Oct. 31, 1944. E. M. ALLEN 2,361,445

REMOTE CONTROL SYSTEM

Filed Dec. 4, 1942 3 Sheets-Sheet 1

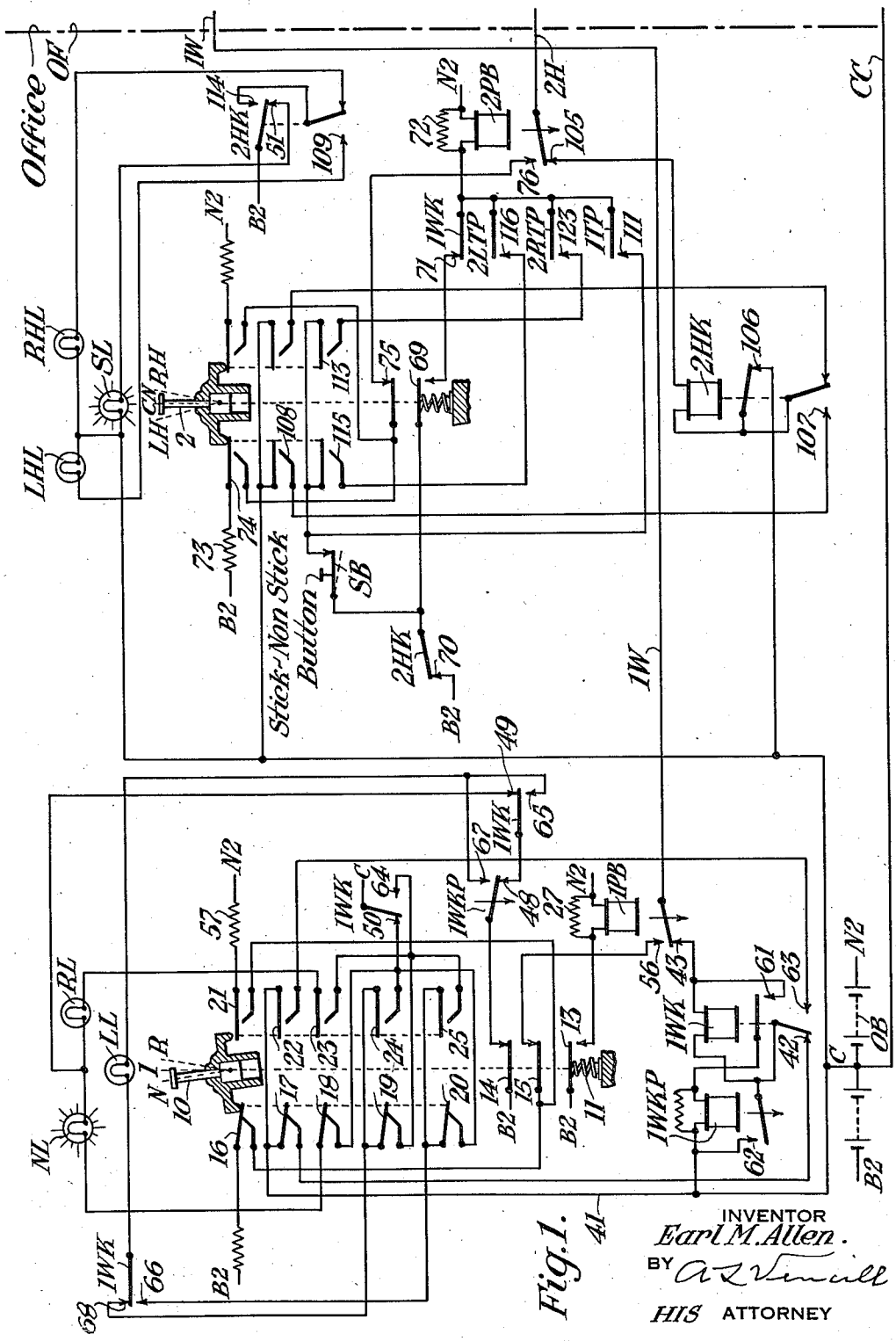


Fig. 1.

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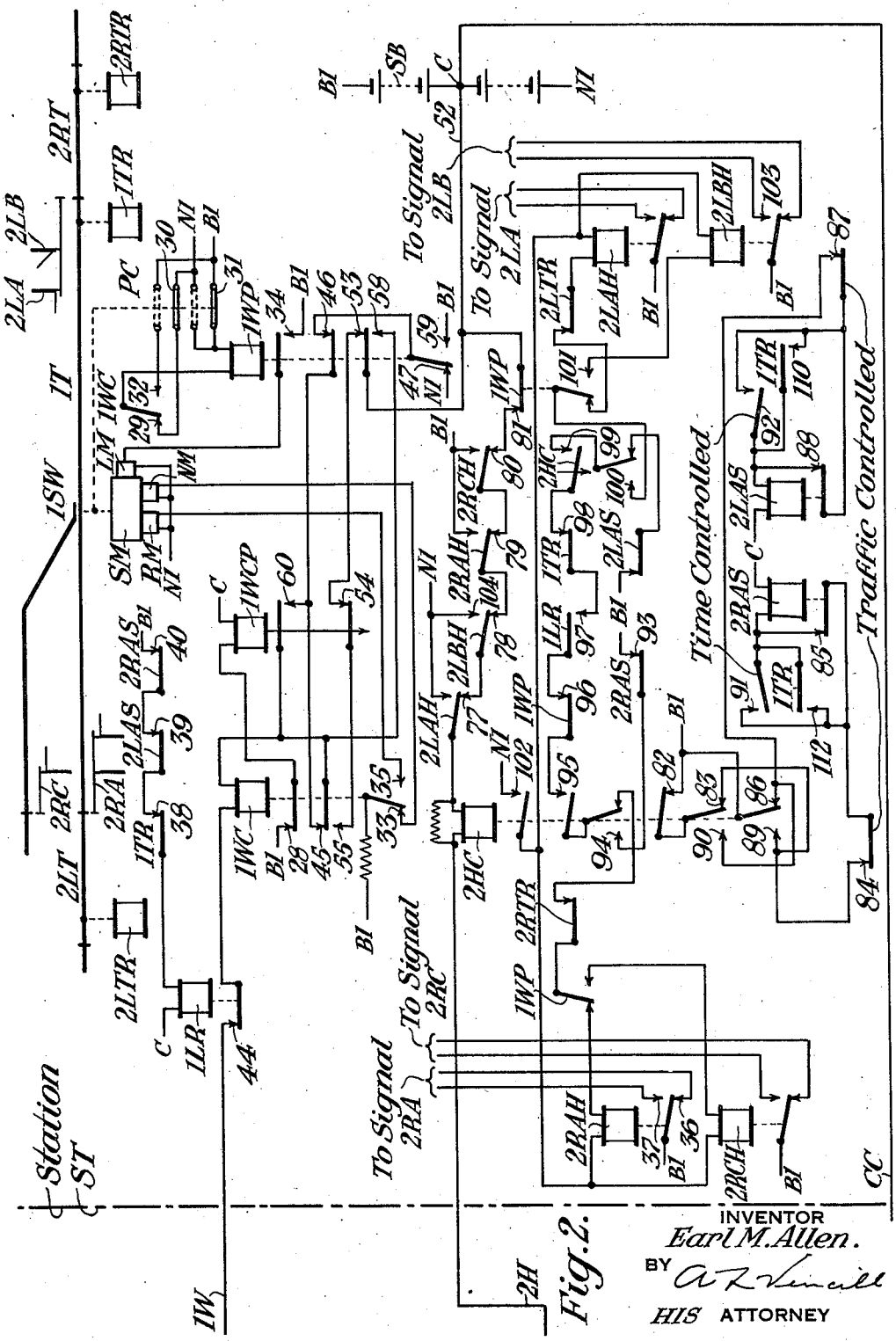


Fig. 2.

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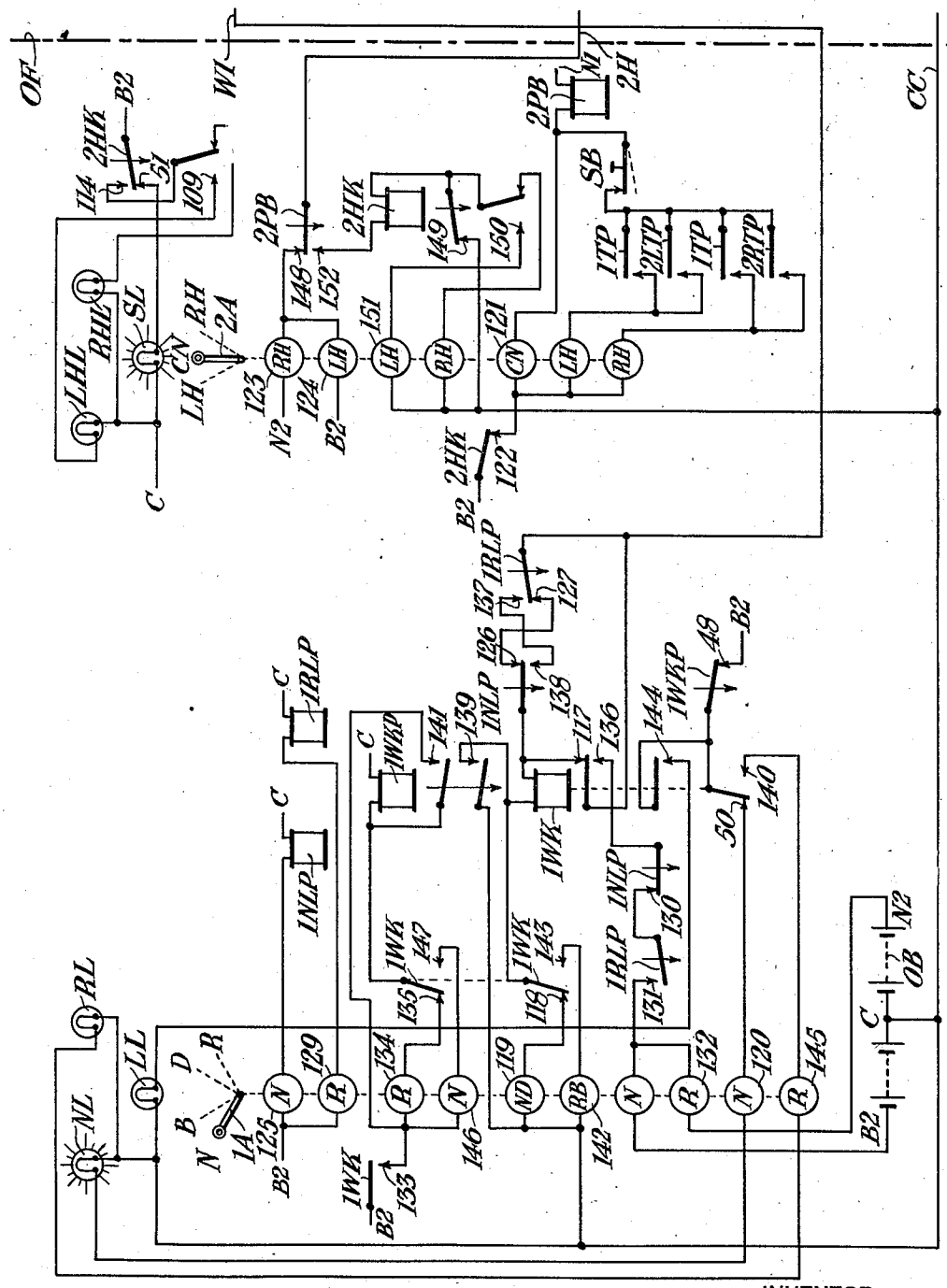


Fig. 3.

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UNITED STATES PATENT OFFICE

2,361,445

REMOTE CONTROL SYSTEM

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Application December 4, 1942, Serial No. 467,839

14 Claims. (Cl. 246—3)

My invention relates to remote control systems, and more particularly to apparatus for controlling railway traffic governing devices from an office and for indicating the condition of such devices at the office.

When a railway traffic controlling device is controlled from a remote office and the condition of such device is indicated at the office, it is in the interest of economy and simplicity if the control current and the indication current are transmitted by a single two-wire line circuit.

Accordingly, a feature of my invention is the provision of novel and improved apparatus for the control and the indication of a railway traffic governing device by the use of a single two-wire line circuit.

Another feature of my invention is the provision of novel control apparatus for railway traffic governing devices wherewith control storage "lockout" is effected. That is, any movement of a control lever prior to the time the controlled device can respond to such lever movement results in no operation of the device after the traffic condition has been removed that caused the "lockout" at the time the lever was moved.

Another feature of my invention is the provision of novel means in a remote control system of the type here involved wherewith a special indication is displayed if a control lever is moved to a position in disagreement with the controlled device when such controlled device is electrically locked.

Still another feature of my invention is the provision of control apparatus incorporating novel "stick non-stick" signal control means and novel means for checking locking relays into the signal control circuit.

Other features, advantages and objects of my invention will appear as the specification progresses.

The above features and advantages embodying my invention are accomplished by utilizing a characteristic of a polarized relay, namely, that the polar armature is operated before the neutral armature is picked up. A source of control current at the office and a source of indication current at the station are provided, the control current source supplying current to a two-wire line circuit extending between the office and station to control a traffic governing device at the station and the indication current source supplying current to this circuit to govern an office indication means. Two polarized relays, one at the office and one at the station, are connected to this line circuit, and except in certain cases, each polarized relay is connected to the line circuit through its own back neutral contact for energization of the relay and operation of its polar armature by current supplied to the circuit by the source at the far end of the circuit, such movement of the polar armature being effected before the neutral armature picks up. The traffic governing device and the indication means are governed through polar contacts of the associated relay. Each polarized relay governs shunt paths around the back neutral contact of the respective relay, so that the relay is subsequently energized to pick up its neutral armature. A time element device is provided at the office to limit to a predetermined short interval the period during which control current can be supplied to the circuit, such time element device being set into action by an initial movement of a control lever. In this way the characteristic of shifting the polar armature before the neutral armature is picked up of a polarized relay of the usual construction is utilized in a circuit network through which a switch or a signal is controlled and indicated through a two-wire line circuit.

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

In the accompanying drawings, Figs. 1 and 2 when taken together with Fig. 1 placed at the left, are diagrammatic views showing one form of apparatus embodying my invention when used to govern a railway switch and its related signals. Fig. 1 discloses the office apparatus and Fig. 2 discloses the station apparatus. Fig. 3 is a diagrammatic view showing another form of office apparatus that may be used with the station apparatus of Fig. 2, and which office apparatus also embodies my invention.

It is to be understood that my invention is not limited to use with a single switch and its related signals and this one use serves as an illustration of the invention. It is to be observed that the invention has peculiar adaptability to use with an unbalanced switch and signal layout.

In the different views like reference characters are used to designate similar parts.

Referring to Figs. 1 and 2, a diagram at the upper right-hand portion of Fig. 2 designates a stretch of railway track that includes a track switch 1SW having signals 2RA, 2RC, 2LA and 2LB associated therewith in the usual arrangement. This stretch of track is formed by the usual insulated rail joints with a detector track section 1T and two approach sections 2LT and 2RT. Each track section is provided with a track

circuit including a track relay designated R plus a prefix corresponding to the section. The track switch 1SW is power operated by a switch machine SM. The type of switch machine is immaterial and an electro-pneumatic type having a normal magnet NM, a reverse magnet RM and a lock magnet LM is shown. It is sufficient for the present application to point out that switch machine SM is operatively connected to the switch through a suitable drive mechanism and is pressure operated in response to energization of its magnets, the arrangement being such that when normal magnet NM and lock magnet LM are simultaneously energized the switch is moved to its normal position, and when the reverse magnet RM and lock magnet LM are simultaneously energized the switch is moved to its reverse position. The signals may be of any standard form and are shown conventionally and it is sufficient to point out that each signal is operable to display either a proceed or a stop indication according as a first or a second operating circuit, to be later described, is closed.

The switch machine and signals associated with switch 1SW are governed in part by traffic conditions as reflected by the track relays, and in part by a remote control system embodying my invention, and which system includes apparatus located partly at an office OF and partly at a station ST.

I shall describe briefly the apparatus for the remote control system and then describe the control and indication of the switch and signals by the remote control apparatus and the track relays.

The office OF and station ST are provided with suitable sources of current, a battery OB being located at the office, and a battery SB being located at the station. These batteries are preferably of the so-called split battery type and battery SB has a positive terminal B1, a negative terminal N1 and a mid terminal C; and battery OB is provided with a positive terminal B2, a negative terminal N2 and a mid terminal C.

Before proceeding further with the description, it is to be noted that many contact fingers of the various relays to be referred to during the description are shown remote from the winding of the relay. In each such case the contact finger is identified by the reference character of the relay and is illustrated in the position corresponding to the normal condition of the relay.

The office apparatus includes two manually operable control levers 1 and 2, the lever 1 being a switch lever for controlling switch 1SW, and lever 2 being a signal lever for controlling the signals at the switch. These levers may take different forms and are shown in Fig. 1 as being of the so-called "push-turn-release" type covered by Letters Patent of the United States No. 2,289,736, granted July 14, 1942, to C. S. Snavely et al., for Circuit controllers, and to which patent reference is made for a full understanding of the construction of such control levers. In the present application it is sufficient to describe these levers only briefly. Referring to lever 1, its handle 10 is biased by a spring 11 to a raised position as viewed in the drawing and is manually depressed a predetermined distance against the bias of spring 11. When handle 10 is depressed it can be axially rotated to a normal position N or to a reverse position R. When the handle 10 is released at either the N or R position, the handle is forced outward by the force of spring 11. Depressing handle 10 actuates contact members 13, 14 and 15, axial movement of the lever to its N position actuates contacts 16 to 20, inclusive, and movement of the lever to its R position actuates contacts 21 to 25, inclusive. Lever 2 is of a similar construction except that it is provided with a normal mid position CN as well as a left-hand position LH and a right-hand position RH.

An office time element device in the form of a slow acting relay 1PB is governed by lever 1, relay 1PB being energized by an obvious circuit including contact 13 closed when handle 10 of lever 1 is depressed. Relay 1PB is provided with a slow release period by a resistor 27 connected across the relay winding, and consequently when lever handle 10 is depressed, rotated and then released, the relay 1PB is first energized and picked up and then is deenergized to be released at the end of a predetermined slow release period. A polarized indication relay 1WK, a slow release repeater indication relay 1WKP, and indicator lamps NL, RL and LL are also associated with lever 1 in a manner to appear when the operation of the apparatus is described. Similarly, a slow release relay 2PB, a polarized indication relay 2HK and indicator lamps LHL, RHL and SL are associated with lever 2.

The apparatus at the station ST includes a polarized switch controlling relay 1WC and a polarized signal controlling relay 2HC, and each of which relays is controlled by the office apparatus through a respective line circuit to be explained hereinafter. A slow release repeater relay 1WCP and a polarized switch controlled relay 1WP are associated with relay 1WC, relay 1WCP being energized by an obvious circuit including front contact 28 of relay 1WC, and relay 1WP being governed jointly by relay 1WC and a pole changer PC operatively connected to switch 1SW. When relay 1WC is energized at normal polarity to close its normal polar contact 29, and switch 1SW occupies its normal position, causing contact members 30 and 31 of pole changer PC to occupy the position illustrated by solid lines in Fig. 2, relay 1WP is energized at normal polarity by a circuit readily understood by an inspection of Fig. 2; but when relay 1WC is energized at reverse polarity to close reverse polar contact 32 and the switch occupies its reverse position causing contact members 30 and 31 to be set at the position illustrated by dotted lines, relay 1WP is energized at reverse polarity. In other words, when there is agreement between the switch controlling relay 1WC and the switch 1SW as to their positions, switch controlled relay 1WP is energized at a polarity corresponding to the position of the switch, and when there is disagreement between relay 1WC and the switch, the relay 1WP is deenergized. Relays 1WC and 1WP govern the operation of switch machine SM, the arrangement being such that when relay 1WC is energized at normal polarity closing normal polar contact 33, and relay 1WP is released closing back contact 34, magnets NM and LM are simultaneously energized by obvious circuits to operate switch machine SM as required to move the switch to its normal position, and when relay 1WC is energized at reverse polarity closing reverse polar contact 35 and relay 1WP is released closing back contact 34, magnets RM and LM are simultaneously energized and the switch machine is operated as required to move the switch to its reverse position.

The signal controlling relay 2HC governs four signal control relays, there being a signal con-

trol relay for each signal. These signal control relays are designated H plus a prefix corresponding to the signal, and each such relay governs the operating circuits for the respective signal. For example, when relay 2RAH is deenergized closing back contact 36 an operating circuit is formed for causing signal 2RA to display a stop indication, and when relay 2RAH is energized to close front contact 37 an operating circuit is closed for causing signal 2RA to display a proceed indication. Each of the other signal control relays govern similar operating circuits.

The station apparatus also includes a traffic controlled circuit network which cooperates with the signal controlling relay 2HC in governing the signals, and which circuit network would be of standard practice and will be pointed out more fully when the operation of the apparatus is described. Furthermore, the station apparatus includes two locking relays 2RAS and 2LAS which are associated with traffic over switch 1SW, and which locking relays are governed by a traffic locking circuit network. Such traffic locking circuit network would also be of standard practice except as it is modified to include contacts of the signal controlling relay 2HC and a brief description of such network will be sufficient for a full understanding of my invention. Locking relays 2RAS and 2LAS are each normally energized by a stick circuit. When relay 2HC is operated to its right-hand and reverse position the stick circuit for relay 2RS extends from terminal B1 of the station battery through back contact 82 and reverse polar contact 83 of relay 2HC, a contact 84 governed by traffic conditions, front contact 85 of relay 2RAS and winding of that relay to terminal C of the station battery; and the stick circuit for locking relay 2LAS extends from terminal B1 through reverse polar contact 86 of relay 2HC, a contact 87 controlled by traffic conditions, front contact 88 of relay 2LAS and winding of that relay to terminal C. At such time as the signal controlling relay 2HC is operated to its left-hand and normal position the stick circuit for relay 2RAS is completed through normal polar contact 89 of relay 2HC, and the stick circuit for relay 2LAS is completed through back contact 82 and normal polar contact 90 of relay 2HC. A shunt path including either a contact 91 of the usual time element relay not shown, or back contact 112 of track relay 1TR, serves to shunt front contact 85 and provides relay 2RAS with a pick-up circuit. Similarly, a shunt path including either contact 92 governed by a time element relay or back contact 110 of track relay 1TR shunts contact 88 and provides relay 2LAS with a pick-up circuit.

A special lock relay 1LR is provided at the station, and governed by the locking relays and by traffic at the switch, the circuit for energizing lock relay 1LR including front contacts 38, 39 and 40 of relays 1TR, 2LAS and 2RAS, respectively. The function of this special lock relay 1LR will appear hereinafter.

A two-wire line circuit including a line wire W1 and a common return line wire CC extends from the office to the station for transmitting control current from the office to the station to energize the switch controlling relay 1WC at a polarity corresponding to the position of switch lever 1 and for the return transmission of indication current for controlling indication relay 1WK at a polarity corresponding to the position of the switch 1SW. In like manner, a two-wire line circuit including a line wire 2H and the common return wire CC is provided for transmission of control current from the office to the station for energizing the signal controlling relay 2HC at a polarity corresponding to the position of lever 2 and for the return transmission of indication current for energizing indication relay 2HK at a polarity corresponding to the condition of the signals. The common return wire CC is connected to the mid terminal C of each of the batteries OB and SB.

It should be pointed out that indication polarized relays 1WK and 2HK, and control polarized relays 1WC and 2HC are preferably of the usual and well-known construction and each is characterized by its polar armature being operated before the neutral armature is picked up.

In describing the operation of the apparatus of Figs. 1 and 2, I shall assume the apparatus occupies the position shonw in the drawings. Under this condition indication current is supplied to the line circuit 1W—CC for indicating the normal position of switch 1SW, current flowing from terminal C of battery SB through common line wire CC, wire 41, contact 17 of lever 1, normal polar contact 42 of relay 1WK, winding of relay 1WK, back contact 43 of relay 1PB, line wire 1W, front contact 44 of lock relay 1LR, winding of relay 1WC, front contact 45 of relay 1WC, and front contact 46 and normal polar contact 47 of relay 1WP to terminal N1 of battery SB. It is to be observed that this indication current is controlled as to its polarity by the position of the switch controlled relay 1WP. As an aid in the description I shall assume that control current and indication current that flows in a line circuit in what may be taken as a clockwise direction as viewed in the drawings is of normal polarity and current flowing in a line circuit in a counterclockwise direction is of reverse polarity. Thus this indication current is of normal polarity corresponding to the normal position of the switch, and relays 1WC and 1WK are energized at normal polarity. With relay 1WK energized at normal polarity a local office circuit for indication lamp NL to indicate the normal position of the switch 1SW is closed; this office circuit extending from terminal B2 of battery OB through lever contact 14, back contact 48 of relay 1WKP, front contact 49 of relay 1WK, lamp NL, lever contact 18 and normal polar contact 50 of relay 1WK to terminal C of battery OB.

Under the normal condition of the apparatus of Figs. 1 and 2, the signal lever 2 occupies its mid position CN at which position the line circuit 2H—CC is open and the associated relays 2HC and 2HK are deenergized with the result that the signals are set to stop and the indication lamp SL is illuminated by an obvious circuit including back contact 51 of relay 2HK to indicate the stop position of the signals.

I shall next assume that the switch 1SW is to be moved to its reverse position and to that end the switch lever 1 is moved from its N to its R position. In making such a movement of the lever 1 its handle 10 is first depressed closing contact 13 and relay 1PB is energized. Handle 10 is then rotated to the R position and released, the release of the handle opening contact 13 and relay 1PB is deenergized, relay 1PB being released at the end of its slow release period subsequent to such movement of the lever. The picking up of relay 1PB to open back contact 43 opens the line circuit 1W—CC and both polarized relays 1WK

and 1WC are deenergized and each immediately releases its respective neutral armature. The release of relay 1WK to open front contact 49 and close back contact 61, extinguishes lamp NL and switches the connection of relay 1WK with respect to the line circuit. The release of relay 1WC deenergizes its repeater relay 1WCP and switches the connection of relay 1WC with respect to the line circuit. During the slow release period of the office relay 1PB, control current is supplied from the office battery to the line circuit 1W—CC, current flowing in a counterclockwise direction in the circuit from terminal C of battery OB through line wire CC, wire 52, front contact 53 of relay 1WP, front contact 54 of relay 1WCP, back contact 55 of relay 1WC, winding of relay 1WC, front contact 44 of relay 1LR, line wire 1W, front cotact 56 of relay 1PB, lever contact 15, lever contact 21 and resistance 57 to terminal N2 of battery OB. This control current energizes relay 1WC at reverse polarity, and its polar armature is operated to close reverse polar contacts 32 and 35, such movement of the polar armature being effected before the neutral armature of the relay is moved to open back contact 55. The opening of normal polar contact 29 of relay 1WC deenergizes relay 1WP and that relay is immediately released to close back contacts 34 and 58. With back contact 34 of relay 1WP and reverse polar contact 35 of relay 1WC closed, the switch machine is set into operation to reverse the switch 1SW in the manner previously explained. The closing of back contact 58 of relay 1WP completes a shunt path for the line circuit around back neutral contact 55 of relay 1WC and front contact 54 of repeater relay 1WCP. This shunt path assures that relay 1WC is energized to firmly position its polar armature and if the control current continues for a sufficient interval relay 1WC is energized to pick up its neutral armature and reenergize repeater relay 1WCP. The office battery thus has furnished a control current to operate relay 1WC and in turn control the switch.

At the end of the slow release period of office relay 1PB the supply of control current ceases due to the opening of front contact 56 of relay 1PB. This deenergizes station relay 1WC and it immediately releases its neutral armature if that armature has been picked up, but the polar armature remains in the position to which it was last moved. With relay 1WC released the repeater relay 1WCP is deenergized and releases at the end of its slow release period. Preferably the slow release period of office relay 1PB is such that the relay 1PB is released and the line circuit conditioned to transmit an indication current prior to the completion of the operation of the switch machine SM. With relay 1WCP released and the movement of the switch completed to cause relay 1WP to be energized at reverse polarity, a circuit connection is completed at the station through which indication current is supplied to the line circuit. This indication current flows from terminal B1 of station battery SB through reverse polar contact 59 and front contact 46 of relay 1WP, back contact 60 of relay 1WCP, winding of relay 1WC, front contact 44 of relay 1LR, line wire 1W, back contact 43 of relay 1PB, back contact 61 of relay 1WK, winding of repeater relay 1WKP and line wire CC to terminal C of battery SB. This indication current flows through the line circuit in the same counterclockwise direction as the previously mentioned control current and relay 1WC is energized at reverse polarity to hold its reverse polar contacts closed and to pick up its neutral armature. Repeater relay 1WCP is now energized and picked up to open back contact 60, but a shunt path around back contact 60 is formed at front contact 45 of relay 1WC and the station connection to the line circuit is not disturbed. At the office, the relay 1WKP is picked up closing front contact 62 which connects indication relay 1WK to the line circuit in multiple with relay 1WKP, and consequently relay 1WK is energized by the indication current of reverse polarity. This causes the polar armature of relay 1WK to be operated to its reverse position closing polar contacts 63 and 64, these polar contacts being closed before the neutral armature of relay 1WK is picked up to open back contact 61 in the connection of relay 1WKP. Hence, before relay 1WKP is deenergized to open front contact 62 in the connection of relay 1WK to the line circuit, a stick circuit for relay 1WK is formed through reverse polar contact 63 and lever contact 22. It follows that indication relay 1WK and switch controlling relay 1WC are energized in series at reverse polarity by the indication current supplied to the line circuit. Reverse indication lamp RL is now illuminated to indicate the reverse in position of switch 1SW, current being supplied to lamp RL from terminal B2 through lever contact 14, back contact 48 of relay 1WKP, front contact 49 of relay 1WK, lamp RL, reverse lever contact 23 and reverse polar contact 64 of relay 1WK to terminal C.

Let it now be assumed that a train is to move to the siding over switch 1SW reversed and that the operator controls signal 2LB to its proceed indication in a manner to appear hereinafter to permit such movement, the lock relay 1LR is deenergized to open front contact 44 as will later appear when such control of signal 2LB is effected and the line circuit 1W—CC is opened causing both relays 1WK and 1WC to be deenergized. The release of relay 1WC is followed, in due time, by the release of its repeater relay 1WCP. The release of relay 1WK causes lamp RL to be extinguished and lamp LL to be illuminated, current flowing from terminal B2 through lever contact 14, back contact 48 of relay 1WKP, back contact 65 of relay 1WK, lamp LL, back contact 66 of relay 1WK, lever contact 25 and reverse polar contact 64 to terminal C. The illumination of lamp LL indicates that the switch 1SW is electrically locked by a train movement to the siding. Let it next be assumed for the sake of illustration that while the train is advancing to the siding, the operator moves lever 1 back to its normal position N in an attempt to store a normal switch control lamp LL is extinguished by such operation of the lever due to the opening of lever contact 25. Since lock relay 1LR is now deenergized to open the line circuit and remains deenergized as long as section 1T is occupied due to the shunting of track relay 1TR to open front contact 38, no control current is furnished to the line circuit because of this movement of the switch lever to its N position. When this train has moved into the siding to vacate section 1T, the lock relay 1LR is reenergized and indication current is supplied from battery SB to the line circuit over the circuit previously traced, with the result that relay 1WKP is energized and picked up to connect the indication relay 1WK to the line circuit. The stick circuit for relay 1WK through polar contact 63 is open because lever contact 22 is open with lever 1 set at its normal position

N. When repeater relay 1WKP is deenergized due to the opening of back contact 61 of relay 1WK and relay 1WKP in turn opens the circuit for relay 1WK, a pumping action of these two relays occurs. Since relay 1WKP is slow to release, there is a period when both relays are picked up to form a circuit from terminal B2 through contact 14, front contact 67 of relay 1WKP, lamp LL, front contact 68 of relay 1WK, lever contact 19 and reverse polar contact 64 of relay 1WK to terminal C. Hence this pumping action of the office relays causes lamp LL to be blinked to indicate this attempt of a storage of a switch control. Consequently a "lockout" against a storage of a switch control is effected and lamp LL is blinked as an indication of the attempt at such storage of a switch control.

Assume next that the train moves to the siding and lock relay 1LR is reenergized but lever 1 has not been moved and still is at its R position, indication current is supplied from battery SB to the line circuit and flows through the winding of relays 1WK and 1WKP in multiple since the stick circuit connection for relay 1WK is now closed. This picks up relay 1WK and with relay 1WK picked up, the lamp RL is again illuminated to indicate the reverse position of the switch. It is to be noted that normally both polarized relays 1WC and 1WK are picked up to provide the normal position indication of switch 1SW, both relays are released in response to movement of lever 1 for relay 1WC to close its back contact 55 and condition the station circuit network for control of switch 1SW and for relay 1WK to close its back contact 61 and prepare the office network to subsequently receive indication current, relay 1WC is energized through its back contact 52 by the control current to operate its polar armature to close the switch operating circuit, relay 1WC is energized to pick up its neutral armature through a shunt path including back contact 58 of relay 1WP, the indication current first energizes relay 1WC and repeater relay 1WKP and then relay 1WK to operate the polar armature of relay 1WK to prepare the indication lamp circuit and complete a shunt path through lever contact 22 to retain relay 1WK picked up and thereby complete the lamp circuit at its front contact 49.

Operation of the apparatus to move the switch back to its normal position in response to a movement of lever 1 to its N position is similar to the operation of the apparatus to move the switch to its reverse position, and the operation of the apparatus for movement of the switch to its normal position will readily be understood by an inspection of the drawings when taken in connection with the description of the operation of the apparatus to move the switch to the reverse position.

I shall next describe the operation of the apparatus of Figs. 1 and 2 in the control of the signals, and I shall first assume that the operator wishes to clear signal 2LB, the switch 1SW having been reversed as previously described. The signal lever 2 is operated by first depressing its handle, rotating it to its LH position and then releasing the handle. The depressing of the handle of lever 2 completes a circuit from terminal B2 through back contact 70 of indication relay 2HK, lever contact 69, front contact 71 of relay 1WK, winding of relay 2PB and terminal N2, and slow acting relay 2PB is energized. The release of the handle of lever 2 opens contact 69 and deenergizes relay 2PB and the relay is released at the end of a predetermined slow release period as governed by resistor 72 connected across the relay. During the slow release period of relay 2PB, control current is furnished to the line circuit 2H—CC from battery OB, the circuit being completed from terminal B2 through resistor 73, lever contacts 74 and 75, front contact 76 of relay 2PB, line wire 2H, winding of relay 2HC, back contacts 77, 78, 79 and 80 of signal control relays 2LAH, 2LBH, 2RAH and 2RCH, respectively, front contact 81 of relay 1WP, wire 52, and line wire CC back to terminal C of battery OB. This control current flows in the line circuit clockwise and energizes relay 2HC at normal polarity to close its normal or left-hand polar contacts. This operation of the polar armature of relay 2HC shifts the stick circuit of locking relay 2LAS to the connection including back contact 82 and normal polar contact 90 of relay 2HC, and consequently when relay 2HC picks up its neutral armature the stick circuit of relay 2LAS is opened at back contact 82 and the relay is deenergized. Locking relay 2RAS is retained energized with relay 2HC picked up due to the stick circuit of relay 2RAS being shifted to the connection including normal polar contact 89 of relay 2HC. The release of locking relay 2LAS to open front contact 39 deenergizes lock relay 1LR, and with relay 2HC picked up at normal polarity and lock relay 1LR released, the traffic controlled circuit network for signal control relay 2LBH is completed, and current flows from terminal B1 through front contact 93 of relay 2RAS, normal polar contact 94 and front contact 95 of relay 2HC, front contact 96 of relay 1WP, back contact 97 of relay 1LR, front contact 98 of relay 1TR, front contact 99 and normal polar contact 100 of relay 2HC, reverse polar contact 101 of relay 1WP, winding of relay 2LBH and front contact 102 of relay 2HC to terminal N1. Relay 2LBH is now picked up to close front contact 103 and complete an operating circuit by which signal 2LB is operated to a proceed indication. The picking up of relay 2LBH to open back contact 78 and close front contact 104 transfers the line circuit 2H—CC to a condition to receive indication current from battery SB at the station. During this operation of the relays at the station the office relay 2PB is released to disconnect the office battery OB and terminate the supply of control current. Indication current is now supplied from terminal C of battery SB through line wire CC, back contact 106 of relay 2HK, winding of relay 2HK, back contact 105 of relay 2PB, line wire 2H, winding of relay 2HC, back contact 77 of relay 2LAH and front contact 104 of relay 2LBH to terminal N1. This indication current is of normal polarity and energizes relays 2HK and 2HC in series, relay 2HK operating its polar armature to the left to close normal polar contact 107, such movement of the polar armatures being effected before back neutral contact 106 of the relay is opened. The closing of polar contact 107 completes a stick circuit around back contact 106 through lever contact 108, and consequently indication relay 2HK is energized to pick up its neutral armature. With relay 2HK picked up lamp LHL is furnished current over an office circuit including front contact 114 and normal polar contact 109 of relay 2HK. The illumination of lamp LHL indicates the proceed indication position of signal 2LB.

When the lock relay 1LR is deenergized due to the clearing of signal 2LB, the line circuit 1W—CC becomes open causing indication relay 1WK

to be deenergized to close back contacts 65 and 66 and lamp LL associated with lever 1 is illuminated to indicate the electric locking against movement of the switch. The train advancing past signal 2LB to enter section 1T shunts track relay 1TR to open front contact 98 of track relay 1TR causing relay 2LBH to be deenergized and released, with the result that signal 2LB is operated to its stop position. With relay 2LBH thus released, the line circuit 2H—CC is opened at front contact 104 and relays 2HK and 2HC are deenergized. The release of relay 2HK extinguishes lamp LHL and causes stop lamp SL to be again illuminated. The release of relay 2HC to close back contact 82 causes locking relay 2LAS to be energized over its pick-up circuit completed at back contact 110 of track relay 1TR. Hence when the train vacates section 1T and track relay 1TR is picked up to close front contact 38, the lock relay 1LR is energized and picked up to reclose the line circuit 1W—CC, and the apparatus associated with that circuit is restored to its normal condition where the lamp RL is illuminated.

I shall next assume that the train advances past signal 2LB in the proceed position and the operator has the stick-non-stick button SB at the office open to provide the so-called "stick" control of the signal. Should the operator attempt to clear signal 2LB for a second train before the first train vacates section 1T, and depresses the handle of lever 2 to cause the energizing of relay 2PB, such operation of lever 2 is ineffective to energize relay 2PB because relay 1WK is now released to open front contact 71. Hence the operator must operate lever 2 after the first train has vacated section 1T in order to clear signal 2LB for a following train if the button SB is open.

Non-stick control of the signal is provided by button SB being closed. Under this condition, and assuming that signal 2LB has been cleared for a train to pass to the siding, the relay 2PB is reenergized as soon as the first train enters section 1T to cause signal 2LB to be set to stop, relay 2PB receiving current through back contact 70 of relay 2HK, contact of button SB and back contact 111 of a relay 1TP, not shown, but included in the remote control in the usual manner to indicate occupancy of track section 1T. With relay 2PB picked up, the relay 2HC is reenergized so that when the first train vacates section 1T and track relay 1TR is picked up to close front contact 98 in the network the signal control relay 2LBH is reenergized at once to again clear signal 2LB. Relay 1TP would be picked up with the first train vacating section 1T to deenergize relay 2PB and consequently relay 2HK would be connected to the line circuit as soon as relay 2PB releases to close back contact 105 and relay 2HK would be energized by the indication current, the same as previously described and lamp LHL would be illuminated to again indicate the clear position of signal 2LB. Non-stick control is also provided through lever contact 115 and back contact 116 of a repeater relal 2LTP, not shown, of the remote control system to repeat the condition of track relay 2LTR, or through lever contact 113 and back contact 123 of a repeater relay 2RTP, not shown, for track relay 2RTR.

The operation of the apparatus for controlling any of the other signals is similar to that effected to control signal 2LB, and the operation will be apparent by an inspection of the drawings taken in connection with the description of the apparatus for controlling signal 2LB.

Referring to Fig. 3, the office OF is provided with apparatus which is the same as that in Fig. 1, except levers 1A and 2A are of the rotary type, slow release relay 1PB associated with the switch lever is replaced by two slow release relays 1NLP and 1RLP, and the circuits are modified. The contacts operated by levers 1A and 2A are shown conventionally in the usual manner by circles having letters placed therein to indicate the position at which the contacts are closed. The office apparatus of Fig. 3 would be used with the station apparatus of Fig. 2, the line wires 1W, 2H and CC of Fig. 3 joining corresponding line wires in Fig. 2 to complete the respective line circuits.

It is believed that the apparatus of Fig. 3 can best be understood by a description of the operation of this apparatus in connection with the apparatus of Fig. 2.

The apparatus of Fig. 3 is shown occupying the position corresponding to the normal position of switch 1SW and the stop position of the signals. Under this condition of the apparatus of Fig. 3, relay 1NLP is energized by an obvious circuit including lever contact 125. Also indication current of normal polarity is supplied from the station battery to the line circuit 1W—CC to energize indication relay 1WK at the office in series with the switch controlling relay 1WC at the station, the same as pointed out in connection with Figs. 1 and 2, the office connection in Fig. 3 being completed from line wire CC through lever contact 119, normal polar contact 118 of relay 1WK, winding of relay 1WK and either front contact 117 of relay 1WK or front contact 126 of relay 1NLP and back contact 127 of relay 1RLP to line wire 1W. With relay 1WK thus energized at normal polarity, the lamp NL is illuminated to indicate the normal position of the switch, current being supplied to lamp NL through back contact 48 of relay 1WKP, normal polar contact 50 of relay 1WK and lever contact 120.

The slow release relay 2PB associated with signal lever 2A is normally energized by a circuit including lever contact 121 and back contact 122 of indication relay 2HK, while lamp SL indicating the stop position of the signals is illuminated by a circuit including back contact 51 of the indication relay 2HK.

To reverse the switch, the operator would move the lever 1A to its R position. This opens the line circuit 1W—CC at lever contact 119 to deenergize relays 1WK and 1WC, and these relays immediately release. At the office three things now happen: (*a*) relay 1WKP is energized through back contact 133 of relay 1WK, lever contact 134 and normal polar contact 135 of relay 1WK, and on picking up relay 1WKP completes a stick circuit for itself through its own front contact 141 and back contact 133 of relay 1WK, (*b*) lamp NL is extinguished due to the opening of lever contact 120, and (*c*) relay 1RLP is energized and relay 1NLP is deenergized due to the closing of lever contact 129 and the opening of lever contact 125. Since relay 1NLP is slow to release there is a period during which both of these latter relays are picked up, and during this period control current is supplied to the line circuit 1W—CC from the office battery, current flowing from terminal C of battery OB through line wire CC, wire 52 at the station, front contact 53 of relay 1WP, front contact 54 of relay 1WCP, back contact 55 of relay 1WC, winding of relay 1WC, front contact 44 of lock relay 1LR, line wire 1W, back contact 136 of relay 1WK, front contacts 130 and

131 of relays 1NLP and 1RLP, respectively, and lever contact 132 to terminal N2 of battery OB. This control current energizes relay 1WC at reverse polarity causing its polar armature to be moved to its reverse position before back contact 55 is opened. Relay 1WP and the switch machine SM are now operated to bring about a reverse position of the switch and the reenergization of relay 1WP at reverse polarity in the same manner as described in connection with Figs. 1 and 2. Office relay 1NLP releases at the end of its slow release period during the operation of the station apparatus and discontinues the supply of control current. The energizing of relay 1WP at reverse polarity causes indication current to be supplied at the line circuit from terminal B1 of battery SB through reverse polar contact 59 of relay 1WP, front contact 46 of relay 1WP, back contact 60 of relay 1WCP, winding of relay 1WC, front contact 44, line wire 1W, front contact 137 of relay 1RLP, back contact 138 of relay 1NLP, winding of relay 1WK, front contact 139 of relay 1WKP and line wire CC back to terminal C of the station battery SB. This indication current energizes both relays 1WC and 1WK at reverse polarity. Relay 1WKP is next deenergized due to the opening of back contact 133 of relay 1WK and the lamp RL becomes illuminated by current supplied through back contact 48 of relay 1WKP, reverse polar contact 140 of relay 1WK and lever contact 145.

Let it next be assumed that signal 2LB is cleared in a manner to shortly appear to permit a train to move to the siding, relay 1LR is released to open front contact 44 due to the release of locking relay 2LAS in the clearing of signal 2LB and both relays 1WC and 1WK are deenergized due to the opening of the line circuit. Since relay 1WKP is now released closing back contact 48, the release of relay 1WK to close back contact 144 completes a circuit for lamp LL and that lamp is illuminated to indicate the electric locking condition.

For the sake of illustration, I shall next consider that the operator moves lever 1A back to its N position while the electric locking is in effect in an attempt to store a switch control. The movement of lever 1A to its N position causes relay 1WKP to be energized through back contact 133 of relay 1WK, lever contact 146 and reverse polar contact 147 of relay 1WK. Both lamps RL and LL now become dark due to back contact 48 of relay 1WKP being open. Movement of lever 1A also causes relay 1RLP to become deenergized and relay 1NLP to be energized but no control current flows because the line circuit is open. When the train vacates section 1T in passing to the siding, relay 1LR is picked up to close the line circuit and indication current is again supplied to energize relays 1WC and 1WK, the connection of the line circuit through the office being completed at back contact 127 of relay 1RLP, front contact 126 of relay 1NLP, winding of relay 1WK and front contact 139 of relay 1WKP. The picking up of relay 1WK to open back contact 133 deenergizes relay 1WKP and that relay releases to open front contact 139 to open in turn the line circuit. Relay 1WK next releases because its stick circuit is open at lever contact 142. Thus, a pumping action of relays 1WK and 1WKP results, causing lamp LL to be blinked to indicate to the operator that the switch does not respond to the normal position of lever 1A.

Assuming next that lever 1A is left at its R position and the train vacates section 1T as it passes to the siding, the picking up of relay 1LR to close the line circuit permits relays 1WC and 1WK to be reenergized by the indication current, and lamp RL to be again illuminated due to the picking up of relay 1WK and subsequent release of relay 1WKP.

Operation of the switch to its normal position in response to operation of lever 1A to its normal position will be readily understood by an inspection of Figs. 3 and 2 taken in connection with the description of the operation of the apparatus in moving the switch to its reverse position.

If the operator desires to clear signal 2LB after the switch has been reversed in the manner explained above, the signal lever 2A is moved to its LH position, which causes relay 2PB to be deenergized due to the lever contact 121 being open. During the slow release period of relay 2PB control current is supplied to the line circuit 2H—CC through lever contact 124 and front contact 148 of relay 2PB to energize the signal controlling relay 2HC at the station, the current being of normal polarity. Station relay 2HC when energized at normal polarity brings about the energizing of signal control relay 2LBH and the subsequent clearing of the signal 2LB in the manner explained in connection with the apparatus of Figs. 1 and 2. Also indication current of normal polarity is supplied to the line circuit when relay 2LBH picks up closing front contact 104. Indication relay 2HK is now included in the line circuit by the office connection including back contact 152 of relay 2PB and back contact 149 of relay 2HK, and relay 2HK is energized to cause movement of its polar armature before back contact 149 becomes open. With relay 2HK operated to its normal position, it is connected to the line circuit through its normal polar contact 150, and lever contact 151, and consequently it picks up its neutral armature in response to this indication current. Lamp LHL is next illuminated through the connection including front contact 114 and normal polar contact 109 of relay 2HK, the illumination of lamp LHL indicating the clear position of the signal. Control of any of the other signals by the office apparatus of Fig. 3 is similar to that described for the control of signal 2LB. Also the stick-non-stick control is effected by the button SB of Fig. 3 in substantially the same manner as described in connection with Fig. 1.

Although I have herein shown and described only two forms of remote control systems 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 with a railway traffic governing means operable to a first and a second condition and a direct current relay having a polar armature provided with polar contacts and a neutral armature provided with neutral contacts to control said traffic governing means either to its first or second condition according as a normal or a reverse polar contact is closed, a line circuit, a circuit connection including a back neutral contact of said relay to connect a winding of the relay to said line circuit, a time element device having a first and a second position, control means including a source of direct current and a pole changer and connected to said line circuit through a second position contact of

the time element device for energizing said relay to operate its polar armature according to the position of said pole changer, indicating means operable to a first and a second condition and connected to the line circuit through a first position contact of said time element device, another circuit connection including another contact closed when said neutral armature is released to connect said relay winding to said line circuit, indication supply means including a pole changer operated by said traffic governing means and connected to said line circuit through said other circuit connection to energize said indicating means according to the condition of the traffic governing means and to energize said relay, and a front neutral contact of said relay to shunt said other circuit connection around said other contact.

2. In combination with a railway traffic governing device operable to a first and a second position and a polarized direct current relay which controls said device to its first or second position according as a normal polar contact or a reverse polar contact of the relay is closed, a line circuit, said relay having a winding connected to said circuit through a back neutral contact of the relay, a time element device biased to a first position and operable at times to a second position for a preselected interval, control means including a source of direct current and a pole changer connected to said circuit by a second position contact of the time element device for energizing said relay through said back contact to operate the polar armature of the relay according to the position of said pole changer, an indicating device operable to a first and second position and connected to said line circuit through a first position contact of the time element device, a circuit path including a first contact governed by said relay and closed when its neutral armature is released and a second contact governed by said traffic governing device to connect said relay winding to said line circuit, indication supply means including a pole changer operated by the traffic governing device and connected to the line circuit through said circuit path for energizing said indicating device according to the position of the traffic governing device and for energizing said relay to pick up its neutral armature, and a front contact of said relay to shunt said circuit path around said first contact.

3. In combination, a railway traffic governing device operable to a first and a second position, a polarized direct current relay to control said device either to its first or its second position according as a normal polar contact or a reverse polar contact of the relay is closed, a line circuit, means including a back neutral contact of said relay to connect a winding of the relay to said line circuit; control means including a source of direct current and a pole changer to supply at times to said line circuit a control current for energizing said relay to operate its polar armature to a normal or a reverse position according to the position of said pole changer, a circuit path including a contact controlled jointly by said relay and said traffic governing device and closed by disagreement in the positions of the polar armature of the relay and the device to shunt said back neutral contact for energizing the relay to pick up its neutral armature; and indication means including a source of direct current, a pole changer operated by the traffic governing device and a front neutral contact of said relay to indicate the position of the traffic governing device.

4. In combination, a railway traffic governing device, a polarized relay to control said device to a normal or a reverse position according as a normal or a reverse polar contact of the relay is closed, a line circuit; remote control means including a current source, a control lever operable to a normal and a reverse position and a slow acting relay to supply control current of either normal or reverse polarity to said line circuit during a predetermined time interval; means governed by a movement of said lever to control said slow acting relay, said polarized relay connected to said circuit through its own back neutral contact for energizing the relay by such control current to operate its polar armature, a circuit path including a contact governed by said device and closed when the device is being operated between its positions to shunt said back neutral contact for energizing the relay by the control current to pick up its neutral armature; indication means including a current source, pole changing means governed by said device, a front neutral contact and said winding of the polarized relay to supply to said line circuit an indication current of normal or reverse polarity according to the position of said device, and remote indicating means connected to said circuit through a contact of said slow acting relay to be energized according to the polarity of such indication current.

5. In combination, a railway traffic governing device, a polarized relay to control said device either to a normal or a reverse position according as a normal or a reverse polar contact of said relay is closed; a line circuit; remote control means including a current source, a control lever operable to a normal and a reverse position and a front contact of a slow release relay to supply to said circuit control current of normal or reverse polarity according to the position of said lever; means governed by an initial movement of said lever to energize said slow release relay, said polarized relay connected to said circuit through its own back neutral contact to energize the relay and cause said normal or reverse polar contact to be closed before the relay is picked up, a circuit path including a first contact governed by said polarized relay and closed when the neutral armature of that relay is released and a second contact governed by said device and closed when the device is operated to the position corresponding to the position of the polar armature of the polarized relay to connect said relay winding to said line circuit around said back neutral contact; indication means including in series a source of current, pole changing means governed by said device and said circuit path to supply to said line circuit an indication current of normal or reverse polarity according to the position of said device, remote indicating means connected to said circuit through a back contact of said slow release relay selectively controlled by the polarity of such indication current, and a front neutral contact of said polarized relay to shunt said first contact.

6. In combination, a railway traffic governing device, a polarized relay to control said device either to a normal or a reverse position according as a normal or a reverse polar contact of said relay is closed, a slow release relay energized through a front contact of said polarized relay, a line circuit; remote control means to supply at times said circuit with control current of

either normal or reverse polarity; said polarized relay connected to said circuit through its own back neutral contact in series with a front contact of said slow release relay and a contact governed by said device and closed at the normal and reverse positions of the device for energizing the polarized relay by said control current; indication means including in series a current source, a pole changer governed by said device, a back contact of said slow release relay and a winding of the polarized relay to supply to said line circuit an indication current of normal or reverse polarity according to the position of the device; remote indicating means connected at times to said circuit to be energized by such indication current, and a front neutral contact of said polarized relay to shunt said first contact.

7. In a remote control system the combination comprising, an office and a station each provided with a source of direct current and joined by a line circuit, office control means and an office indicating means each operable to a normal and a reverse condition, an office slow acting relay governed by said control means to be actuated in response to an operation of the control means, a station traffic governing means operable to a normal and a reverse condition, two polarized relays one at the office and one at the station, means including normal and reverse polar contacts and a front neutral contact of said office polarized relay to govern said indicating means, means including normal and reverse polar contacts of said station relay to govern said traffic governing means, means including contacts of said control means and a contact of said slow acting relay to reversibly connect said office current source to said line circuit to supply a control current of a polarity preselected by the condition of the control means during the slow acting period of the slow acting relay, said station polarized relay connected to said circuit through its own back neutral contact for energizing the relay to close either its normal or reverse polar contact in response to such control current, a circuit path including contacts governed by said station relay and said traffic governing means to connect said station relay to said line circuit around said back neutral contact; means including a pole changer governed by the traffic governing means and said circuit path to reversibly connect said station current source to said line circuit to supply an indication current of a polarity preselected by the condition of the traffic governing means; means including a back neutral contact of said office polarized relay and a contact of said slow acting relay to connect the office polarized relay to said circuit to close either its normal or reverse polar contact in response to such indication current, and means including polar contacts of the office polarized relay and contacts of said control means to shunt said last mentioned back neutral contact to pick up the office polarized relay in response to such indication current.

8. In combination, indicating means operable to display either a first or a second indication, a polarized relay, means including a front neutral contact and polar contacts of said polarized relay to control said indicating means either to display its first or its second indication according as said relay is energized at normal or reverse polarity, a line circuit, remote means connected to said line circuit to supply an indication current either of normal or reverse polarity according to a first or a second condition of a device, another relay connected to said line circuit through a back neutral contact of said polarized relay to energize said other relay by such indication current, circuit means including a front contact of said other relay to connect said polarized relay to said line circuit to energize the polarized relay and close its polar contact according to the polarity of the indication current, and means including a normal and a reverse polar contact of said polarized relay to shunt said circuit means around said front contact of said other relay to energize the polarized relay to close its front contact and control the indicating means according to the polarity of the indication current.

9. In combination, traffic governing means operable to a first and a second condition, a remote control means manually operable to a first and a second condition, circuit means governed by said control means to operate said traffic governing means to its first or second condition according as said control means is operated to its first or second condition, a line circuit, means governed by said traffic governing means connected to said line circuit to supply an indication current of either normal or reverse polarity according as the traffic governing means is operated to its first or second condition, a polarized relay connected to said line circuit through its own back neutral contact to energize the relay and close either its normal or reverse polar contacts according to the polarity of such indication current, circuit means including polar contacts of the relay and contacts governed by said control means to connect said polarized relay to the line circuit around said back neutral contact to energize the relay and close its front neutral contact in response to the indication current indicating means operable to display either a first or a second indication, and other circuit means including a front neutral contact and either a normal polar contact or a reverse polar contact of said polarized relay to control said indication means to indicate the condition of siad traffic governing means.

10. In a remote control system for railways, the combination comprising, a railway switch, a switch lever operable to a normal and a reverse position to control said switch, a circuit supplied with indication current of normal or reverse polarity according to the position of said switch, a polarized relay, a slow release relay connected to said circuit through a back neutral contact of said polarized relay, means including a front contact of said slow release relay to connect said polarized relay to said circuit, two circuit paths to connect said polarized relay to said circuit around said front contact, one of such circuit paths including in series a normal polar contact of the polarized relay and a normal position contact of said lever and the other path including in series a reverse polar contact of the polarized relay and a reverse position contact of the lever, said circuit paths to retain said polarized relay energized when there is agreement in position between said switch and lever, a normal and a reverse indication lamp controlled by normal and reverse polar contacts respectively of said polarized relay, another indication lamp, and circuit means including in series a front contact of said slow release relay and a front contact of said polarized relay to intermittently illuminate said other lamp when there is disagreement between the positions of said lever and said switch.

11. In combination with a direct current relay

having a polar armature provided with polar contacts and a neutral armature provided with neutral contacts; an energizing circuit means including a source of direct current, a pole changer, a back neutral contact of said relay and a winding of the relay for energizing the relay to operate said polar armature to either a normal position or a reverse position according to the position of said pole changer; and a shunt circuit controlled by polar contacts of the relay to shunt said energizing circuit means around said back neutral contact for energizing the relay to pick up said neutral armature.

12. In combination, a detector track section provided with a left and a right signal for governing traffic through the section, a first and a second locking relay, a polarized relay, a first stick circuit including either a reverse polar contact or a normal polar contact in series with a back contact of said polarized relay to energize said first locking relay, a second stick circuit including either a normal polar contact or a reverse polar contact in series with a back contact of said polarized relay to energize said second locking relay, a first circuit network including a normal polar contact of said polarized relay and a contact closed when said first locking relay is released to clear said left signal, a second circuit network including a reverse polar contact of said polarized relay and a contact closed when the second locking relay is released to clear said right signal, and remote control means to energize said polarized relay at either normal or reverse polarity.

13. In combination, an office and a station each provided with a source of direct current and joined by a line circuit, said office provided with a control means operable to a first and a second position and an indicating means adapted to display a first and a second indication; said station having signaling means operable to a first, a second and a third condition, two polarized relays one at the office and one at the station, an office slow release relay energized in response to initial movement of said control means toward either of its positions, means including contacts of said control means and a front contact of said slow release relay to connect the office current source to said line circuit to supply a control current of normal or reversed polarity according to the first or second position of the control means, said station polarized relay connected to said line circuit through a contact closed only at the first condition of the signaling means to energize that relay by said control current, station means including polar contacts of the station polarized relay to control the signaling means to either its second or third condition according as a normal or a reverse polar contact of the station relay is closed, other station means including contacts of the signaling means to connect the station current source to said line circuit through a winding of the station relay to supply an indication current of either normal or reverse polarity according as the signaling means occupies its second or third condition, said office polarized relay connected to said line circuit through its own back contact and a back contact of said slow release relay to energize the office polarized relay by such indication current, means including polar contacts of the office polarized relay and contacts of said control means to shunt around said back contact of the office polarized relay to pick up that relay by said indication current, and means including a front contact and polar contacts of said office polarized relay to control said indicating means.

14. In a remote control system for railways, the combination comprising, a railway switch, a switch lever to control said switch, means controlled by said switch to supply a line circuit with indication current of normal or reverse polarity according to the position of the switch, a polarized relay, another relay, means including contacts of said lever and polar contacts of said polarized relay to energize said other relay when there is agreement in the positions of the lever and the polar armature of the polarized relay and a back neutral contact of the polarized relay is closed, means including a front contact of said other relay to connect said polarized relay to said line circuit to energize that relay by said indication current, other means including polar contacts of the polarized relay and contacts of said lever to connect the polarized relay to said line circuit to energize the polarized relay by the indication current when said other relay is released, a normal and a reverse lamp controlled by normal and reverse polar contacts respectively of the polarized relay to indicate a normal and a reverse position respectively of the switch when said lever and switch are in agreement, and another lamp controlled by a back contact of the polarized relay in series with a back contact of said other relay to provide a blinking light when said lever and switch are in disagreement.

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