

Oct. 5, 1937.

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2,095,044

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Oct. 18, 1935

2 Sheets-Sheet 1

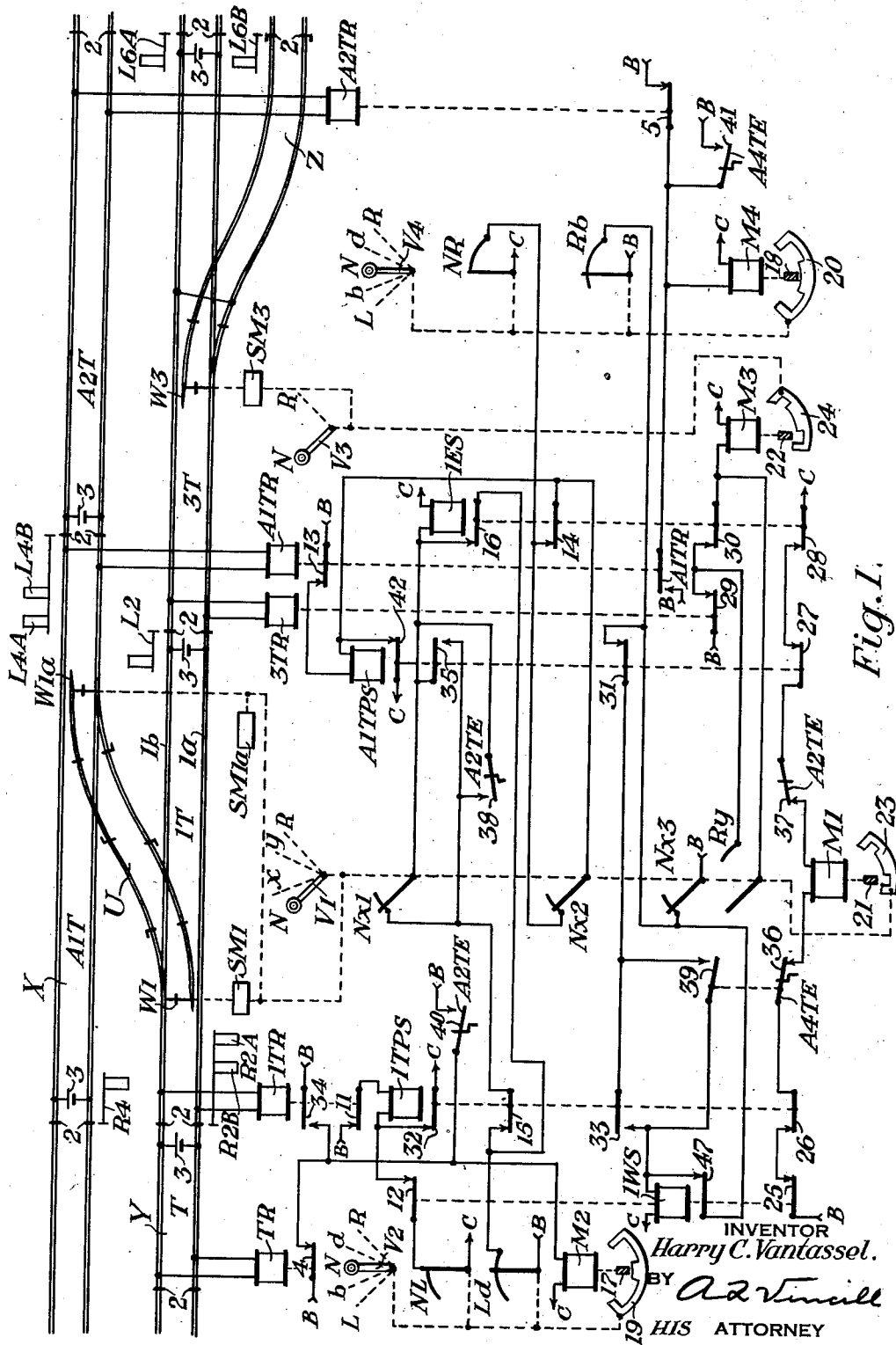


Fig. 1.

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Oct. 5, 1937.

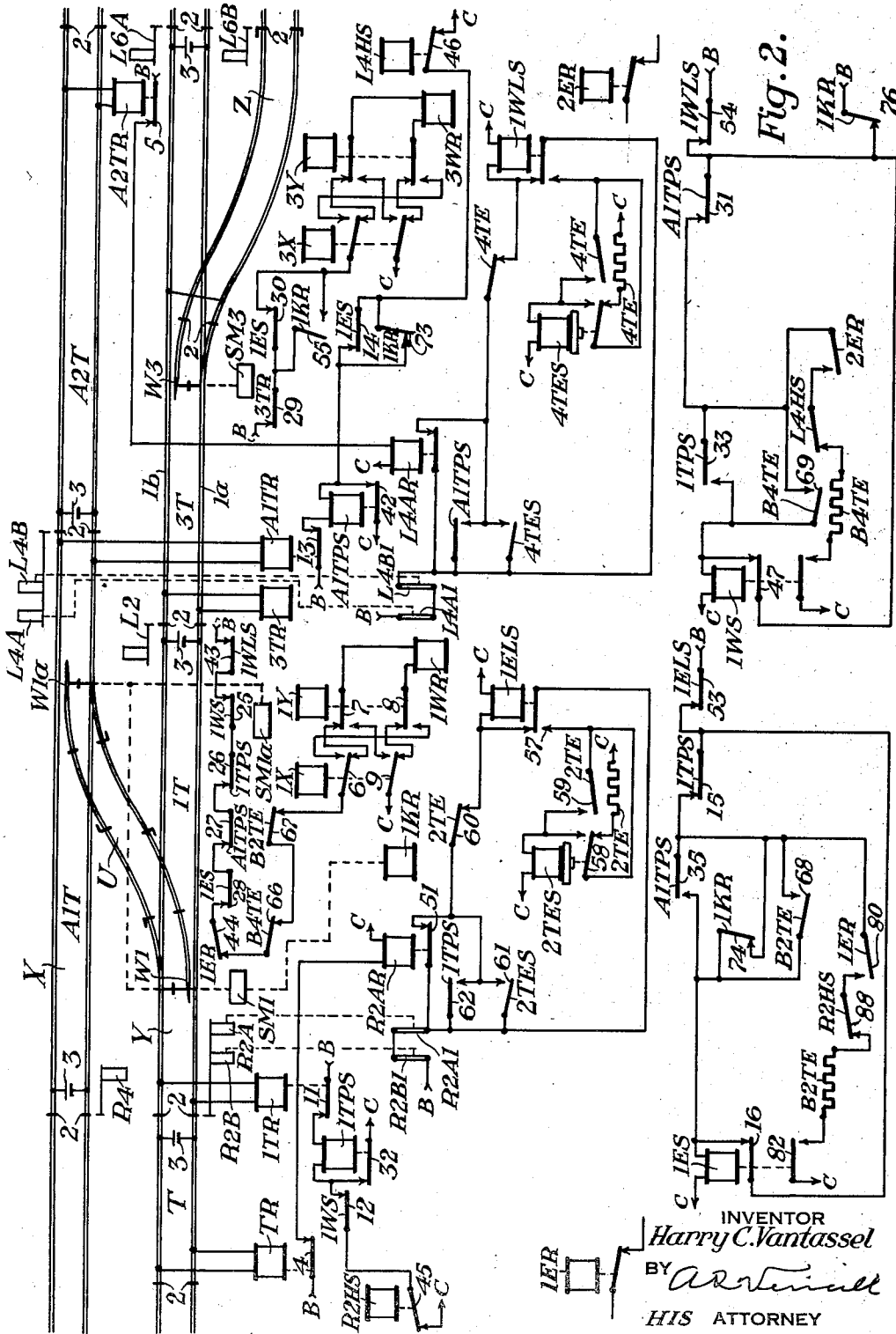
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,095,044

RAILWAY TRAFFIC CONTROLLING
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Application October 18, 1935, Serial No. 45,612

14 Claims. (Cl. 246—134)

My invention relates to railway traffic controlling apparatus, and more particularly to apparatus which will give maximum protection to traffic movements over non-track circuited sections of a track layout.

The apparatus of my invention is an improvement over that disclosed in the copending applications Serial No. 125,659, filed July 29, 1926, by Herbert A. Wallace for Railway traffic controlling apparatus; Serial No. 313,772, filed October 20, 1928, by Howard A. Thompson for Multiple control apparatus; and Serial No. 416,061, filed December 23, 1929, by Howard A. Thompson for Multiple control apparatus.

In the accompanying drawings, Figs. 1 and 2 are diagrammatic views showing alternative forms of circuits and apparatus, each embodying my invention.

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

Referring first to Fig. 1, the reference characters 1a and 1b designate the rails of a stretch of railway track designated Y, the rails of which are divided by insulated joints 2 to form track sections T, 1T, and 3T, respectively. Each track section is provided with the usual track circuit including a track battery 3 and a track relay designated R with a prefix designating the section to which it belongs. A siding Z is connected with section 3T through the medium of a switch designated W3.

The stretch of track Y is provided for normal traffic movements from left to right, while a similar stretch of track X is provided for normal traffic movements from right to left, a crossover having associated switches W1 and W1a being provided to permit traffic movements between tracks X and Y. Signals L4A and L4B are provided for directing traffic movements toward the left over switch W1a in its normal position and over switches W1a and W1 in their reverse position, respectively; while signals R2A and R2B are provided for directing traffic movements toward the right over switch W1 in its normal position and over switches W1 and W1a in their reverse positions, respectively. The slow speed signals L6A, L6B, and L2 are provided for directing traffic movements toward the left over switch W3 normal, switch W3 reversed and over switch W1 normal, respectively. The slow speed signal R4 is provided for directing traffic movements toward the right over switch W1a normal. The stretch of track X is provided with two track circuited sections A1T and A2T, respectively. The portion of the crossover between sections 1T and A1T includes a non-track circuited section U, and therefore other means, as will appear hereinafter, is provided to provide protection for traffic movements between tracks X and Y.

The movement of traffic over tracks X, Y, and

Z is under the control of an operator and is effected by means of the interlocked signal control levers V2 and V4 and the switch control levers V1 and V3. These levers are of a type commonly employed in power interlocking practice and each is provided with an electric lock controlled by a lock magnet M identified by a numerical suffix corresponding to the lever it controls. In addition, track repeating stick relays 1TPS and A1TPS, and route locking relays 1ES and 1WS are provided for controlling the lever locking. A local source of direct current is provided for energizing the various relays and magnets, but to simplify the drawings, only the terminals of the source have been shown, these bearing the references B and C to designate the supply and common return terminals, respectively, of the source. Relay 1TPS is normally energized and has a pick-up circuit which may be traced from terminal B of the local source of current, front contact 11 of the track relay 1TR, relay 1TPS, front contact 12 of relay 1WS, contact NL of lever V2, to the other terminal C of the source. A stick circuit for relay 1TPS is also closed, and may be traced from terminal B, contact 11 of relay 1TR, the winding and front contact 32 of relay 1TPS to terminal C.

Relay A1TPS is normally energized, and has a pick-up circuit which may be traced from terminal B over front contact 13 of the track relay A1TR, relay A1TPS, front contact 14 of relay 1ES in multiple with normally closed contact N22 of switch lever V1, contact NR of signal lever V4 to terminal C. A stick circuit for relay A1TPS is also closed, and may be traced from terminal B, contact 13 of relay A1TR, the winding and front contact 42 of relay A1TPS to terminal C. Route locking relay 1ES has a pick-up circuit which may be traced from terminal B, contact Ld of signal lever V2, front contact 15 of relay 1TPS, contact N21 of lever V1 and back contact 35 of relay A1TPS in multiple, relay 1ES to terminal C. Relay 1ES is normally energized over its stick circuit, which may be traced from terminal B, contact Ld of lever V2, front contact 16 and winding of relay 1ES to terminal C. Relay 1WS has a pick-up circuit which may be traced from terminal B over contacts Rb of lever V4 and N23 of lever V1 in multiple, contact 31 of relay A1TPS, back contact 33 of relay 1TPS, relay 1WS to terminal C. Relay 1WS is normally energized over its stick circuit, which may be traced from terminal B over contacts Rb of lever V4 and N23 of lever V1, in multiple, front contact 47 and winding of relay 1WS to terminal C.

The signal lever lock magnets M2 and M4 are held energized over circuits including contact 4 of the track relay TR and 5 of the track relay A2TR, respectively, as is obvious from the drawings, so that their locking dogs 17 and 18 are held

out of engagement with their locking segments 19 and 20, respectively. These levers are therefore normally free to be moved by the operator. The switch lever lock magnets M1 and M3 are also energized, so that their respective locking dogs 21 and 22 are held out of engagement with the notches of their respective segments 23 and 24. The switch control levers V1 and V3 are accordingly also normally free to be moved by the operator. The circuit for magnet M1 may be traced from terminal B, front contact 25 of relay IWS, front contact 26 of relay ITPS, back contact 36 of a time element mechanism A4TE, magnet M1, back contact 37 of a second time element mechanism A2TE, front contact 27 of relay A1TPS, front contact 28 of relay IES, to terminal C. The circuit for magnet M3 may be traced from terminal B, front contacts 29 and 30 of relays 3TR and IES, respectively, magnet M3, to terminal C. The time element mechanism A2TE is provided with a pair of normally open contacts 40 and 38 which may be closed at times to bridge contacts 4 and 35 in the circuits for magnet M2 and relay IES, respectively. Time element mechanism A4TE has similar contacts 41 and 39 which may be closed at times to bridge contacts 5 and 33 in the circuits for magnet M4 and relay IWS, respectively.

The circuits employed in the control of the several signals shown may comprise any one of several well known arrangements, but since the particular arrangement of signal circuits employed has no bearing on the present invention, none of the signal circuits have been shown. It is believed sufficient to explain that, as in ordinary practice, when signal lever V2 is moved to its R position, signal R2A or R2B will be cleared depending on whether switches W1 and W1a are in the normal or reverse position, respectively, and that signal L2 will be cleared when switches W1 and W1a are in their normal position and lever V2 is moved to the L position. In a similar manner, when signal lever V4 is moved to its R position and switches W1 and W1a are in their normal position, signal R4 will be cleared, and signal L4A or L4B will be cleared when signal lever V4 is moved to its L position, depending on whether switches W1 and W1a are in the normal or reverse position, respectively. As none of the circuits embodied in the present invention employ contacts of the signal lever used in the control of signals L6A and L6B, the lever for controlling these signals has not been shown.

As the circuits employed to control switch machines SM1 and SM1a for controlling switches W1 and W1a and switch machine SM3 for controlling switch W3 form no part of the present invention, they have also been omitted from the drawings. It is believed sufficient to explain that when switch control lever V1 is moved to position N, as shown, the switch machines SM1 and SM1a will be operated to move their switches to the normal position, and that similarly when lever V1 is moved to position R, it will be effective to cause the switch machines to move switches W1 and W1a to their reverse position. In a similar manner, movement of lever V3 controls the operation of switch machine SM3 to move switch W3 to normal or to reverse.

It is believed that an understanding of the invention can best be obtained by describing the various operations which occur during the control of traffic movements. For this purpose, it will first be assumed that switches W1 and W1a of the crossover are in their normal position, as

shown, and that the operator moves signal lever V2 to the R position to clear signal R2A to permit a traffic movement from left to right over track Y. As lever V2 is moved from position N, the pick-up circuit for relay ITPS is opened at contact NL of lever V2, but relay ITPS remains picked up over its stick circuit. When lever V2 is moved beyond position d, contact Ld opens the pick-up and stick circuits for relay IES. Relay IES accordingly releases, and its front contact 16 opens a second point in its own stick circuit. Relay IES also, at front contact 14, opens one of the two multiple paths in the pick-up circuit for relay A1TPS, and at its front contact 28, opens the circuit for lock magnet M1. Magnet M1 accordingly releases and drops its locking dog 21 into the normal notch of segment 23, thereby locking switch lever V1 against movement. Relay IES likewise, at its front contact 30, opens the circuit for lock magnet M3, which releases and drops its locking dog 22 into the normal notch of its segment 24, thereby locking switch control lever V3 against movement, so that switches W1, W1a, and W3 are locked against operation.

If now an approaching train enters section T, track relay TR releases and, at its front contact 4, opens the circuit for lock magnet M2, which releases and drops its locking dog 17 into a notch of its segment 19 to prevent return movement of lever V2 beyond its indication position d. In this position the signal circuits are open, the signal levers being arranged in accordance with the usual practice so that a cleared signal may be returned to its stop position manually by a movement of the lever from its R to its d position or from its L to its b position, as the case may be.

If now a train accepts the cleared signal R2A, and enters section IT, track relay ITR releases and, at back contact 34, closes an obvious circuit for magnet M2 which again picks up and withdraws the locking dog 17 from the notch in segment 19, enabling the operator to return lever V2 to its normal position N. Relay ITR also, at its front contact 11, opens the stick circuit for relay ITPS. Relay ITPS then releases, its front contact 32 opening a second point in its stick circuit, its front contact 15 opening a second point in the pick-up circuit for relay IES, and its back contact 33 closing a point in a pick-up circuit for relay IWS. Front contact 26 of relay ITPS opens a second point in the circuit for lever lock magnet M1, thereby preventing movement of switches W1 and W1a through the medium of switch lever V1 while section IT is occupied. Switch lever V3 controlling switch W3 remains locked because relay IES is still deenergized.

When the train enters section 3T, track relay 3TR releases and, at front contact 29, opens a second point in the circuit for magnet M3, thereby preventing movement of switch W3 while section 3T is occupied. When the train vacates section IT, track relay ITR again picks up, and assuming the operator to have restored signal lever V2 to its normal position, at front contact 11 again completes the pick-up circuit for relay ITPS. When relay ITPS picks up, its front contact 15 completes the pick-up circuit previously traced for relay IES, while its front contact 26 closes one of the two points opened in the circuit for magnet M1. When relay IES picks up, its front contact 28 completes the circuit for magnet M1 which accordingly picks up to withdraw locking dog 21 to unlock switch lever V1. Relay IES also, at front contact 30 closes one of the two points opened in the circuit for magnet M3, 75

so that this magnet can pick up to withdraw its locking dog 22 to unlock switch lever V3 as soon as the train vacates section 3T. It will therefore be seen that when signal R2A is cleared, relay IES functions as an ordinary route locking relay.

It will now be assumed that switch lever V1 has been reversed and that accordingly switches W1 and W1a are in their reverse position, and that signal lever V2 is moved to its R position to clear signal R2B for a traffic movement from left to right from track Y to track X over the crossover. If now a train moves past signal R2B and enters section 1T, track relay 1TR releases and effects the release of relay 1TPS. The circuit changes effected by the release of relay 1TPS are the same as already described, magnet M1 releasing to lock switch lever V1. Relay IES also releases and performs the same circuit changes as already described, except that, since lever V1 is in its R position, its contact R_y in multiple with front contact 30 of relay IES is closed. Lock magnet M3 therefore remains energized and lever V3 is left free to be moved by the operator, this being permissible because the route which has been established does not include switch W3.

With lever V1 in its R position, one branch of the pick-up circuit previously traced for relay A1TPS will be open at contact Nz2 of lever V1 and, on account of relay IES being deenergized, the other branch of this circuit will be open at contact 14 of relay IES. Relay A1TPS will, however, remain energized over its stick circuit.

When the train vacates section 1T, if the train is short enough to be wholly included within section U, track relay 1TR will pick up before relay A1TR releases, and these relays will for a time fail to show the presence of the train on the crossover track. The switch locking however remains effective even though the operator has in the meantime restored signal lever V2 to position N, because relay IES will not pick up when relay 1TPS picks up, as in the case of the movement over switch W1 normal previously described due to the fact that the pick-up circuit for relay IES is now open at contact Nz1 of switch lever V1, this lever being now in its reverse position. Relay IES will therefore remain released after the train vacates section 1T, thus holding the circuit for lock magnet M1 open at front contact 28 while the train remains wholly within section U, and switches W1 and W1a therefore remain locked. When the train enters section A1T, track relay A1TR releases and, at its front contact 13, opens the stick circuit for relay A1TPS. When relay A1TPS releases, its front contact 27 opens a second point in the circuit for magnet M1 to prevent M1 from picking up as long as section A1T remains occupied, and its back contact 35 which is in multiple with contact Nz1 completes the pick-up circuit for relay IES. When relay IES picks up, its front contact 14 closes to prepare a pick-up circuit for relay A1TPS and its front contact 28 closes one point in the circuit for magnet M1. Front contact 14 of relay IES is included in the pick-up circuit of relay A1TPS in order to insure that even though relay A1TR is deenergized but a short time due to the high speed movement of a short motor car over the crossover, relay A1TPS will remain deenergized until relay IES is picked up.

When the train vacates section A1T, relay A1TR again picks up and at front contact 13

closes the prepared pick-up circuit for relay A1TPS. Relay A1TPS then picks up and at front contact 27 completes the circuit for magnet M1, which, in turn, picks up to withdraw its locking dog 21 to enable the operator to again move switch lever V1 to effect movement of switches W1 and W1a.

It will be observed that lock magnet M2 of signal lever V2 is energized as long as the approach section T is unoccupied and that therefore free movement of the lever to any of its several positions is at such time possible. If the operator moves lever V2 to the R position to clear signal R2A or R2B and then attempts to return the lever to its N position after approach section T has become occupied, locking dog 17 of magnet M2 will at the time be in engagement with a notch of its segment 19 and so will prevent the immediate restoration of lever V2 beyond position d. When contact Ld becomes closed, relay IES will pick up provided relay 1TPS is energized and lever V1 is normal, closing contact 28 to energize magnet M1. It is to be understood, however, that lever V1 can be moved only when lever V2 is in position N owing to the customary mechanical locking arrangement effective between levers V2 and V1 and that lever V1 is locked mechanically by lever V2 when V2 is in other than its N position. It will be evident, therefore, that when signal R2A is put to stop manually, lever V2 may be restored to position N if there is no train approaching in section T and lever V1 will then become unlocked, but if signal R2B is put to stop manually, these conditions do not suffice, lever V1 remaining locked because contact Nz1 in the pick-up circuit of relay IES will then be open.

The operator can, however, release the locking after an appropriate delay when lever V1 is locked by lever V2 or by relay IES, by operating the time element mechanism A2TE. When this mechanism is actuated to close its front contacts 38 and 40, its back contact 37 opens the circuit for magnet M1. As soon as contact 40 closes, magnet M2 picks up and frees lever V2 so that the operator may restore it to position N, to release the mechanical locking of lever V1 by lever V2 while the closing of contact 38 completes a pick-up circuit for relay IES which may be traced from terminal B, contacts Ld, 15 and 38, relay IES to terminal C. Relay IES, therefore, picks up and at front contact 28 again closes a point in the circuit for magnet M1. The time element mechanism A2TE may now be restored to normal to close back contact 37 to complete the circuit for magnet M1 to unlock switch lever V1 at the end of a predetermined time interval. In practice this time interval is made such that a train approaching in section T will either be brought to a stop before entering section 1T, or if unable to stop will enter section 1T and cause contact 26 to open before contact 37 closes so as to maintain the locking effective until the train vacates section 1T.

It will next be assumed that a train accepts signal R2B and enters section 1T, and that lever V2 is then restored to position N, but that the train does not enter section A1T but backs out of section 1T with a view to making a subsequent movement over track Y under the control of signal R2A. Relay IES having been released, magnet M1 is deenergized to lock lever V1 so that switches W1 and W1a cannot be restored to normal. The locking may be released in this instance by operation of the time release mecha-

nism A2TE to close contact 38 thereby energizing relay IES to close contact 28, and by then restoring mechanism A2TE to normal to close contact 37 to complete the circuit for magnet M1, thereby releasing the locking of lever V1 so that switches W1 and W1a may be restored to normal to permit signal R2A to be cleared to effect the desired train movement. It will be evident, therefore, that the apparatus of my invention provides complete time locking protection against the movement of switches W1 and W1a when a train occupies the non-track circuited section U.

My apparatus can also be employed to advantage to protect train movements over a crossover in which section 1T adjoins section A1T, but which is so infrequently used that the crossover track may become heavily coated with rust so as to interfere with the proper shunting of the track circuits by light-weight equipment, as it will be evident that relay IES will maintain the locking effective while the train is upon the crossover and until it reaches the clean rails of the main track portion of section A1T to shunt the track relay A1TR.

The route locking and time element release circuits having to do with a traffic movement to the left from track X to track Y over the crossover involve the operation of relays A1TPS and IWS and time element mechanism A4TE and are similar to and function in the same manner as the corresponding circuits for the opposite direction already described, and it follows that their manner of operation will therefore be clear without further explanation. With the crossover normal, one result of clearing signal R2A is to release relay IES to lock switch lever V3 as already pointed out but since the upper track X is not provided with a switch corresponding to W3 the circuits having to do with a corresponding traffic movement to the left over track X are differently arranged. Thus route locking relay IWS is prevented from releasing when lever V4 is moved to the left to clear signal L4A by reason of the connection from terminal B over contact N23 when switch lever V1 is in its normal position, so that relay IWS does not control the locking circuits for track Y when switches W1 and W1a are normal. It will be apparent however that when switch lever V1 is in its reverse position and signal lever V4 has been moved to its L position to clear signal L4B for a crossover move the control of relay IWS will be similar to that of relay IES by signal lever V2.

In Fig. 2 I have illustrated my invention applied to the same track arrangement as employed in Fig. 1 and involving the same track relays, track repeating relays and wayside signal equipment. The invention, as shown in Fig. 2, contemplates the remote control of the switches and signals either over a direct wire system or through the medium of any one of the well known centralized traffic control systems. In this form of my invention remote controlled switch control relays IX and IY, 3X and 3Y and remote controlled signal control relays R2HS and L4HS take the place of the signal levers employed in the form of the invention illustrated in Fig. 1, while approach locking relays IELS and IWLS take the place of lever locking, and emergency release relays IER and 2ER, and thermal time element relays B2TE and B4TE take the place of the time element mechanisms A2TE and A4TE.

In Fig. 2, in order to prevent unduly complicating the drawings, contacts of various of the

relays employed are in some instances not adjacent their relay, but in each such instance a reference character corresponding to the relay to which a contact belongs is associated with the contact in addition to the usual reference numeral given to such contact.

The control of switches W1 and W1a and of switch W3 in Fig. 2 is effected by means of polarized switch control relays IWR and 3WR. The normal control circuit for relay IWR may be traced from terminal B, contact 43 of relay IWLS, contacts 25, 26, 27, and 28 of relays IWS, ITPS, A1TPS, and IES, respectively, back contact 44 of the emergency release relay IER, back contacts 66 and 67 of thermal relays B4TE and B2TE, respectively, back contact 6 of reverse switch control relay IX, front contact 7 of normal switch control relay IY, relay IWR, front contact 8 of relay IY, back contact 9 of relay IX to terminal C, this circuit being completed when relay IY is energized and relay IX is deenergized, to energize relay IWR in the normal direction. The reverse control circuit for relay IWR is similar but includes front contacts 6 and 9 and back contacts 7 and 8 and effects the energization of relay IWR in the reverse direction when relay IX is energized and relay IY is deenergized. Contacts 25 to 28 are the same as the contacts bearing the same references in Fig. 1, and contacts 66 and 67 correspond in function to contacts 36 and 37 in Fig. 1, and it follows that relay IWR is deenergized by the opening of one or another of these contacts under conditions corresponding to the locking of lever V1 by magnet M1 in Fig. 1, while contact 43, as will hereinafter appear, opens to deenergize relay IWR under conditions corresponding to the locking of lever V1 by lever V2 in Fig. 1. Contact 44 is a check contact which insures that relay IER is deenergized before the locking is released. The local circuits by means of which relay IWR controls the switch machines SM1 and SM1a have been omitted to simplify the drawings, but it is to be understood that switches W1 and W1a are caused to move to normal or to reverse when relay IWR is energized in its normal or reverse direction, respectively, and are locked against operation when relay IWR is deenergized.

A polar switch indication relay IKR is associated with switches W1 and W1a in the usual manner, and it is to be understood that relay IKR is energized to close its polar contacts to the left when switches W1 and W1a are locked normal and to the right when the switches are locked reverse.

A similar arrangement is provided for the control of switch W3 by relay 3WR, the circuit for relay 3WR, like the circuit of lock magnet M3 of Fig. 1, including contacts 29 and 30 of relays 3TR and IES, contact 30 being shunted by a contact 55 of relay IKR which takes the place of contact Ry of Fig. 1 and is closed when switches W1 and W1a are reversed. The circuits for relays ITPS and A1TPS are the same as in Fig. 1 except that the pick-up circuits include back contacts 45 and 46 of signal control relays R2HS and L4HS, respectively, instead of the lever contacts NL and NR, and contact 14 in the circuit of relay A1TPS is shunted by normal contact 73 of relay IKR in place of lever contact N22. Likewise the circuits for the route locking relays IES and IWS are similar to those employed in Fig. 1 except that polar contacts 74 and 76 of relay IKR are substituted for lever contacts N21 and N23, the circuits of Fig. 2 also including front contacts 53 75

and 54 of approach locking relays IELS and IWSL in place of contacts Ld and Rb of the signal levers, and contacts 68 and 69 of time element relays B2TE and B4TE in place of contacts 38 and 39 of time element mechanisms A2TE and A4TE.

Approach locking relay IELS is normally energized and has three pick-up circuits, one of which may be traced from terminal B, contacts R2B1 and R2A1 closed by signals R2B and R2A, respectively, in the stop position, front contact 51 of an approach relay R2AR which is a repeater of track relay TR, back contact 60 of thermal time element relay 2TE, relay IELS, to terminal C. The second pick-up circuit is similar to that just traced except that it includes back contact 62 of relay ITPS which bridges contact 51 when relay ITPS is deenergized. The third pick-up circuit includes contact 61 of a stick relay 2TES controlled by relay 2TE. Relay IELS has a stick circuit which may be traced from terminal B, contacts R2B1 and R2A1, front contact 57 and winding of relay IELS to terminal C. Relays 2TE and 2TES serve to pick-up relay IELS in the event signal R2A or R2B is put to stop when there is a train approaching in section T and relay R2AR is consequently deenergized, as will hereinafter be pointed out. Relays IWSL, 4TE and 4TES are provided with circuits similar to those of relays IELS but which are controlled by contacts L4A1 and L4B1 closed by signals L4A and L4B, respectively, in their stop position, and by relays A1TPS and L4AR, the latter relay being a repeater of track relay A2TR.

It is believed that a clear understanding of the form of the invention shown in Fig. 2 can best be obtained by describing the various operations which occur during the usual traffic movements. It will first be assumed that the operator has energized the signal control relay R2HS in order to clear signal R2A for a train movement over track Y from left to right with switch W1 normal. The circuits for clearing the signals form no part of the present invention and these circuits have therefore not been shown. It is believed sufficient to explain that these circuits are controlled in such a manner that either signal R2A or R2B may be cleared depending upon the position of the polar contacts of relay IKR and hence upon the position of switches W1 and W1a of the crossover, when relay R2HS is energized.

When the relay R2HS is picked up, signal R2A moves to its proceed position, and signal contact R2A1, which is closed only when signal R2A is at stop, opens the circuits for the approach locking relay IELS. Relay IELS accordingly releases and at its front contact 53 opens the circuits for route locking relay IES. Relay IES then releases, and its front contact 28 opens the circuit for switch control relay IWR, so that the operation of relay IWR through the medium of the remote controlled relays IX and IY is prevented, thereby locking switches W1 and W1a against movement. Since the switches W1 and W1a are normal, the polar contacts of relay IKR will be to the left, as shown, so that contact 73 of relay IKR is closed to bridge contact 14, thereby preventing relay IES from interfering with the control of relay A1TPS when the route set up does not involve track X. Contact 55 of relay IKR is open, and since contact 30 of relay IES is also open, relay 3WR is deenergized to lock switch W3.

When the approaching train enters section IT, relays ITR and ITPS release, causing signal R2A to return to stop to close contact R2A1, whereupon the pick-up circuit for relay IELS becomes

closed over back contact 62 of relay ITPS. Relay IELS picks up, closing contact 53 in the circuit of relay IES, but relay IES remains deenergized because contact 15 of relay ITPS is now open. As soon as the train enters section 3T, track relay 3TR releases and at its front contact 29 opens another point in the circuit for relay 3WR. Relay R2HS may now be released by the operator to close back contact 45 so that relay ITPS will pick up when the train vacates section IT, and then since contact 74 of relay IKR in the pick-up circuit for relay IES is closed, the closing of contact 15 of relay ITPS will cause relay IES to again become energized, closing contact 28 in the circuit for relay IWR to release the locking for switches W1 and W1a. When the train vacates section 3T, relay 3TR will pick up to close contact 29 in the circuit for relay 3WR to release the locking for switch W3.

It will now be assumed that switches W1 and W1a have been reversed and that relay R2HS has been energized to clear signal R2B. When the signal clears, contact R2B1 opens the circuits for relay IELS and this relay releases, opening contact 53 to deenergize relay IES. The route set up in this case does not include section 3T and the operation of switch W3 is not interfered with by the release of relay IES because contact 55 of relay IKR is now closed to the right bridging contact 30 of relay IES in the circuit for relay 3WR.

When the train vacates section IT, if it is short enough to be wholly included within the section U, track relay ITR will pick up before relay A1TR releases as pointed out in connection with Fig. 1. If the operator releases R2HS, relay ITPS will pick up when the train vacates section IT but relay IES will remain deenergized because its pick-up circuit is open at contact 74 of relay IKR, and switches W1 and W1a will remain locked by relay IES as long as the train remains wholly within section U. When the train enters section A1T, relay A1TR releases, deenergizing relay A1TPS to open contact 27 in the circuit for relay IWR and closing back contact 35 to complete the pick-up circuit for relay IES. When relay IES picks up its front contact 14 closes to prepare a pick-up circuit for relay A1TPS and its front contact 28 closes one point in the circuit for relay IWR.

When the train vacates section A1T, relays A1TR and A1TPS pick up. Relay A1TPS then closes contact 27 to complete the circuit for relay IWR to release the locking for switches W1 and W1a.

If the operator clears signal R2A or R2B and then returns the signal to its stop position manually, the operations which follow will depend on which route has been set up and also upon the condition of the approach section T. If section T is unoccupied and the operator releases relay R2HS to manually return signal R2A or R2B to stop, the pick-up circuit for relay IELS becomes closed over contacts R2B1 and R2A1 and contact 51 of relay R2AR as soon as the signal returns to its stop position. Relay IELS will then pick up and if switches W1 and W1a are normal, contact 74 of relay IKR will be closed so that relay IES will pick up and the release of the switch locking will be obtained without delay. If, however, the switches W1 and W1a are in their reverse position, contact 74 of relay IKR will be open, and to pick up relay IES to release the switch locking it will be necessary for the operator to energize the remote con-

trolled emergency release relay IER. When relay IER picks up, the thermal time element relay B2TE becomes energized over a circuit which may be traced from terminal B, contacts 53, 15 and 80 of relays IELS, ITPS and IER, respectively, back contact 88 of relay R2HS, the heating element of thermal relay B2TE, back contact 82 of relay IES to terminal C. It is to be understood that the contacts of the thermal relays herein shown are of the bi-metallic type and are deflected by heating, so that, after a short time interval, relay B2TE opens its back contact 67 in the circuit of relay IWR, and at the end of a predetermined heating period closes its front contact 68, bridging contacts 74 and 35 and completing the pick-up circuit for relay IES. Relay IES then picks up, completing its stick circuit, as will be clear from the drawings, and at its back contact 82 opens the circuit for relay B2TE. After a predetermined cooling period the contacts of relay B2TE restore to their normal position, and back contact 67 again closes to place the relay IWR under control of remote controlled relays IX and IY.

If the approach section T is occupied, relays TR and R2AR will be deenergized, and if signal R2A or R2B is returned manually to the stop position so that contacts R2A1 and R2B1 are closed, front contact 51 of relay R2AR will be open, so that relay IELS will fail to pick up. If back contact 57 of relay IELS remains closed when the signal is put to stop, a circuit is completed from terminal B, contacts R2B1 and R2A1, back contacts 57 and 58 of relays IELS and 2TES, respectively, and the heating element of thermal relay 2TE to terminal C. After a short time interval contact 60 of relay 2TE opens and at the end of a predetermined heating period front contact 59 of relay 2TE closes, completing a pick-up circuit for stick relay 2TES which may be traced from terminal B, contacts R2B1 and R2A1, back contact 57 of relay IELS, front contact 59 of relay 2TE, relay 2TES to terminal C. Relay 2TES picks up, opening the circuit for relay 2TE and closing front contact 58 to bridge contact 59 to complete its stick circuit. Relay 2TES also closes its front contact 61 which bridges contacts 51 and 62 in the pick-up circuit for relay IELS. Relay 2TE is now deenergized, and at the end of a predetermined cooling period its back contact 60 again closes and completes the pick-up circuit for relay IELS, which then picks up, closing front contact 57 to complete its stick circuit and opening back contact 57 to release relay 2TES.

It will next be assumed that a train accepts signal R2B and enters section IT and that the operator deenergizes relay R2HS, but that the train does not enter section AIT but backs out of section IT with a view to making a subsequent movement over track Y under the control of signal R2A. Relay IELS having become energized when the train entered section IT, will remain energized after the train vacates section IT as long as the signal remains at stop, but relay IES will have been deenergized and will remain so because contact 74 of relay IKR is open. The switches will therefore remain locked, subject to manual release after a time delay by the operation of the emergency relay IER as already described.

The circuits having to do with traffic movements from right to left over the upper stretch of track and over the crossover and involving relays AITPS, IWLS, and B4TE are similar to and func-

tion in the same manner as the corresponding relays and circuits employed in traffic movements from left to right over the lower stretch of track, and their manner of operation will therefore be clear without further explanation. Since, however, the upper stretch of track is not provided with a switch corresponding to W3 the route locking relay IWS is prevented from releasing when contact 76 of relay IKR is in its normal position, and it follows that as in Fig. 1, relay IWS does not control the locking circuits for track Y when switches W1 and W1a are normal. It will be apparent, however, that when the relay IKR is in its reverse position and relay L4HS is picked up to clear signal L4B for a crossover move the operation of relay IWS will be similar to that of relay IES as hereinbefore described.

It will be clear from the foregoing that both forms of my invention herein illustrated provide full time locking protection against the operation of switches W1 and W1a if a train moves over the crossover and fails for a time to shunt the track relay of either section IT or AIT.

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

Having thus described my invention, what I claim is:

1. In combination, two adjacent sections of railway track each provided with a track circuit including a normally energized track relay released when the section is occupied, a third section of track adjoining one of said sections, a crossover including track switches and extending between said adjacent sections, a normally energized route locking relay having a front contact included in a locking circuit for said switches, two signals including one for governing train movements over the route extending from one adjacent section over the crossover to the other and one for governing train movements over the route extending from said one section to said third section, means for effecting the release of said route locking relay when either signal is cleared, means including the track relay for said one adjacent section for energizing said route locking relay rendered effective when the train vacates said one adjacent section provided the route established includes said third section, and means including the track relay of the second of said adjacent sections for delaying such energization of the route locking relay until the train has entered said second section provided the route established includes the crossover.

2. In combination, two adjacent sections of railway track each provided with a track circuit including a normally energized track relay released when the section is occupied, a third track section adjoining one of said sections including a siding switch, a crossover including two track switches for connecting said adjacent sections, a normally energized route locking relay having front contacts included in locking circuits for said crossover switches and for said siding switch, two signals for governing train movements into one of said adjacent sections and over the crossover into the other adjacent section or into said third section, respectively, in accordance with the position of the crossover switches, means for effecting the release of said route locking relay when either signal is cleared, means controlled by the track relay of said one section for picking

up said route locking relay when the train vacates such section provided the route established includes said third section, means controlled by the track relays of both adjacent sections for picking up said route locking relay when the train vacates one and enters the other of said adjacent sections provided the route established includes the crossover, and means for bridging the route locking relay contacts included in the locking circuit of the siding switch when the route established includes the crossover.

3. In combination, two adjacent sections of railway track each including a track switch and connected by a crossover track to provide a traffic route at times from one section to the other when said switches are reversed, a plurality of manually controllable signals for governing train movements into said sections, switch locking means for locking said switches against movement when a signal is cleared for the movement of a train from one adjacent section to the other, means for releasing said locking means automatically when a train governed by such signal has entered and vacated such other section, and time element means effective to cause the release of said switch locking means after a delay period in the event the cleared signal is returned to its stop position manually.

4. In combination, two adjacent sections of railway track each including a track switch and connected by a crossover track to provide a traffic route at times from one section to the other when said switches are reversed, signals for governing train movements into said sections, switch locking means for locking said switches against movement when a signal is cleared, means for releasing said switch locking means automatically when a train which has entered one section with said switches reversed enters and vacates the other section, means for also locking said switches against movement as long as the section first entered by the train is occupied irrespective of the position of said switches, time element means for at times effecting the release of said switch locking means in the event a signal is returned to its stop position manually, and other means for effecting the immediate release of said switch locking means when a signal is returned to its stop position manually provided the switches are normal and there is no train approaching within a predetermined distance of the signal.

5. In combination, two adjacent sections of railway track each provided with a track circuit, a crossover including two track switches connecting said sections, a relay for each section controlled in accordance with the condition of the associated track circuit, a signal for governing the movement of traffic from one of said sections to the other, a signal lever for clearing said signal, a route locking relay having a pick-up circuit including a normally closed contact of said lever, a front contact of one of said track controlled relays and a back contact of the other track controlled relay, a stick circuit for said route locking relay including one of its own front contacts and the normally closed contact of said lever, and means preventing the movement of said switches when said route locking relay is deenergized or when either track controlled relay is deenergized.

6. In combination, two adjacent sections of railway track each provided with a track circuit, a crossover including two track switches connecting said sections, a relay for each section controlled in accordance with the condition of the

associated track circuit, signals for governing the movement of traffic into said sections when the switches are normal and from one section to the other when the switches are reversed, a switch lever operable to a normal or reverse position for operating said switches to normal or to reverse, a signal lever operable from a normal to a reverse position to clear one or another of said signals depending on the position of said switches, a route locking relay having a pick-up circuit including normally closed contacts of both of said levers and a front contact of one of said track controlled relays, a second pick-up circuit for said route locking relay including a normally closed contact of said signal lever, a front contact of one of said track controlled relays and a back contact of the other track controlled relay, a stick circuit for said route locking relay including its own front contact and a normally closed contact of said signal lever, and locking means preventing the movement of said switch lever when said route locking relay is deenergized or when either track controlled relay is deenergized.

7. In combination, two adjacent sections of railway track connected by a track switch, a signal for governing train movements over the route including said two sections, signal control means for clearing the signal, a normally closed track circuit for each section each including a track relay, a normally energized stick relay for each of said sections, a normally energized route locking relay, means for releasing said route locking relay when said signal is cleared, means controlled by each track relay when deenergized for releasing the corresponding stick relay, manually controlled means for picking up said stick relays, means for picking up said route locking relay effective when said signal is put to stop provided the stick relay for one section is energized and the stick relay for the other section is deenergized, and means effective when said route locking relay is deenergized or when either track relay is deenergized to prevent operation of said switch.

8. In combination, a railway traffic route including two adjacent sections of railway track connected by a track switch, a normally closed track circuit for each section each including a track relay, a normally energized stick relay for each of said sections, a normally energized route locking relay, a signal for governing train movements over said traffic route, manually operable signal control means for clearing the signal, a normally energized approach locking relay, means actuated by the signal when cleared to effect the release of said approach locking relay, means responsive to release of the approach locking relay for effecting the release of said route locking relay, means including one of said track relays and one of said stick relays for picking up said approach locking relay when a train governed by said signal enters the first section of the route, means including the other track relay and the other stick relay for completing a pick-up circuit for said route locking relay when said train enters the second section of said route, and means effective when said approach locking relay or said route locking relay or either track relay is deenergized to prevent operation of said switch.

9. In combination, a first and a second section of railway track, a track circuit for each section each having a track relay, a track switch for establishing a traffic route from said first to said second section when said switch is re-

versed, a normally energized route locking relay, a first signal for governing the movement of traffic over said first section when the switch is normal, a second signal for governing the movement of traffic over said two sections when the switch is reversed, manually controlled means for clearing said signals, means releasing said route locking relay when either signal is cleared, means controlled by the track relay for the first section for picking up said route locking relay when a train governed by said first signal vacates the first section, means controlled by the track relay for the second section for picking up said route locking relay when a train governed by said second signal enters the second section, manually controllable time element means effective to pick-up said route locking relay when a cleared signal is manually restored to stop, and means preventing the operation of the track switch when said route locking relay is deenergized or when either of said track relays is deenergized.

10. In combination, a stretch of railway track divided into a first and a second section, a first and a second signal for governing traffic movements in opposite directions over said stretch, manually controllable means for clearing said first signal, other manually controllable means for clearing said second signal, a first and a second route locking relay, a first and a second stick relay, a pick-up circuit for said first stick relay arranged to be opened if said second route locking relay is deenergized or if said first signal is cleared by said first manually controllable means, a stick circuit for said first stick relay closed only if said first track section is unoccupied, a pick-up circuit for said second stick relay arranged to be opened if said first route locking relay is deenergized or if said second signal is cleared by said other manually controllable means, a stick circuit for said second stick relay closed only if said second track section is unoccupied, a pick-up circuit for said first route locking relay controlled by a front contact of said first stick relay and by a back contact of said second stick relay, a stick circuit for said first route locking relay closed if said first signal is controlled to indicate stop, a pick-up circuit for said second route locking relay controlled by a front contact of said second stick relay and by a back contact of said first stick relay, a stick circuit for said second route locking relay closed if said second signal is controlled to indicate stop, and track switches controlled by said first and second route locking relays.

11. In combination, a stretch of railway track divided into a first and a second section, a first and a second signal for governing traffic movements in opposite directions over said stretch, manually controllable means for clearing said first signal, other manually controllable means for clearing said second signal, a first and a second route locking relay, a first and a second stick relay, a pick-up and a stick circuit for said first stick relay each of which is opened by a train entering said first section, a contact controlled by said first manually controllable means and a contact controlled by said second route locking relay for also opening the pick-up circuit for said first stick relay if said first signal is cleared or if said second route locking relay is deenergized respectively, a pick-up and a stick circuit for said second stick relay each of which is opened by a train entering said second section, a contact controlled by said second manually

controllable means and a contact controlled by said first route locking relay for also opening the pick-up circuit for said second stick relay if said second signal is cleared or if said first route locking relay is deenergized respectively, a pick-up and a stick circuit for said first route locking relay opened when said first signal is cleared, a front contact of said first stick relay and a back contact of said second stick relay included in series in the pick-up circuit for said first route locking relay, a pick-up and a stick circuit for said second route locking relay opened when said second signal is cleared, a front contact of said second stick relay and a back contact of said first stick relay included in series in the pick-up circuit for said second route locking relay, and traffic governing means for said stretch of track controlled by said stick and route locking relays.

12. In combination, a stretch of railway track divided into a first and a second section, a first and a second signal for governing traffic movements in opposite directions over said stretch, manually controllable means for clearing said signals, a first and a second route locking relay, a first and a second stick relay, means for deenergizing said first or second route locking relay when said first or second signal respectively is cleared, means for deenergizing said first or second stick relay when a train enters said first or second track section respectively, means for energizing said first or second stick relay when said first or second signal respectively is controlled to indicate stop, means for energizing said first route locking relay when said first stick relay is energized and said second stick relay is deenergized, means for energizing said second route locking relay when said second stick relay is energized and said first stick relay is deenergized, and traffic governing means for said stretch of track controlled by said stick and route locking relays.

13. In combination, a stretch of railway track divided into a first and a second section, a signal for governing traffic movements over said stretch, manually controllable means for clearing said signal, a route locking relay, a stick relay, means for deenergizing said route locking relay when said signal is cleared, means for deenergizing said stick relay when a train enters said first section, means for energizing said stick relay if said signal is controlled to indicate stop provided the train leaves said first section, means for energizing said route locking relay if said stick relay is energized and a train enters said second section, and other traffic governing means for said stretch controlled by said stick and route locking relays.

14. In combination, a stretch of railway track divided into a first and a second section, a signal for governing traffic movements over said stretch, manually controllable means for clearing said signal, a route locking relay, a stick relay, a control circuit for said route locking relay opened if said signal is cleared, a second control circuit for said route locking relay closed if said stick relay is energized and a train enters said second track section, a control circuit for said stick relay opened if said first track section is occupied by a train, a second control circuit for said stick relay closed when said signal is controlled to indicate stop, and other traffic governing means for said stretch of track controlled by said stick and route locking relays.