Sept. 25, 1934. H. S. YOUNG 1,974,439

RAILWAY TRAFFIC CONTROLLING APPARATUS

Original Filed Sept. 5, 1931 2 Sheets-Sheet 1

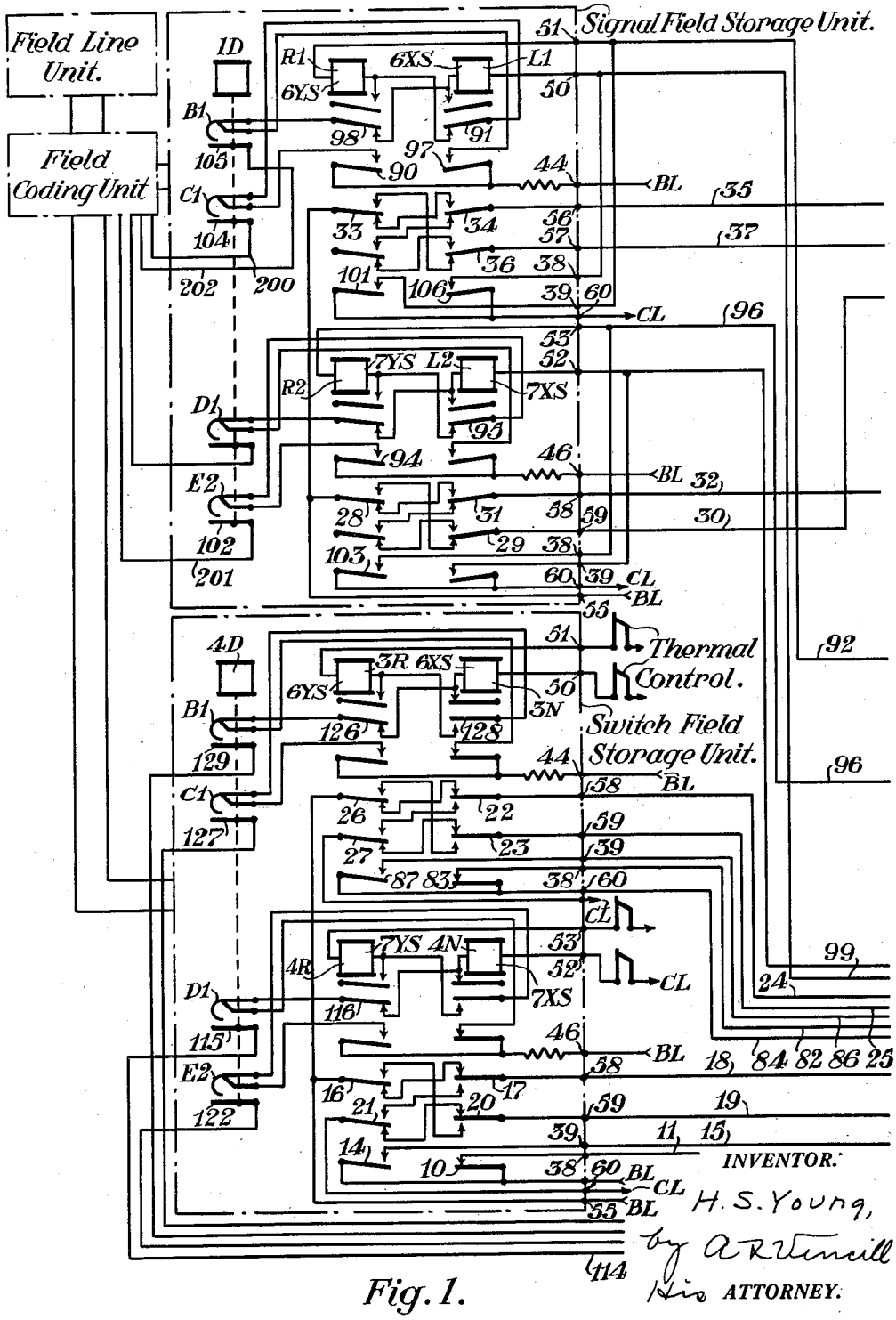


Fig. 1.

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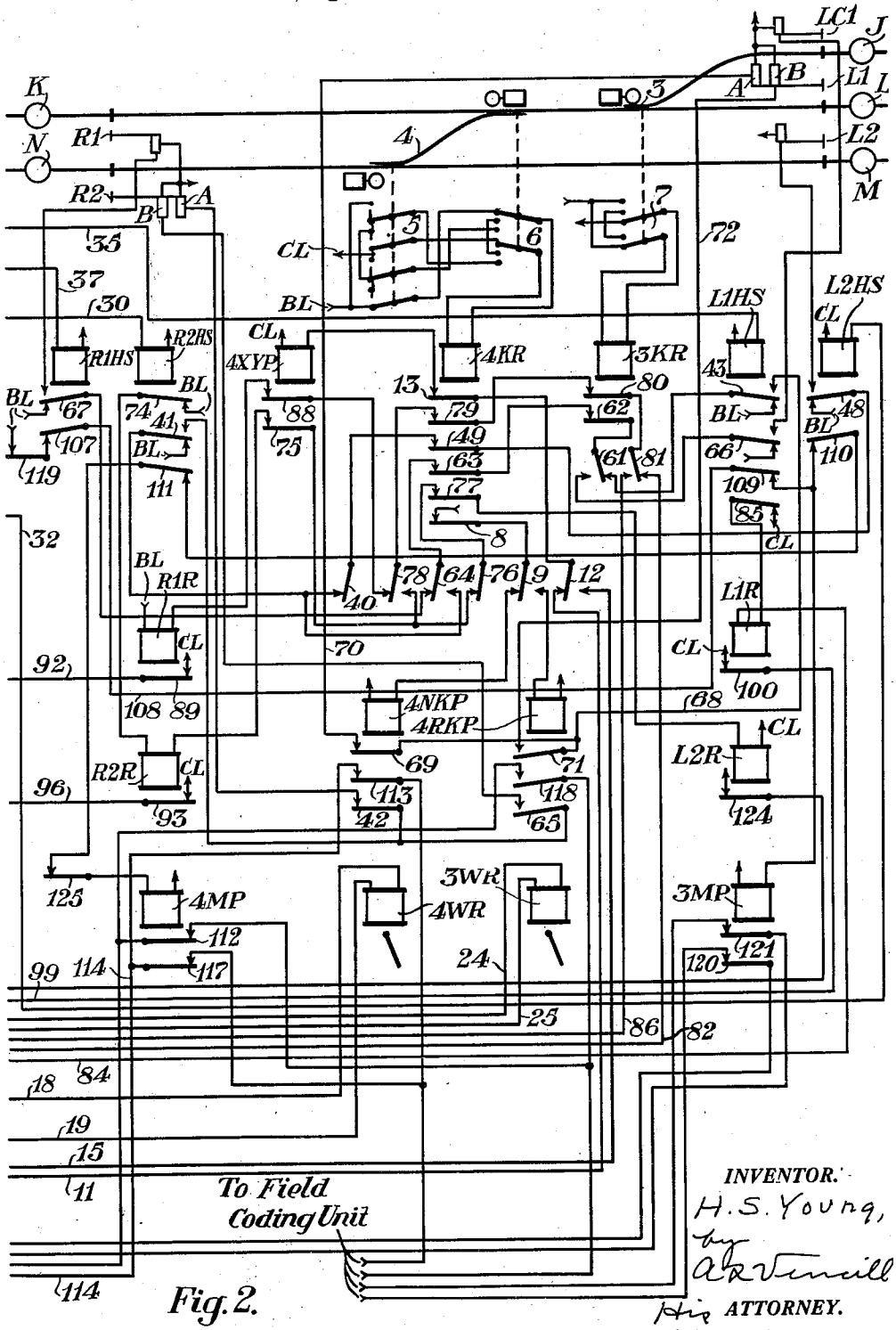


Fig. 2.

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Patented Sept. 25, 1934 1,974,439

UNITED STATES PATENT OFFICE

1,974,439

RAILWAY TRAFFIC CONTROLLING APPARATUS

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Application September 5, 1931, Serial No. 561,425
Renewed January 2, 1934

23 Claims. (Cl. 246—3)

My invention relates to railway traffic controlling apparatus for governing traffic moving over railway switches, and more particularly it relates to apparatus applied to a remote control system to govern signals and switches for a track layout having a plurality of traffic routes.

One feature of my invention is the provision, in a remote control system, of means that require that all the switches of a route must agree as to position with the remote controlled switch controlling relays before a remote controlled signal controlling relay can function to clear a signal.

I have further provided that a switch controlling relay of the remote control system cannot be selected to change the position of a switch until the signal controlling relays of the remote control system for the signals governing traffic over that switch are deenergized to, in turn, deenergize the signal governing relay for each signal. Other features of my invention will appear also as the specifications progress.

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

The accompanying Figs. 1 and 2 when taken together with Fig. 1 placed at the left constitute a diagrammatic view of one form of my invention when applied to the apparatus for governing the switches and signals of the track layout shown diagrammatically at the upper part of Fig. 2.

While my invention may be used in connection with different types of remote control systems, it is particularly adapted to a remote control system designed on the current sequence principle, such, for example, as disclosed and described in the United States application for Letters Patent by Snavely, Miller and Tunell, entitled Remote control system, Serial No. 538,380, filed May 18, 1931.

In this remote control system the codes are given individual character by the sequence in which the control circuits are operated. A line channel consisting of three wires connects serially from the central office equipment through each field station equipment. This three wire channel provides two independently operated series circuits and one common return circuit. Since two independent series circuits are provided, the line action at any instant may be given any one of three characters depending upon whether the first circuit, the second circuit or both circuits are operated. These three variables have been designated for convenience as "X", "Y" and "Z". Each code action, either control or indication, consists of eight successive steps. Each step has a specific function and may be identified by any one of the three characters "X", "Y" or "Z".

The apparatus at each field location is grouped into three units known as the field line unit, field coding unit, and field storage unit. In the disclosure of this application only enough of the field apparatus of this remote control system is shown to clearly set forth the manner whereby the apparatus of my invention can be made to cooperate with the apparatus of a remote control system.

Stick relays at each field storage unit are operated by control codes transmitted from the central office to the field coding unit and these relays, in turn, control standard signal system relays for operating switch and signal functions. The stick relays of a single field storage unit are adapted to control the operation of four distinct functions, for example, the relays of a storage unit may control the two positions of a single switch and a group of signals protecting traffic in each direction over the switch. Since in the above remote control system any combination from one up to nine field storage units may be connected to and operated from one field line unit and one field coding unit, in Fig. 1 two field storage units are shown diagrammatically as being controlled from the same field line and coding units. Two field storage units are the number required to govern the operation of the switches and signals of the track layout shown in Fig. 2. One of these storage units I have termed the signal field storage unit and the other the switch field storage unit due to the fact that the relays of one unit control the signals and the relays of the other unit control the operation of the switches.

As my invention has nothing to do with the apparatus of either the field line unit or the field coding unit, these units are only indicated in Fig. 1 by a rectangular symbol. Of the field storage units only the stick relays and certain contacts operated by the relay D are shown, inasmuch as this apparatus is that with which my invention is directly associated. In Fig. 1 the stick relays of the storage units are given a reference character that identifies the corresponding relay in the above-mentioned application, Serial No. 538,380. For each of these relays there is also placed a reference character that identifies the function which that relay controls with respect to the track layout of Fig. 2. When referring to one of these relays in this description I shall use the reference character corresponding to the control function as a suffix to the reference char-

acter that identifies the corresponding relay in the previously mentioned application. For example, the relay 6YS of the signal field storage unit governs the operation of signal R1 of the track layout and this relay will be referred to as relay 6YSR1. In like manner, I shall refer to the relays that govern the signals L1, R2 and L2 as 6XSL1, 7YSR2 and 7XSL2, respectively. The relay 6YS of the switch field storage unit governs the reverse position of the switch 3 and will be identified in this description by the reference character 6YS3R, while the relay 6XS that governs the normal position of the switch 3 will be identified as relay 6XS3N. Relays 7YS4R and 7XS4N govern the reverse and normal position of the crossover 4, respectively. Each terminal connection of the field storage units of Fig. 1 is given the same reference character that also identifies the corresponding connection in the previously mentioned patent application.

For this description it is deemed sufficient to say that the remote control system permits the operator at a central office to select any one of the stick relays of the field storage units and that when one of these relays is selected it is held energized after the control code is completed by a stick circuit that may be controlled automatically by the apparatus of a signal system or by the remote control system when a new control code is transmitted.

While in Fig. 2 a specific track layout is disclosed it will be understood that my invention is adapted to other track layouts that may involve an entirely different combination of switches. The layout shown in Fig. 2 will serve, however, to illustrate the principle by which I propose to check the position of each switch of a route before a signal controlling relay governed by a remote control system can function to clear the signal governing traffic over the proposed route as well as the other features of my invention. It will be understood that the traffic rails of the tracks will be arranged in track sections by insulated rail joints and that each section will be equipped with a track circuit in accordance with the standard practice, and also that the switches are preferably operated by a switch machine of some one of the standard types now in general use. The signals to govern traffic over the routes may be of any of the standard types and are here shown as semaphore signals. Signals R1 and R2 govern traffic movements from the left to the right, while signals L1, LC1 and L2 govern traffic movements from the right to the left, and each signal is adapted to display either a clear or stop indication. For convenience, the different tracks of the layout shown in Fig. 2 have been given the reference characters J, K, L, M and N.

Power for operating the apparatus of Figs. 1 and 2 may be obtained from any convenient source either alternating current or direct current but which source is not shown in the figures. In this description I shall consider the source to be direct current and that all relays are direct current relays. The positive terminal of the source of power is indicated throughout the figures by the reference character BL, while the negative terminal is indicated by the reference character CL.

4KR and 3KR are polarized switch controlled relays. The circuit for relay 4KR is controlled by the circuit controllers 5 and 6 operated by the two opposite ends of the crossover 4, respectively, in the well known manner so that the relay 4KR is energized by current of one polarity when the two ends of the crossover are both normal and by current of a reverse polarity when the two ends of the crossover occupy the reverse position. Likewise, the switch controlled relay 3KR is governed by a circuit controlled by the circuit controller 7 operated by the switch 3 in such a manner that the relay is energized with current of normal polarity when switch 3 is normal and by current of reverse polarity when switch 3 is reversed. As this method of controlling the switch controlled relays 4KR and 3KR is so well known to the art it is thought unnecessary to describe the controlling circuits in detail, and that they can be readily understood by an inspection of Fig. 2.

4NKP and 4RKP are repeater relays for the switch controlled relay 4KR. The relay 4NKP is energized by a circuit that includes the front contact of the neutral armature 8 and the left-hand or normal contact of the polarized armature 9 of relay 4KR, while relay 4RKP is energized by the same circuit when the polarized armature 9 is reversed to engage its right-hand or reverse contact, and thus it follows that relay 4NKP is energized when the crossover 4 is normal and that relay 4RKP is energized when the crossover 4 is reversed.

Relay 4XYP is a repeater relay energized by an agreement circuit governed by the switch controlled relay 4KR and the stick relays 7YS4R and 7XS4N of the switch field storage unit. This agreement circuit extends from the positive terminal BL through the front contact of armature 10 of relay 7XS4N when that relay is selected by a control code, terminal connection 38, wire 11, left-hand or normal contact of polarized armature 12 of relay 4KR, front contact of armature 13, winding of relay 4XYP and to the negative terminal CL. If the stick relay 7YS4R is selected and the crossover 4 reversed the circuit for the relay 4XYP extends from the positive terminal BL through the front contact of armature 14 of relay 7YS4R, terminal connection 39, wire 15, the right-hand or reverse contact of polarized armature 12 and then as before traced through the winding of relay 4XYP to the negative terminal CL. It follows, therefore, that there must be an agreement as to position between the switch stick relays of the remote control system and the switch controlled relay governed by the position of the crossover 4 in order that the relay 4XYP may be energized.

4WR and 3WR are the usual polarized switch controlling relays. Relay 4WR is energized by current of normal polarity when the relay 7XS4N is selected by the despatcher so that a circuit extends from the terminal connection 55 connected to the positive terminal BL, through the back contact of armature 16 of relay 7YS4R, front contact of armature 17 of relay 7XS4N, terminal connection 58, wire 18 to the winding of relay 4WR and then by wire 19 to the terminal connection 59, front contact of armature 20, back contact of armature 21 and to the negative terminal CL of the source of power. An inspection of Fig. 1 will disclose that with relay 7YS4R selected and relay 7XS4N deenergized current of reverse polarity is supplied to the relay 4WR. When relay 4WR is energized with current of normal polarity, that is when relay 7XS4N is selected, then the polarized armatures operated by relay 4WR close operating circuits to the switch machine associated with each end of crossover 4 for positioning the crossover 4 normal, while when the relay 4WR is energized by current

of the reverse polarity, that is when relay 7YS4R is selected the polarized armatures of 4WR close operating circuits to position the crossover 4 reversed. These operating circuits controlled by the relay 4WR form no part of my invention and are therefore omitted from the figure for the sake of clearness as it is thought that they would add nothing to the understanding of my invention, it being understood these operating circuits control a switch machine at each end of the crossover 4 in accordance with the usual practice. In a like manner the polarized switch controlling relay 3WR controls operating circuits for the switch machine associated with the switch 3. Relay 3WR is itself controlled by the two stick relays 6YS3R and 6XS3N of the switch field storage unit in such a manner that when relay 6XS3N is selected and its armatures 22 and 23 engage front contacts current of normal polarity is supplied to the wires 24 and 25 leading to the two terminals of the winding for relay 3WR. When the relay 6YS3R is selected and its armatures 26 and 27 brought into engagement with front contacts then the current supplied to the winding of relay 3WR is of the reverse polarity.

The signal R2 is governed by the signal governing relay R2HS, while the controlling circuit for the relay R2HS is governed by the stick relay 7YSR2 of the remote control system. This controlling circuit starts at a terminal connection 55 connected to the positive terminal BL and includes the front contact of armature 28 of relay 7YSR2 when that relay is energized by a control code, back contact of armature 29 of relay 7XSL2, terminal connection 59 and wire 30 to the winding of relay R2HS whose opposite terminal is connected to CL. In the event the stick relay 7XSL2 of the remote control system is selected a circuit extends from the terminal connection 55 through the back contact of armature 28, front contact of armature 31 to the terminal connection 58, thence by wire 32 to the winding of the signal governing relay L2HS that governs the operation of the signal L2, and then to the negative terminal CL. Again, if the stick relay 6XSL1 of the remote control system is selected by a control code transmitted from a central office a circuit is completed from the terminal connection 55 through the back contact of the armature 33, front contact of armature 34 of relay 6XSL1 to the terminal connection 56 and thence by wire 35 to the winding of the signal governing relay L1HS and to the negative terminal CL, and this relay L1HS governs the operating circuits of the L1 signals. Once again, in the event the control code is such as to select the relay 6YSR1 a circuit is completed from the terminal connection 55 through the front contact of armature 33 of relay 6YSR1, back contact of armature 36 of relay 6XSL1 to the terminal connection 57 and thence by wire 37 to the winding of the signal governing relay R1HS that controls the operation of the signal R1. Thus it follows that each signal HS governing relay repeats the position of an associated code controlled stick relay of the signal field storage unit.

In considering the operating circuits for the different signals, I shall first take up the operating circuit for clearing the signal R2. With the crossover 4 in its normal position so that the switch controlled relay 4KR is normal, an operating circuit for signal R2 extends from the positive terminal BL at the back contact of armature 48 of the relay L2HS through the front contact of the armature 49 of relay 4KR, normal contact of the polarized armature 40, front contact of armature 41 of relay R2HS when that relay is energized as a result of a control code selecting the relay 7YSR2, front contact of the armature 42 of relay 4NKP and then to the mechanism A of signal R2 and to the negative terminal CL. In the event the cross over 4 is reversed and switch 3 normal, the operating circuit for signal R2 extends from the positive terminal BL at the back contact of armature 43 of relay L1HS, normal contact of the polarized armature 61 of the relay 3KR if switch 3 is normal, front contact of armature 62, front contact of armature 63, reverse contact of armature 64, front contact of armature 41 of relay R2HS, front contact of armature 65 of the relay 4RKP and the mechanism B of the signal R2 to negative terminal CL. There also exists an alternative path for the mechanism B of the signal R2 when the switch 3 is reversed so that the switch controlled relay 3KR is reversed. This alternative circuit starts at the back contact of the armature 66 of relay L1HS and includes the reverse contact of the polarized armature 61 of the relay 3KR and then as before traced to the mechanism B of signal R2. The signal R1 is provided with operating circuits that are the same as those described for the mechanism B of signal R2 from positive terminal BL up to the polarized armature 64 of relay 4KR thence by its normal contact to the armature 67 of relay R1HS and then by its front contact when that relay is energized as the result of a control code that selects the relay 6YSR1 to the signal R1 and to the negative terminal CL.

The operating circuits for the signals L which govern traffic from the right to the left are of a similar nature to those just described for the signals R. The operating circuit for the signal L2 starts at the positive terminal BL at the back contact of the armature 41 of the opposing signal governing relay R2HS and includes the normal contact of the polarized armature 40 of relay 4KR, front contact of the armature 49, front contact of the armature 48 of relay L2HS when that relay is energized and to the signal L2. When the crossover 4 and the switch 3 are both normal, signal L1 is provided with an operating circuit that starts at the positive terminal BL at the back contact of armature 67 of relay R1HS and includes the normal contact of polarized armature 64, front contact of armature 63, front contact of armature 62, normal contact of armature 61, front contact of the armature 43 of the relay L1HS when that relay is energized in response to a control code that selects the relay 6XSL1, wire 68, front contact of armature 69 of relay 4NKP and wire 70 to the mechanism A of the signal L1. In the event the crossover 4 is reversed then the circuit for the signal L1 starts at the positive terminal BL at the back contact of armature 41 of the relay R2HS and includes the reverse contact of armature 64, armature 63, armature 62, normal contact of armature 61, front contact of armature 43, wire 68, front contact of armature 71 of relay 4RKP and wire 72 to the mechanism B of signal L1. In the case the switch 3 is reversed, an operating circuit for the signal LC1 extends from positive terminal BL the same as traced for signal L1 up to the polarized armature 61 of the relay 3KR and thence through its reverse contact to the armature 66 of relay L1HS and then by its front contact when relay L1HS is energized to the signal LC1. Thus each signal operating circuit is not only controlled by the signal governing relay which repeats the position

of a code relay of the remote control system, but is also controlled by the position of the switches for the route over which the signal governs traffic.

In my system each traffic route is provided with a check locking circuit that includes a relay at each end of the circuit and which are preferably connected in series. These relays are indicated in Fig. 2 by the reference characters R1R, R2R, L1R and L2R, respectively. By means of contacts controlled by the switch controlled relays, a circuit is completed for each possible route of the track layout which includes either relay R1R or R2R at the left-hand end of the circuit and either relay L1R or L2R at the right-hand end of the circuit. Considering the route from the track N to the track M, the check locking circuit extends from the positive terminal BL through the back contact of the armature 74 of the relay R2HS, winding of the relay R2R, front contact of armature 75 of the relay 4XYP, normal contact of the polarized armature 76 of relay 4KR, armature 77 and winding of the relay L2R to the negative terminal CL. This circuit being completed only when the relay 4XYP is energized, the relays R2R and L2R will be energized only when there is an agreement as to position between the crossover 4 and the switch controlling relays 7YS4R and 7XS4N. When the route extends from a track N to the track L, a check locking circuit is provided that extends from positive terminal BL at the back contact of armature 74 through the winding of relay R2R, armature 75 of relay 4XYP, reverse contact of the polarized armature 78 of relay 4KR, front contact of armature 79, front contact of armature 80 of relay 3KR, normal contact of polarized armature 81, wire 82, terminal connection 38, front contact of the armature 83 of relay 6XS3N, terminal connection 60, wire 84, winding of the relay L1R and back contact of the armature 85 of relay L1HS to the negative terminal CL. In order for this last circuit to be completed, it requires that the signal governing relays for the opposing signals R2 and L1 be deenergized, that the switch controlled relay 4KR be reversed, that relay 3KR be normal, that the relay 4XYP be energized and that the stick relay 6XS3N of the remote control system be selected. As relay 4XYP is energized only when there is agreement between the relay 4KR and the relays 7XS4R and 7XS4N and as agreement is required between relays 3KR and 6XS3N, it follows that this check locking circuit insures agreement between the switches of the route from N to L and the switch controlling relays of the remote control system. Considering next that the route set up extends from the track N to the track J, the check locking circuit that is established extends from the positive terminal BL at the back contact of armature 74 through the winding of relay R2R and then by the front contact of the armature 75, reverse contact of polarized armature 78, armature 79, armature 80, reverse contact of the armature 81 as relay 3KR is now reversed, wire 86, terminal connection 39, front contact of armature 87 of the stick relay 6YS3R as this relay is selected to reverse switch 3, terminal connection 60, wire 84 to the winding of the relay L1R and thence by the back contact of armature 85 to the negative terminal CL. When the route extends from the track K to the track L, the check locking circuit provided starts at the positive terminal BL and includes the winding of relay R1R, front contact of the armature 88 of relay 4XYP, normal contact of the armature 78, armature 79, armature 80, normal contact of polarized armature 81, wire 82, terminal connection 38, front contact of armature 83 of relay 6XS3N, terminal connection 60, wire 84 and winding of relay L1R to the negative terminal CL through the back contact of armature 85. Again, if the switch 3 is reversed and the route established extends from the track K to the track J, a check locking circuit extends from positive terminal BL through the winding of relay R1R up to the polarized armature 81 by the same circuit as just traced above and hence by its reverse contact along wire 86, terminal connection 39, front contact of armature 87 of relay 6YS3R and wire 84 to the winding of the relay L1R and to the negative terminal C1 through the back contact of armature 85. Thus it is to be seen that there is a circuit associated with each route which circuit includes a relay at each end of the route and which is completed and the relays energized only in the event the switch controlled relays and the switch controlling stick relays of the remote control system occupy corresponding positions.

I shall now consider the control exerted by the relays R1R, R2R, L1R and L2R, the control circuits for which have just been described. Referring to relay R1R, when that relay is energized so that its armature 89 engages its front contact, there is made possible the completion of an energizing circuit for the signal controlling relay 6YSR1 of the remote control system. Assume that a control code has been transmitted by the operator located at the central office for energizing the relay 6YSR1. This control code when applied to the field coding unit will select the circuit for relay 6YSR1 and will cause among other things the relay 1D of the field storage unit to become energized and lift its armatures. As armature 104 is brought into engagement with the contact C1, positive energy, now supplied by the field coding unit to wire 200, is connected to that contact. From contact C1 a circuit extends through the back contact of armature 91 of relay 6XSL1, winding of the relay 6YSR1, terminal connection 51, wire 92, front contact of armature 89 of relay R1R and to the negative terminal CL. At the completion of the control code when relay 1D becomes deenergized and armature 104 drops, the relay 6YSR1 is retained energized by a stick circuit that extends from positive terminal BL to the terminal connection 44 and thence by front contact of the armature 90 of the relay 6YSR1, contact C1, back contact of armature 91, winding of relay 6YSR1, terminal connection 51, terminal connection 39, front contact of armature 101 and to the negative terminal CL at the terminal connection 60. From the foregoing discussion, it is evident that the relay 6YSR1 cannot be picked up in response to the control code unless the relay R1R is energized so as to close the connection to the negative terminal CL at front contact of its armature 89. That is to say, relay 6YSR1 cannot function to clear signal R1 unless there is agreement between the position of the switch controlled relay for the switches over which traffic is governed by the signal R1 and the switch controlling relays of the remote control system that govern those switches. To illustrate this point let us consider that the relay 6YS3R has been selected to reverse the switch 3 so as to set up the route from the track K to the track J, the crossover 4 being in its normal position of course. The switch controlled relay 4KR must

be normal indicating the normal position of the crossover 4, the switch controlled relay 3KR must be reversed indicating the reverse position of the switch 3 and the switch controlling relays 7XS4N and 6YS3R must be energized in order to complete the circuit for the relay R1R before the control code for the relay 6YSR1 can energize that relay to clear the signal R1 for a traffic movement from track K to track J.

When the despatcher transmits a control code to the field coding unit for selecting the circuit to the relay 7YSR2, the relay 1D of the field storage unit is also energized and its armature 102 brought into engagement with the contact E2 to connect positive energy, now supplied to the wire 201 by the field coding unit, to that contact. Extending from the contact E2, we can trace a circuit that includes the back contact of the armature 95 of the relay 7XSL2, winding of the relay 7YSR2, terminal connection 53, wire 96 and front contact of the armature 93 of the relay R2R to the negative terminal CL. As relay 7YSR2 picks up, it closes a stick circuit whereby it is retained energized at the completion of the control code. This stick circuit is similar to the stick circuit described for the relay 6YSR1 and includes positive terminal BL at terminal connection 46, front contact of armature 94, contact E2, back contact of armature 95, winding of relay 7YSR2, terminal connection 53, terminal connection 38 and the front contact of the armature 103 to the negative terminal CL at terminal connection 60. As the energizing circuit for the relay 7YSR2 includes a front contact of armature 93 of relay R2R, it follows that for relay 7YSR2 to respond to the control code and thereby clear signal R2 there must be an agreement between the switches of the route over which traffic is governed by the signal R2 and the respective switch controlling relays of the remote control system so that relay R2R may be energized. For illustration, if both the crossover 4 and the switch 3 have been reversed, by the despatcher sending control codes to energize the relays 7YS4R and 6YS3R, to establish a route from the track N to the track J, the circuit for energizing relay R2R is completed only when relay 4XYP is energized, relays 4KR and 3KR reversed and relay 6YS3R picked up. To energize relay 4XYP requires that there be agreement between the relay 4KR and the relay 7YS4R and as agreement is required between 3KR and 6YS3R, it follows that before the signal controlling relay 7YSR2 can be picked up in response to the control code, the switch controlled relays and the switch controlling relays of the remote control system must agree as to the position for both the crossover 4 and the switch 3. An analysis of the other routes governed by the signal R2 will disclose the fact that in each instance relay R2R must be energized before the signal controlling relay 7YSR2 can function to clear the signal R2, and as has been pointed out above R2R can be energized only in the event the switch controlled relays and the switch controlling relays occupy corresponding positions.

Taking up the case of traffic from the right to the left which is governed by the signals L2, L1 and LC1; should the despatcher transmit to the field coding unit a control code to select the circuit for the relay 6XSL1 to clear the signal L1, the control code will also energize the relay 1D to bring the armature 105, which is now connected to positive energy over wire 202 through the field coding unit, into engagement with the contact B1. From the contact B1 a circuit extends through the back contact of the armature 98, winding of relay 6XSL1, terminal connection 50, wire 99 and front contact of the armature 100 of relay L1R to the negative terminal CL. Relay 6XSL1 is provided with a stick circuit similar to that described for the relay 6YSR1 and which includes its own front contacts 97 and 106 so that it is retained energized at the completion of the control code. As the energizing circuit for the relay 6XSL1 includes the front contact of the armature 100 of relay L1R it follows that for this relay to function to clear the signal L1 a circuit for energizing L1R must be completed. It was shown above that relay L1R is connected in series in a circuit with either relay R1R or R2R dependent upon the set up of the switch 3 and the crossover 4, and that in each case the circuit was completed only when there was an agreement between the switch controlled relays and the switch controlling relays of the remote control system. It is apparent, therefore without any further description that before either the signal L1 or LC1 can be cleared by the despatcher acting to energize relay L1HS, the route over which the train is to advance past these signals must be properly established.

An inspection of Figs. 1 and 2 will disclose the fact that the energizing circuit for the relay 7XSL2 is completed through the front contact of the armature 124 of relay L2R. As relay L2R is connected into a check locking circuit in series with the relay R2R and which circuit can be completed only when the switch controlled relay 4KR agrees as to position with the switch controlling relays of the remote control system, it follows that the principle regarding the clearing of the signals R1, R2 and L1 also holds good for the signal L2.

I wish to here point out that while the contact controlled by the several relays R1R, R2R, L1R and L2R is included in each instance in that part of the circuit that leads from the winding of the signal controlling relay to the negative terminal CL, these contacts could as readily be included in that part of the circuit leading from the field coding unit to an armature operated by the relay 1D of the field storage unit. For illustration, the contact 89 controlled by relay R1R could be included in the wire 200 leading from field coding unit to the armature 104. As a matter of fact such a location for the contact controlled by the check locking relays is to be preferred if proper terminal connections are provided in the field storage unit for, by such an arrangement, the extra stick contacts of the signal controlling relays of the field storage unit could be avoided.

Furthermore, it is to be noted that inasmuch as a control code for selecting a signal controlling relay cannot pick up that relay unless unless the route governed by the signal is already established and a check locking relay energized, a signal code cannot be stored by the remote control system for clearing the signal unless the route governed by the signal is already set up. This avoids the possibility of a signal code being stored by the despatcher, while another route is being used, and thus eliminates the possibility of a stored code being overlooked by the despatcher that would result in a signal being cleared unintentionally.

As stated earlier in the specification, I have provided that a switch controlling stick relay of the remote control system cannot be picked up to change the position of a switch unless the signal

controlling relay for each signal governing traffic over the switch is deenergized. Associated with each switch or crossover is a relay identified by the reference character MP with a prefix corresponding to the switch. Referring to relay 4MP associated with crossover 4, this relay is provided with a circuit that starts at the positive terminal BL of a contact 119 governed by the usual route locking for the switch 3 but which forms no part of my invention and includes the back contact of armature 107 of relay R1HS, wire 108, back contact of armature 109 of relay L1HS, back contact of armature 110 of relay L2HS, back contact of armature 111 of relay R2HS, contact 125 governed by the route locking for the crossover 4 but which also form no part of my invention, winding of relay 4MP and to the negative terminal CL. It follows from the description of this circuit for the relay 4MP that for the relay to be energized the signal governing relay for each signal governing traffic over the crossover 4 must be deenergized, and thus in turn each signal controlling relay deenergized. If a control code be sent to clear signal R2, the energizing of the signal governing relay R2HS will open the circuit to the relay 4MP and that relay is deenergized. If, now, a control code be sent to reverse the crossover 4, the relay 7XS4N will be deenergized by the control code, but the relay 7YS4R will not be picked up due to the fact that its energizing circuit is connected from the positive energy in the field coding unit to armature 122 of the relay 4D through the front contact of armature 112 of the relay 4MP which, as stated above, was deenergized when the signal governing relay R2HS was picked up. It follows therefore that the switch controlling relay 7YS4R can not be selected by a control code to reverse the crossover 4 as long as the signal R2 is clear to advance a train over the crossover. In like manner, the energizing of any signal governing relay that controls a signal governing traffic over the crossover 4 will deenergize the relay 4MP and thereby prevent the switch controlling relay of the remote control system from functioning to reverse the crossover. With the crossover 4 in its reverse position and a signal cleared to advance a train over the crossover, the switch controlling relay 7XS4N is prevented from responding to a code for positioning the crossover 4 normal, as its energizing circuit is held open at the front contact of the armature 117 of relay 4MP.

While the deenergizing of the relay 7XS4N by a reverse code does not affect the signal R2 already cleared, as the signal controlling relay 7YSR2 is held energized by its stick circuit, it does open the circuit to the relay 4XYP and that relay in turn opens the circuit to each of the relays R1R, R2R, L1R and L2R showing that disagreement exists between the position of the crossover 4 and the switch controlling relays of the remote control system and thus the signal R2 cannot now be set at stop and another signal cleared.

In connection with the operation of a crossover 4, if a control code is sent to reverse the crossover while the relay 4MP is deenergized, the normal controlling relay 7XS4N will be deenergized as stated above, but the crossover will remain in its normal position as the relay 7YS4R cannot function. With the crossover 4 remaining in its normal position, the relay 4KR will remain in its normal position also and the repeater relay 4NKP will be retained energized. Under this condition, where the switch fails to respond to the control code, the despatcher can reenergize the normal relay 7XS4N by sending a normal control code, inasmuch as the energizing circuit for the relay 7XS4N is now connected to the positive energy from the field coding unit by a by-pass circuit that includes the front contact of armature 113 of relay 4NKP, wire 114, armature 115 actuated by the relay 4D, contact D1, back contact of armature 116, winding of relay 7XS4N, and to the negative terminal CL at the terminal connection 52.

The armature 117 of relay 4MP controls the energizing circuit for the relay 7XS4N and serves a similar function to that just described for the armature 112. With the crossover 4 placed in its reverse position and a normal code is sent at a time when relay 4MP is deenergized, the relay 7YS4R will become deenergized while the relay 7XS4N will fail to function. As the crossover 4 now remains in its reverse position, the relay 4KR also remains in its reverse position and relay 4RKP is retained energized. The despatcher, under this condition, can by transmitting the proper code, reenergize the relay 7YS4R as its energizing circuit is now completed by a by-pass circuit through the front contact of armature 118 of the relay 4RKP. Therefore, these by-pass circuits around the armatures of the relay 4MP permit the despatcher to reenergize the switch controlling relays for the crossover 4 and intentionally set up a route over the crossover in the position it already occupies when he finds that it is impossible to effect a change in its position.

Relay 3MP associated with the switch 3 is controlled by a circuit that includes the back contact of the armature 109 of the relay L1HS and a back contact of the armature 107 of the relay R1HS as will be evident from an inspection of Fig. 2, and thus the relay 3MP is deenergized whenever relay R1HS or L1HS is selected to clear a signal governing traffic over the switch 3. This relay 3MP controls at the front contact of its armatures 120 and 121 the energizing circuits for the switch controlling relays 6YS3R and 6XS3N, respectively. The energizing circuit for relay 6XS3N starts at the positive energy in the field coding unit and includes the front contact of armature 121, armature 129 of relay 4D, contact B1, back contact of armature 126, winding of the relay 6XS3N, and to the negative terminal CL. The energizing circuit for the relay 6YS3R starts at positive energy in the field coding unit and includes the front contact of armature 120, armature 127 of relay 4D, contact C1, back contact of armature 128, winding of the relay 6XS3R, and to the negative terminal CL. It follows from the description of these energizing circuits that neither the relay 6YS3R nor 6XS3N can be selected by a control code as long as a signal governing traffic over the switch 3 is cleared.

If it seems desirable to do so, by-pass circuits around the armatures 120 and 121 can be readily provided in a manner similar to the by-pass circuits provided around the armatures 112 and 117 of the relay 4MP. These by-pass circuits around the relay 3MP would be controlled by the relay 3KR in a manner such that with the switch 3 remaining in its normal position after a reverse switch controlling code has deenergized the relay 6XS3N, the energizing circuit for the relay 6XS3N would be closed around the armature 121. When the switch 3 occupies its reverse position then the by-pass would be around the armature 120 and closed by the reverse position of the relay 3KR. The control of the relays 4MP and 3MP, as shown in the figures, will serve to

illustrate the principle by which I propose to prevent the remote control system from changing the position of a switch as long as a signal is cleared to advance a train over the switch, and also the manner whereby the despatcher can reenergize the switch controlling relay corresponding to the original position of the switch.

In the operation of my system, when a signal is once cleared, a control code for clearing an opposing signal cannot function. Assume, for example, that the signal R2 is cleared for a movement over the route from the track N to the track M. After the control code has selected the relay 7YSR2, it is held energized by its stick circuit. As the signal governing relay R2HS is energized to close the operating circuit for the signal R2 it opens the check locking circuit that now includes relays R2R and L2R at the back contact of the armature 74 and thus these two relays R2R and L2R both become deenergized. With relay L2R deenergized, it is impossible for a control code to select the relay 7XSL2 for the opposing signal L2 as the energizing circuit for relay 7XSL2 is held open at the armature 124 of relay L2R. Thus it is seen that once a signal is cleared for a route, a control code for clearing the opposing signal is prevented from functioning.

Such a system as here described provides a complete check of the switch and signal control circuits in a remote control system by means that can readily be applied to any track layout. The utility of such a complete check on the operation of remote controlled switches and signals will be apparent to all familiar with this type of signaling systems.

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

Having thus described my invention, what I claim is:

1. In combination, a traffic route including a plurality of railway switches, a signal at each end of the route to govern traffic in opposite directions through the route, a remote controlled switch controlling relay for each position of each switch of the route to govern the operation of the respective switch, a remote controlled signal controlling relay for each signal to govern the operation of the signal, a check locking relay for each signal, a circuit for energizing said check locking relays arranged to be closed only when each switch of the route agrees as to position with its remote controlled switch controlling relays, and means rendered effective by each check locking relay when energized to permit the associated signal controlling relay to function to clear its signal.

2. In combination, a system of traffic tracks adapted to be arranged into a plurality of different traffic routes each including a plurality of track switches, a signal at each end of each route to govern traffic in opposite directions through the route, a check locking relay for each end of each route, remote controlled means for each switch to establish the position of the switch, a remote controlled signal controlling relay for each signal to govern the operation of the signal, means for completing a circuit when a route is established for energizing the check locking relay for each end of the route when each switch of the route occupies the position corresponding to that of its remote controlled means, means rendered effective by each check locking relay when energized to permit the signal controlling relay for the signal at its end of the route to become energized, and means rendered effective when a signal controlling relay is energized to clear the corresponding signal.

3. In combination, a system of traffic tracks adapted to be arranged into a plurality of different traffic routes each including a plurality of track switches having a normal and a reverse position, a signal at each end of each route to govern traffic in opposite directions through the route, remote controlled means for each switch to establish the position of the switch, a remote controlled signal controlling relay for each signal to govern the operation of the signal, a switch controlled relay for each switch having a normal and a reverse position corresponding to the normal and reverse positions of its switch, a circuit for each route controlled by the remote controlled means and the switch controlled relay of each switch of the route and closed only when there is agreement as to position between the remote controlled means and the switch controlled relay for each switch of the route, two check locking relays for each circuit one for each end of the route with which the circuit is associated, means rendered effective by each check locking relay when energized to permit the signal controlling relay for the signal at its end of the route to become energized, and means rendered effective when said signal controlling relay is energized to clear the corresponding signal.

4. In combination, a traffic route including a plurality of railway switches each having a given position for establishing said route, a signal at each end of the route to govern traffic in opposite directions through the route, switch controlling means for each switch having a given condition for establishing the given position of the switch, a circuit controlling device for each switch adapted to asume a given condition when such switch occupies said given position, a circuit controlled by the switch controlling means and the circuit controlling device of each switch of the route arranged to be closed only when the switch controlling means and the circuit controlling devices of all the switches of the route assume their given condition, a check locking relay for each signal which becomes energized when said circuit is closed, a signal controlling relay for each signal, an energizing circuit for each signal controlling relay which becomes closed only when the corresponding check locking relay is energized, and means rendered effective to clear the signal when said signal controlling relay is energized.

5. In combination, a railway switch having a normal and a reverse position, a signal to govern traffic over said switch, a signal governing relay to clear the signal when energized, a second relay energized only when said signal governing relay is deenergized, a normal and a reverse switch controlling relay to govern the normal and reverse positions of the switch respectively, an energizing circuit for each switch controlling relay each closed when said second relay is energized and open when said second relay is deenergized, and means governed by the position of the switch rendered effective when the switch occupies either position to close a by-pass around said second relay for the energizing circuit associated with the switch controlling relay that governs the position which the switch already occupies.

6. In combination, a railway switch having a

normal and a reverse position, a normal and a reverse remote controlled switch controlling relay to establish the normal and reverse positions of the switch respectively, a polarized switch controlled relay adapted to assume a normal position in response to the normal position of the switch and to assume its reverse position in response to the reverse position of the switch, an energizing circuit for the normal switch controlling relay closed by the normal position of said polarized relay, and an energizing circuit for the reverse switch controlling relay closed by the reverse position of said polarized relay.

7. In combination, a railway switch having a normal and a reverse position, a signal to govern traffic over said switch, a normal and a reverse remote controlled switch controlling relay to establish the normal and reverse position of the switch respectively, a polarized switch controlled relay adapted to assume a normal position in response to the normal position of the switch and a reverse position in response to the reverse position of the switch, an energizing circuit for each of said switch controlling relays, a relay MP energized when said signal is at stop to close both of said energizing circuits, and means controlled by the polarized relay to close the energizing circuit to the normal switch controlling relay around said relay MP when said polarized relay occupies its normal position and to close the energizing circuit for the reverse switch controlling relay around said relay MP when the polarized relay occupies its reverse position.

8. In combination, a route including a plurality of railway track switches, a signal for governing traffic movements over said route, a signal stick relay, means controlled by said stick relay for controlling said signal, a normal switch relay for each switch, a reverse switch relay for each switch, means controlled by each of said normal and reverse switch relays for operating the corresponding switch to normal and reverse positions respectively, a switch indication relay controlled by each switch and arranged to be energized in the normal or the reverse direction according as the switch is in its normal or its reverse position, a checking relay controlled by a normal or a reverse switch relay for each of said switches and by the indication relay for each of said switches and arranged to be energized only if each switch is in the position required by the route and if the corresponding switch relay is energized, a code controlled pick-up circuit for said signal stick relay energized only if said checking relay is energized, and a code controlled stick circuit for said signal stick relay.

9. In combination, a route including a plurality of railway track switches, a signal for governing traffic movements over said route, a signal stick relay, means controlled by said stick relay for controlling said signal, a normal switch relay for each switch, a reverse switch relay for each switch, means controlled by each of said normal and reverse switch relays for operating the corresponding switch to normal and reverse positions respectively, a switch indication relay controlled by each switch and arranged to be energized in the normal or the reverse direction according as the switch is in its normal or its reverse position, code-controlled means controlling said signal stick relay in part, and means controlled by a normal or a reverse switch relay for each of said switches and by the indication relay for each of said switches for permitting said signal stick relay to store a code control for said signal only if each of the switches of the route is in the position required by the route at the time the code control is delivered at the signal stick relay and only if a corresponding normal or reverse switch relay is energized at the time the code control is delivered at the signal stick relay.

10. In combination, a stretch of multiple track railroad including a plurality of track switches, a plurality of signals including one for governing the movement of traffic over each route through said stretch; independently operable manual control means for each switch effective to operate its switch only when each signal governing a route over such switch is in its most restrictive condition; a signal relay for each independent route through said stretch; a plurality of interconnected signal circuits selectively closed in accordance with the routes determined by the positions of the switches of said stretch when the signal relays for such routes are energized, to clear the corresponding signals; a pickup circuit for each signal relay including a manually operable contact and closed only when each switch of the selected route governed by such relay agrees in position with its control means, and a stick circuit for each signal control relay including said manually operable contact but independent of the switches of the selected route and of their control means, whereby the operation of the control means for any switch of a route when a signal for such route has been cleared will not result in changing the indication of the signal.

11. In an interlocking control system for a plurality of railway tracks interconnected by switches to form a plurality of routes, a normal and a reverse control relay for each switch, means controlled by the normal and the reverse control relay for each switch for causing operations of the corresponding switch to normal and reverse positions respectively, a checking relay for each route end, a checking circuit for each route including the control winding of the checking relay for each end of the route and controlled by each switch of the route in the position required by the route and also controlled by the corresponding normal or reverse control relay for each switch of the route to energize the checking relays for the route only if each switch of the route and its control relay are in corresponding conditions, a signal for each route end for governing traffic movements over the corresponding routes, a stick relay for each of said signals for controlling the corresponding signal, a pick-up circuit for each of said stick relays energized only if the checking relay for the corresponding route end is energized, and a stick circuit for each of said stick relays for retaining the corresponding stick relay in its energized condition independently of the condition of the associated checking relay.

12. In an interlocking control system for a plurality of railway tracks interconnected by switches to form a plurality of routes, a checking relay for each route end, a checking circuit for each route including the control winding of the checking relay for each end of the route and controlled by each switch of the route in the position required by the route to energize the checking relays for the route only if each switch of the route is in the position required for the route, a signal for each route end for governing traffic movements over the corresponding routes, a stick relay for each of said signals for controlling the corresponding signal, a pick-up circuit for each

of said stick relays energized only if the checking relay for the corresponding route end is energized, and a stick circuit for each of said stick relays for retaining the corresponding stick relay in its energized condition independently of the condition of energization of the associated checking relay.

13. In an interlocking control system for a plurality of railway tracks interconnected by switches to form a plurality of routes, switch control means for each switch for causing operations of the corresponding switch to normal and reverse positions, a checking relay for each route end, a checking circuit for each route including the control winding of the checking relay for each end of the route and controlled by the switch control means for each switch of the route to energize the checking relays for the route only if each switch of the route is controlled to be operated to the position required for the route, a signal for each route end for governing traffic movements over the corresponding routes, a stick relay for each of said signals for controlling the corresponding signal, a pick-up circuit for each of said stick relays energized only if the checking relay for the corresponding route end is energized, and a stick circuit for each of said stick relays for retaining the corresponding stick relay in the energized condition independently of the condition of energization of the associated checking relay.

14. In an interlocking control system for a plurality of railway tracks interconnected by switches to form a plurality of routes, switch control means for each switch for causing operations of the corresponding switch to normal and reverse positions, a checking relay for each route end, a checking circuit for each route including the control winding of the checking relay for each end of the route and controlled by each switch of the route and by its switch control means to energize the checking relays for the route only if each switch is in the position required for the route and if the switch control means is in the condition which corresponds to the position of the switch, a signal for each route end for governing traffic movements over the corresponding routes, a stick relay for each of said signals for controlling the corresponding signal, a pick-up circuit for each of said stick relays energized only if the checking relay for the corresponding route end is energized, and a stick circuit for each of said stick relays for retaining the corresponding stick relay in the energized condition independently of the condition of energization of the associated checking relay.

15. In combination, a railway track switch, a normal and a reverse control relay for controlling operations of said switch to its normal and reverse positions respectively, a normal and a reverse indication relay energized if and only if said switch is in its normal or its reverse position respectively, a traffic control contact, a circuit for energizing each of said control relays only if said traffic contact is closed, a circuit for energizing said normal control relay independently of said traffic control contact if said normal indication relay is energized, and a circuit for energizing said reverse control relay independently of said traffic control contact if said reverse indication relay is energized.

16. In combination, a traffic route including a plurality of railway switches each having a normal and a reverse position, a signal to govern the movement of traffic over the route, a remote controlled switch controlling relay for each position of each switch of the route to establish the respective normal or reverse position of the switch, a remote controlled stick relay to govern the operation of said signal, a switch controlled relay for each switch having a normal and a reverse position arranged to repeat the normal and reverse position of its switch, a pick-up circuit for said stick relay closed only when each switch controlled relay of the route agrees as to position with its switch controlling relay for the route, a stick circuit for said stick relay independent of said switch controlling relays, and a circuit for clearing the signal including a front contact of said stick relay.

17. In combination, a traffic route including a plurality of railway switches each having a normal and a reverse position, a signal to govern the movement of traffic over the route, a remote controlled switch controlling relay for each position of each switch of the route to establish the respective normal or reverse position of the switch, a remote controlled stick relay to govern the operation of said signal, a switch controlled relay for each switch having a normal and a reverse position arranged to repeat the normal and reverse position of its switch, a pick-up circuit for said stick relay closed only when each switch controlled relay of the route agrees as to position with its switch controlling relay for the route, a stick circuit for said stick relay independent of said switch controlling relays, and a circuit for clearing the signal controlled by said switch controlled relays and closed only when said stick relay is energized.

18. In combination, a traffic route including a plurality of railway switches, a signal at each end of the route to govern the movement of traffic in opposite directions over the route, remote controlled switch controlling means for each switch to govern the operation of the switch, a remote controlled stick relay for each signal, a pick-up circuit for each stick relay closed only when each switch of the route agrees as to position with its remote controlled switch controlling means, a stick circuit for each stick relay independent of said switch controlling means, and a circuit for clearing each signal controlled by each switch of the route and closed only when the corresponding stick relay is energized and the stick relay for the opposing signal is deenergized.

19. In combination, a traffic route including a plurality of railway switches, a signal at each end of the route to govern the movement of traffic in opposite directions over the route, remote controlled switch controlling means for each switch to govern the operation of the switch, a remote controlled stick relay for each signal, a pick-up circuit for each stick relay closed only when the other stick relay is deenergized and each switch of the route agrees as to position with its remote controlled switch controlling means, a stick circuit for each stick relay independent of said switch controlling means, and a circuit for clearing each signal controlled by each switch of the route and closed only when the corresponding stick relay is energized.

20. In combination, a traffic route including a plurality of railway switches, a signal at each end of the route to govern the movement of traffic in opposite directions over the route, remote controlled switch controlling means for each switch to govern the operation of the switch, a remote controlled relay for each signal, an energizing circuit for each remote controlled relay closed

only when each switch of the route agrees as to position with its remote controlled switch controlling means and the other remote controlled relay is deenergized, means preventing the release of each remote controlled relay when energized if its energizing circuit is opened by the operation of the remote controlled means for a switch of said route, a circuit for clearing each signal controlled by each switch of the route and closed only when the corresponding remote controlled relay is energized, and means preventing the operation of any switch of said route in response to the operation of its remote controlled means when one of said signals has been cleared.

21. In combination, a traffic route including a plurality of railway switches, a signal at each end of the route to govern the movement of traffic in opposite directions over the route, remote controlled switch controlling means for each switch to govern the operation of the switch, a remote controlled relay for each signal, a check locking relay for each signal, a circuit for energizing said check locking relays in series arranged to be closed only when each switch of the route agrees as to position with its remote controlled switch controlling means, an energizing circuit for the remote controlled relay for each signal including a front contact of the associated check locking relay, and a circuit for each signal controlled by each switch of the route and closed only when the corresponding remote controlled relay is energized and the remote controlled relay for the opposing signal is deenergized.

22. In combination, a traffic route including a plurality of railway switches, a signal at each end of the route to govern the movement of traffic in opposite directions over the route, remote controlled switch controlling means for each switch to govern the operation of the switch, a remote controlled relay for each signal, a check locking relay for each signal, a circuit for energizing said check locking relays in series arranged to be closed only when each switch of the route agrees as to position with its remote controlled switch controlling means, an energizing circuit for the remote controlled relay for each signal including a front contact of the associated check locking relay, means effective when either remote controlled relay becomes energized to deenergize said check locking relays to thereby prevent the energization of the other remote controlled relay, and a circuit for clearing each signal controlled by each switch of the route and by a front contact of the corresponding remote controlled relay.

23. In combination, a system of traffic tracks adapted to be arranged into a plurality of different traffic routes each including a plurality of track switches, a signal for each route, a remote controlled means for each switch to govern the position of the switch, a remote controlled signal controlling relay to govern the operation of the signal, a circuit for each route completed upon the establishing of the route for energizing a check locking relay when each switch of the route occupies the position corresponding to that of its remote controlled means, means rendered effective by the check locking relay when energized to permit the signal controlling relay for the signal associated with the route established to become energized, means for maintaining said signal controlling relay energized subject to manual control irrespective of the condition of its check locking relay, and means controlled by said signal controlling relay and by each switch of the established route for clearing the corresponding signal.

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