit for signal RB. Signal RB will therefore clear and the lock relay LR will become deenergized. The de-

energization of the lock relay, in turn, will deenergize the switch operating relay WR. As soon as signal RB has cleared the train may enter section DE, and when the train does this the resultant deenergization of the track relay TR will cause signal RB to return to its stop position and relay RHS to become energized in its normal direction. When the train vacates section DE, the track relay TR and lock relay LR will both become energized. The energization of the track relay will interrupt the circuit which was previously closed for relay RHS but the contacts of this relay will remain in their normal positions. The energization of the lock relay will complete another circuit for relay WR passing from terminal B through contact 42—45 of circuit controller CC2, wire 160, normal contact 161—162 of relay LHS, normal contact 144—145 of relay RHS, front contact 74 of relay LR, contact 75—76 of relay OR, wire 78, the winding of relay WR, wire 79, front contact 80 of relay LR, normal contact 147—149 of relay RHS, and normal contact 150—152 of relay LHS to terminal C. Relay WR will therefore become energized by current of normal polarity and will cause motor M to operate the switch and lock movement in the direction to restore the parts to their mid stroke position. When the parts of the movement reach their mid stroke position contact 42—45 of circuit controller CC2 will open and will deenergize relay WR, which in turn will interrupt the motor circuit and thus stop the motor. The operation of the switch and lock movement to its mid stroke position will permit the switch point 2 to return to its normally closed position under the action of the spring connecting rod SC.

If the motor M had become overloaded while operating the switch point 2 to its open position for any reason, the resultant energization of the overload relay OR would have caused it to close its contact 76—77 and open its contact 75—76. The closing of contact 76—77 under these conditions would have completed another holding circuit for winding 50 while the opening of contact 75—76 would have interrupted the circuit for relay WR, and would thus have caused this relay to become deenergized and deenergize motor M. The holding circuit for winding 50 under these conditions may be traced from terminal B of the source through reverse contact 153—155 of relay WS, reverse contact 147—148 of relay RHS, front contact 80 of lock relay LR, resistor 88, winding 50 of relay OR, contact 76—77, front contact 74 of relay LR, reverse contact 144—146 of relay RHS, and reverse contact 141—143 of relay WS to terminal C. When this circuit becomes closed it will remain closed and retain relay OR energized until lever V2 or V3 is operated to reverse relay WS or relay RHS.

We will next assume that it is desired to clear signal LA to permit a train approaching switch A from the right to proceed past the switch. To accomplish this result, the operator will leave lever V2 in the position shown, and will move lever V3 to its LH position and operate push button PB. When push button PB is operated relay LHS will reverse its polar contacts, and the reversal of these contacts, in turn, will complete an energizing circuit for relay WR passing from terminal B of the source through normal contact 141—142 of relay WS, reverse polar contact 161—163 of relay LHS, normal polar contact 144—145 of relay RHS, front contact 74 of relay LR, contact 75—76 of overload relay OR, wire 78, the winding of relay WR, wire 79, front contact 80 of relay LR, normal polar contact 147—149 of relay RHS, reverse contact 150—151 of relay LHS, and normal polar contact 153—154 of relay WS to terminal C. Relay WR will therefore become energized with current of normal polarity and will complete the energizing circuit for motor M including the normal polar contacts of relay WR. The completion of this circuit will cause motor M to operate the switch and lock movement to the extreme position in which switch point 2*a* becomes opened and both switch points become locked. When the switch and lock movement reaches this extreme position and the switch points become locked, contact 46—47 of circuit controller CC1 will open and will interrupt the motor circuit and contact 110—111 of this circuit controller will become closed and will complete the energizing circuit for signal LA. Signal LA will therefore clear and lock relay LR will become deenergized and will interrupt the circuit for the switch operating relay WR. As soon as signal LA clears, the train may proceed into section DE, and when the train does this track relay TR will become deenergized and will cause signal LA to return to the stop position. The deenergization of the track relay will also complete the circuit for winding 120 of relay LHS so that this latter relay will now restore its polar contacts to their normal positions. When the train vacates section DE, track relay TR and lock relay LR will both again become energized, and as soon as the lock relay becomes energized relay WR will become energized in the reverse direction over the previously described circuit including contact 42—43 of circuit controller CC2. Motor M will thereupon become energized and will operate in the direction to restore the switch and lock movement to its mid stroke position. When the switch and lock movement reaches this position, contact 42—43 of circuit controller CC1 will open and will deenergize relay WR which, in turn, will deenergize the motor M.

If it is desired to permit a train on the branch track to proceed past the switch into the main track, the operator will move lever V2 to its *r* position, lever V3 to its LH position and will then operate push button PB. The movement of lever V2 to its *r* position will cause relay WS to close its reverse polar contacts, while the operation of push button PB following the movement of lever V3 to its LH position will cause relay LHS to also close its reverse polar contacts. With the reverse polar contacts of relays WS and LHS closed another energizing circuit for relay WR becomes closed passing from terminal B through reverse polar contact 153—155 of relay WS, reverse polar contact 150—151 of relay LHS, normal polar contact 147—149 of relay RHS, front contact 80 of relay LR, wire 79, the winding of relay WR, wire 78, contact 75—76 of overload relay OR, front contact 74 of relay LR, normal contact 144—145 of relay RHS, reverse polar contact 161—163 of relay LHS, and reverse polar contact 141—143 of relay WS to terminal C. The closing of this energizing circuit causes relay WR to become energized with current of reverse polarity, whereup motor M becomes energized in the direction to open the switch point 2. When the switch point 2 becomes opened and both switch points become locked contact 48—49 of circuit controller CC1 opens and deenergizes motor M, and contact 110—112 becomes closed and completes the circuit for signal LB. Signal LB thereupon clears to indicate that the train may proceed. When the

train enters section DE track relay TR becomes deenergized, and deenergizes signal LB putting this signal to stop. From this point on the operation of the apparatus is identical to that previously described after signal RB had moved to its stop position due to a train entering section DE.

If motor M had become overloaded when it was operating under the conditions just described, either to open the switch point 2, or to subsequently permit it to close, the overload relay OR would have operated to deenergize the motor in a manner which is similar to that described hereinbefore in connection with the clearing of signal RB except for the fact that the holding circuit which would have become closed for winding 50 of relay OR if the overload had occurred while switch point 2 was being opened would have been different from that previously described due to the fact that the reverse contacts of relay LHS would then have been closed. This circuit may be traced from terminal B through reverse contact 153—155 of relay WS, reverse contact 150—151 of relay LHS, normal contact 147—149 of relay RHS, front contact 80 of relay LR, resistance 88, winding 50 of relay OR, contact 76—77 of relay OR, front contact 74 of relay LR, normal contact 144—145 of relay RHS, reverse contact 161—163 of relay LHS, and reverse contact 141—143 of relay WS to terminal C.

It follows from the foregoing that with the apparatus arranged as shown in Fig. 5, if either of the signal control relays LHS or RHS is operated to clear one of the signals governing traffic over the switch S, the switch and lock movement will assume a position in accordance with the position of the switch control relay WS. However, if the signal relays are set to cause the signals governing traffic over the switch to assume their stop positions, the circuits are so arranged that the switch and lock movement will be automatically operated to its mid position to permit the switch points to move to their closed positions in response to the bias of the spring connecting rod SC. Moreover, when a train movement over the switch has occurred, as soon as the train clears section DE, the switch and lock movement will automatically return to its mid stroke position and the switch points to their closed positions.

Referring now to Fig. 6, in the control arrangement here illustrated the switch operating relay WR is controlled by the lock relay LR, by the switch control relay WS and by a time element relay TER in such manner that the switch will assume the closed point condition a predetermined length of time after the signals have been placed at stop, or after the switch control relay has been operated to change the position of its polar contacts provided the signals are not subsequently cleared within said predetermined length of time.

As shown in Fig. 6, the two windings 117 and 118 of relay WS are provided with energizing circuits which are identical with those described in connection with Fig. 5 except for the fact that the contact 102 of push button PB has been included in each of these circuits so that in order to close these circuits it is necessary to move lever V2 to the proper position and then operate the push button.

Associated with the relay WS is a relay TESR of the two winding polar magnetic stick type. This relay is generally referred to in accordance with railway signaling practice as a time element stick relay and is provided with two windings 165 and 166. The winding 165 as shown is arranged to be energized whenever either one of the windings 117 or 118 of relay WS becomes energized, over a circuit which is completed by the closing of contact 102 of push button PB, and the parts are so arranged that whenever this winding becomes energized relay TESR will open its reverse polar contacts. The winding 166 of relay TESR is arranged to be energized whenever time element relay TER becomes deenergized over a circuit which includes back contact 167 of relay TER. The current supplied to the winding 166 over this circuit flows in the direction to operate the polar contacts of the relay to their reverse positions.

The time element relay TER may be of any suitable type which will operate the necessary contacts in the desired manner. As here shown, it is provided with three contacts 167, 168—170, and 171—173 which close immediately when the relay becomes deenergized and which subsequently remains closed until a predetermined time interval expires after the relay becomes energized, and with two other contacts 168—169 and 171—172 which open immediately when the relay becomes deenergized and which remain open after the relay becomes energized until the predetermined time interval has expired.

The relay TER as shown is controlled by the lock relay LR and the time element stick relay TESR over a circuit which passes from terminal B through reverse contact 176 of relay TESR, front contact 174 of relay LR and the winding of relay TER to terminal C.

As shown in Fig. 6, lever V2 occupies its *n* position and push button PB is open. Under these conditions, the circuits for both windings 117 and 118 of relay WS and the circuit for winding 165 of relay TESR are all open. The polar contacts of relay WS are held by the magnetic stick properties of the relay in their last operated positions which positions are illustrated as being their normal positions. Section DE is unoccupied and the signals L and R are all in their stop positions. The lock relay LR is therefore energized. The reverse polar contact 176 of relay TESR is closed and since relay LR is energized, the energizing circuit for relay TER is closed. Relay TER is therefore energized, and as a result the energizing circuit for winding 166 of relay TESR is open at contact 167 of relay TER. All circuits for relay WR are open, and this relay is therefore deenergized so that overload relay OR and motor M are both deenergized. The switch and lock movement occupies its mid stroke position, and the points of switch A are both held closed by the bias of the spring connecting rod SC.

We will now assume that the operator desires to position the switch for main line traffic over it. Since lever V2 already occupies its *n* position, he may do this by merely operating push button PB. When he does this, winding 117 of relay WS and winding 165 of relay TESR will become simultaneously energized. The energization of winding 117 of relay WS will have no effect on the remainder of the apparatus since the normal polar contacts of this relay are already closed. The energization of winding 165 of relay TESR, however, will cause this relay to open its reverse contact 176, whereupon relay TER will become deenergized and will open its contacts 168—169 and 171—172 and will close its contacts 167, 168—170, and 171—173. The closing of contact 167 of relay TER will complete the cir-

cuit for winding 166 of relay TESR, and this relay will therefore immediately reclose its reverse polar contact 176 and thus establish the energizing circuit for relay TER. The contacts 167, 168—170, and 171—173 of relay TER, however, will now remain closed and the contacts 168—169 and 171—172 will remain open until the expiration of the time interval for which relay TER is set. The closing of contacts 168—170 and 171—173 of relay TER completes an energizing circuit for the switch operating relay WR which circuit may be traced from terminal B through normal contact 141—142 of relay WS, contact 171—173 of relay TER, front contact 74 of relay LR, contact 75—76 of relay OR, wire 78, the winding of relay WR, wire 79, front contact 80 of relay LR, contact 168—170 of relay TER and normal polar contact 153—154 of relay WS to terminal C. The current flowing in this circuit energizes relay WR in the normal direction and causes it to close its front contact 61. As soon as this contact becomes closed, the energizing circuit for motor M previously described in connection with Fig. 4 becomes closed, and the motor starts to operate the switch and lock movement to the extreme position in which switch point 2a is open. When the switch and lock movement reaches this extreme position contact 46—47 of circuit controller CC1 opens and deenergizes the motor. As soon as the operation of the switch and lock movement is completed, the lever operator will be apprised of this fact by suitable means not shown and he will thereupon cause the desired signal to be cleared. When the signal clears, the lock relay LR will become deenergized and will deenergize relay WR, to thereby cause the switch points to remain in the positions for main line traffic over the switch. The time interval for which relay TER is set will be in accordance with time locking standards for interlocked switches and will depend upon the distance between the distant and home signals, train speeds, braking distances and related conditions. In any event this time interval will be made long enough so that under normal operating conditions it will not expire until after the switch and lock movement has completed its stroke and the signal has had an opportunity to clear. If the operator does not clear the signal before this time element expires, then the lock relay will be energized when contacts 168—169 and 171—172 of relay TER become closed at the expiration of the time interval and the closing of these contacts will complete another energizing circuit for relay WR passing from terminal C through contact 168—169 of relay TER, front contact 180 of relay LR, wire 79, the winding of relay WR, wire 78, contact 75—76 of relay OR, front contact 74 of relay LR, contact 171—172 of relay TER, wire 175, and contact 42—43 of circuit controller CC2 to terminal N. The current flowing in the circuit will energize relay WR in the reverse direction, and will thus cause motor M to restore the switch and lock movement to its mid stroke position. When it reaches this position the resultant opening of contact 42—43 of circuit controller CC2 will interrupt the circuit for relay WR, and will thus cause this relay to become deenergized and deenergize motor M.

Assuming that the operator has caused signal LA or RA to become cleared following the operation of the switch and lock movement to its one extreme position under the conditions just described, and that a train subsequently moves over section D—E past the switch, when the train clears section D—E, the resultant reenergization of the locking relay will complete the energizing circuit for the time element relay TER and as soon as the time interval for which this relay is adjusted has expired, the resultant closing of contacts 168—169 and 171—172 of the relay, will complete the circuit described above for relay WR and will thus cause the switch points to be returned to their normal closed positions.

If the motor current increases more than a predetermined amount above its normal value while the motor is operating the switch and lock movement to either extreme position to open the switch point 2, the overload relay OR will operate to deenergize the motor in the same manner as with the apparatus previously described in connection with Fig. 4. However, when the overload relay operates under these conditions, the closing of the contact 76—77 will complete a holding circuit for winding 50 passing from terminal B through normal contact 141—142 of relay WS, contact 171—173 of relay TER, front contact 74 of relay LR, contact 76—77 of relay OR, winding 50, resistance 88, front contact 80 of relay LR, contact 168—170 of relay TER and normal contact 153—154 of relay WS to terminal C. This circuit will maintain relay OR energized until the polar contacts of relay WS are reversed.

If the motor current increases sufficiently to operate relay OR while the motor is returning the switch and lock movement to its mid stroke position from the extreme position in which the switch point 2a is open, the closing of contact 76—77 will complete another holding circuit for winding 50 of relay OR passing from terminal C through contact 168—169 of relay TER, front contact 80 of relay LR, resistance 88, winding 50 of relay OR, contact 76—77 of relay OR, front contact 74 of relay LR, contact 171—172 of relay TER, wire 175, and contact 42—43 of circuit controller CC2 to terminal N. This circuit will retain relay OR energized until the operator operates push button PB to energize relay TESR in the normal direction and thus deenergize relay TER.

If the operator desires to position the switch for traffic into or out of the branch track or siding he will move lever V2 to its r position and then operate push button PB. When push button PB is operated under these conditions it will cause relay TESR to open its contact 176 and thus deenergize relay TER in exactly the same manner as was described hereinbefore when the push button was operated with lever V2 in its N position. Relay WS, however, will now reverse its polar contacts, and as soon as these contacts have become reversed, relay WR will become energized in the reverse direction and will reverse its polar contacts by virtue of a circuit passing from terminal B through reverse contact 153—155 of relay WS, contact 168—170 of relay TER, front contact 80 of relay LR, wire 79, the winding of relay WR, wire 78, contact 75—76 of relay OR, front contact 74 of relay LR, contact 171—173 of relay TER and reverse contact 141—143 to terminal C. The energization of relay WR in the reverse direction will cause the motor M to operate the switch and lock movement to the extreme position in which the switch point 2 becomes opened, and when it reaches this position contact 48—49 of circuit controller CC1 will open and will deenergize motor M. If the operator causes signal RB or LB to clear before relay TER has completed its time element, the resultant de-

energization of the lock relay LR, will again deenergize the time element relay and will also deenergize relay WR so that the switch and lock movement will remain in its extreme position. However, if the operator does not clear one or the other of the signals RB or LB before relay TER completes its time element, the resultant closing of contacts 168—169 and 171—172 of relay TER will complete a circuit for relay WR passing from terminal B through contact 42—55 of circuit controller CC2, wire 175, contact 171—172 of relay TER, front contact 74 of relay LR, contact 75—76 of relay OR, wire 78, the winding of relay WR, wire 79, front contact 80 of relay LR, and contact 168—169 of relay TER to terminal C. Relay WR will therefore become energized in the normal direction and will cause motor M to return the switch and lock movement to its mid stroke position to thus permit the switch point 2 to reclose. When the switch and lock movement reaches its mid stroke position contact 42—45 of circuit controller CC2 will open and will deenergize relay WR to thus deenergize the motor.

If the operator does cause signal LB or RB to become cleared before the time element expires under the conditions described above and thus causes relay LR to become deenergized, as soon as the train vacates section D—E, the resultant reenergization of this relay will reclose the circuit for the time element relay TER, and when this relay completes its time element the switch machine will operate to restore the switch and lock movement to its mid stroke position in exactly the same manner as was described above when the operator did not clear one or the other of signals RB or LB before relay TER completed its time element.

If motor M becomes overloaded while it is operating the switch and lock movement to the extreme position to open switch point 2, the overload relay will operate to deenergize motor M, and another holding circuit for winding 50 will become closed. This circuit will be identical with that described above when motor M became overloaded while operating the switch and lock movement to its other extreme position except that this circuit will now include reverse contacts 153—155 and 141—143 of relay WS in place of the normal contacts 153—154 and 141—142 of this relay.

Likewise if the motor M becomes overloaded when it is operating the switch and lock movement to its mid stroke position from the position in which the switch point 2 is open overload relay OR will again operate to deenergize the motor, and under these conditions winding 50 will become energized over a circuit which is identical to that described above when motor M became overloaded while operating the switch from its other extreme position to its mid stroke position except for the fact that this circuit includes contact 42—45 of circuit controller CC2 in place of contact 42—43 of circuit controller CC2.

It follows from the foregoing that with the apparatus arranged as shown in Fig. 6, any time the operator operates push button PB, the resultant operation of the TESR relay causes the time element relay TER to become deenergized, which, in turn, causes the switch and lock movement to move to one extreme position or the other in accordance with the position of the polar contacts of the switch control relay WS, and that if the signals are not cleared for traffic movements over the switch so that the locking relay is deenergized, the switch machine will reassume its mid stroke position automatically after the time element for which the time element relay is set has expired. Furthermore, if the signals are cleared, upon the expiration of a predetermined time interval after the train has completed its movement over the switch, the switch and lock movement will automatically return to its mid stroke position.

Although we have herein shown and described only a few forms of railway traffic controlling apparatus embodying our 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 our invention.

Having thus described our invention, what we claim is:

1. In combination, a normal and a reverse switch control relay each capable of assuming normal and reverse positions, means for selectively energizing said relays to cause them both to assume their normal positions, both to assume their reverse positions, or one to assume its normal position and the other its reverse position, a railway switch having independently movable switch points, and means controlled by said relays for causing said switch points to both assume closed positions or one or the other switch point to move to an open position according as one relay occupies its normal position and the other relay its reverse position, or as both relays occupy their normal positions or as both relays occupy their reverse positions.

2. In combination, a railway switch having independently movable switch points, a lever having normal and reverse and intermediate positions, a normal switch control relay and a reverse switch control relay each having normal and reverse polar contacts, means controlled by said lever for causing both relays to close their normal contacts, both relays to close their reverse contacts, or one relay to close its normal contacts and the other its reverse contacts according as said lever occupies its normal, its reverse, or intermediate position, and means controlled by said relays for controlling said switch in such manner that one point or the other will be open or both points will be closed according as the normal contacts of both relays are closed, the reverse contacts of both relays are closed, or the normal contacts of one relay and the reverse contacts of the other relay are closed.

3. In combination, a railway switch having independently movable switch points biased to normally closed positions, a switch and lock movement operable between an intermediate and two extreme positions and operatively connected with said switch points in such manner that both points will be permitted to move to their normally closed positions in response to said bias or one point or the other will be opened to line up one or the other of two traffic routes over the switch according as said switch and lock movement is operated to its intermediate or to one or the other of its extreme positions, a motor included in said switch and lock movement for operating it, a polarized switch operating relay, a first circuit controller responsive to the position of the switch and lock movement and having a first contact closed at all times except when the switch and lock movement occupies its one extreme position and a second contact closed at all times except when said switch and lock movement occupies its other extreme position, a second circuit controller re-

sponsive to the position of the switch points and having two contacts one of which is closed when the one switch point occupies any position but its closed position and the other of which is closed when the other switch point occupies any position but its closed position; means including the normal polar contacts of said switch operating relay and said first contact for energizing said motor in the direction to operate said switch and lock movement to its one extreme position, means including the reverse polar contacts of said switch operating relay and said second contact for energizing said motor in the direction to operate said switch and lock movement to its other extreme position, a lever operable between an intermediate and two extreme positions, means effective when said lever occupies its intermediate position for energizing said switch operating relay in the direction to close its normal or its reverse polar contacts according as said one or said other contact is then closed, and other means for energizing said switch operating relay in the direction to close its normal contacts or its reverse contacts according as said lever occupies its one or its other extreme position.

4. In combination, a railway switch having independently movable switch points biased to normally closed positions, a switch and lock movement operable between an intermediate and two extreme positions and operatively connected with said switch points in such manner that both points will be permitted to move to their normally closed positions in response to said bias or one point or the other will be opened to line up one or the other of two traffic routes over the switch according as said switch and lock movement is operated to its intermediate or to one or the other of its extreme positions, a polarized switch operating relay, means for energizing said switch and lock movement in a manner to cause it to move toward its one or its other extreme position according as said switch operating relay is energized by current of one polarity or the other, a lock relay picked up only when traffic conditions are favorable for operating said switch, normal and reverse polarized switch control relays each having normal and reverse polar contacts, means for energizing said switch operating relay with current of said one polarity when said lock relay is picked up and the normal polar contact of both said switch control relays are closed, means for energizing said switch operating relay with current of said other polarity when said lock relay is picked up and the reverse polarized contacts of said switch control relays are both closed, a circuit controller responsive to the positions of the switch points and having two contacts one of which is closed when the one switch point occupies any position but its closed position, and the other of which is closed when the other switch point occupies any position but its closed position, means effective when said lock relay is picked up and the normal polar contacts of the one switch control relay and the reverse polar contacts of the other switch control relay are closed for energizing said switch operating relay with current of one polarity or the other according as the one or the other contact of said circuit controller is then closed, and means for selectively energizing said switch control relays.

5. In combination, a railway switch having independently movable switch points, a switch and lock movement operable between an intermediate and two extreme positions and operatively connected with the switch points of said switch in such manner that said points will both be closed or one point or the other will be opened according as said switch and lock movement occupies its intermediate position or is moved to one extreme position or the other, signals governing traffic movements over said switch, right-hand and left-hand signal control relays, means controlled by said relays for controlling said signals, a switch control relay, means controlled by said switch control relay and by said signal control relays for selectively energizing said switch and lock movement to operate it between its intermediate and two extreme positions, and means for selectively controlling said switch and said signal control relays.

6. In combination, a railway switch having independently movable switch points, signals governing traffic movements over said switch, right-hand and left-hand signal control relays governing the energization of said signals in accordance with the positions of the switch points, a polarized switch control relay, means controlled by said switch control relay and by said signal control relays for causing both switch points to occupy closed positions when said signal control relays are operated to the positions to cause said signals to indicate stop and for causing one switch point or the other to move to an open position depending on the positions of the polar contacts of said switch control relays when said signal control relays are conditioned to cause a signal to clear for traffic movements in either direction over said switch, and means for selectively controlling said switch and signal control relays.

7. In combination, a railway switch having the switch points independently movable to closed and open positions, signals governing traffic movements over said switch, right-hand and left-hand signal control relays governing the energization of said signals, a switch control relay operable to two positions, means controlled by said relays for causing both switch points to assume their closed positions whenever said signal control relays are conditioned to cause the signals to indicate stop and for causing one switch point or the other to assume its open position in accordance with the position of said switch control relay whenever the signal control relays are conditioned to cause a signal to indicate proceed, and means for selectively controlling said switch and signal control relays.

8. In combination, a railway switch having the switch points indepenently movable to closed and open positions, signals governing traffic movements over said switch, right-hand and left-hand signal control relays governing the energization of said signals, a switch control relay operable to two positions, means controlled by said relays for causing both switch points to assume their closed positions whenever said signal control relays are conditioned to cause the signals to indicate stop and for causing one switch point or the other to assume its open position in accordance with the position of said switch control relay whenever the signal control relays are conditioned to cause a signal to indicate proceed, means for delaying the clearing of any one of said signals until the switch points have assumed positions corresponding to the position of said switch control relay, and means for selectively controlling said switch and signal control relays.

9. In combination, a railway switch having the switch points independently movable to closed and open positions, signals governing traffic move-

ments over said switch, right-hand and left-hand signal control relays governing the energization of said signals, a switch control relay operable to two positions, means controlled by said relays for causing one switch point or the other to assume its open position so that both points will occupy a position corresponding to that of the switch control relay whenever the signal control relays are operated to effect the clearing of a signal, said open switch point being restored to its closed position whenever the signal control relays are operated to restore a signal to its stop position, and means for selectively controlling said relays.

10. In combination, a railway switch having the switch points independently movable to open and closed positions, a switch control relay operable to two positions, means for energizing said relay to operate it to either one of its two positions, signals governing traffic movements over said switch, and means controlled in part by said switch control relay for causing one switch point or the other to move to its open position whenever said switch control relay becomes energized and to subsequently return to its closed position automatically unless said signals are cleared within a predetermined time interval after said switch control relay becomes energized.

11. In combination, a railway switch having its switch points indepenedntly movable to open and closed positions, signals governing traffic movements over said switch, a lever having two positions, a push button, and means set into operation whenever said push button is operated for causing one point or the other to open depending on whether said lever then occupies its one or its other position and to subsequently return to its closed position automatically at the expiration of a predetermined time interval unless said signals are cleared prior to the expiration of said time interval.

12. In combination, a railway switch having its switch points independently movable to open and closed positions, a lever having two positions, a push button, a time element stick relay having two windings, a time element relay, a switch control relay having two positions, means for energizing said switch control relay to operate it to its one position or the other position when said push button is operated depending upon whether said lever then occupies its one or its other position, means effective whenever said push button is operated to energize the one winding of said time element stick relay to cause it to assume one position, a lock relay picked up only when traffic conditions are favorable for operating said switch, means effective when said time element relay becomes deenergized for energizing the other winding of said time element stick relay to cause it to assume another position, means effective if said lock relay is energized when said time element stick relay occupies its other position for energizing said time element relay, means effective when said time element relay becomes deenergized for causing one point or the other of said switch to move to its open position depending upon whether said switch control relay then occupies its one or its other position, and means effective whenever said time element relay completes its time interval for causing both switch points to assume closed positions if said lock relay is then energized.

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