

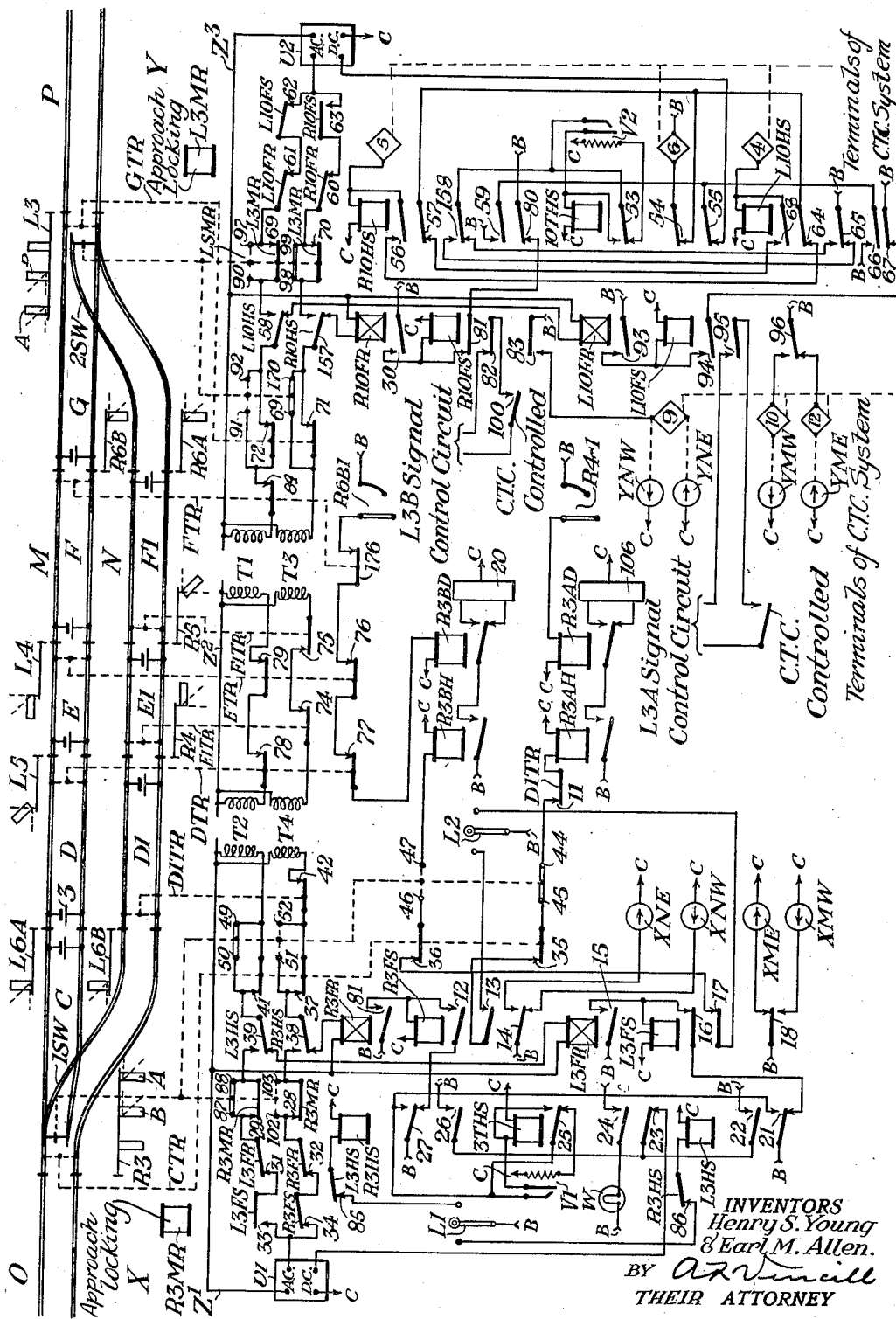
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RAILWAY SIGNALING SYSTEM

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RAILWAY SIGNALING SYSTEM

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The present invention relates in general to railway signaling systems, but more particularly to traffic controlling circuits employed in such systems in governing the movement of traffic in both directions over each track of a multiple track stretch over which traffic normally moves in one direction only.

One feature of the invention consists in the provision of circuits and apparatus so arranged that but one control wire per track and the usual existing common are required.

A further feature of the invention relates to the provision of circuits and apparatus enabling the employment of alternating current over the traffic locking circuits; thereby enabling, by the use of simple transformers, the employment of an existing common, even though such common is divided up into a number of cut sections.

Other features of the invention not specifically mentioned will appear as the specification proceeds and from the claims forming a part thereof.

The accompanying drawing diagrammatically illustrates the invention when applied to a stretch of double track each end of which converges into a single track stretch.

In the following description reference is made to this drawing, in which like characters designate similar parts. At certain places in the drawing, circuit controlling contacts are located remote from their governing relays in order to enable the showing of the circuits in a simplified manner. In all such instances, the reference character which is applied to the governing relay is also located near the contact, and the contact is shown in the position corresponding to the normal condition of the relay.

No sources of direct current are shown, but instead the opposite terminals of any suitable sources of such current are designated by the characters B and C. The relays herein disclosed as being operated over the traffic locking circuits are of the alternating current type and the current for actuating these relays is provided by two alternators U1 and U2.

The reference character M designates the westbound track and the reference character N designates the eastbound track of a double track stretch extending between two locations designated X and Y, respectively. At location X, the two tracks converge, through a switch 1SW, into a single track designated by the reference character 0 while at location Y the two tracks converge through a switch 2SW into a single track designated by the reference character P.

Each track section is provided with the usual

track circuit consisting of a source of current, such as a battery 3, and a track relay designated by the reference character TR having a prefix corresponding to the section to which it belongs. These track relays are designated conventionally by dash lines connected to the track rails at the end of a section opposite the battery.

The automatic signaling system employed may be of any one of several well-known forms. However, the control circuits for such signals form no part of the invention and have for the most part been omitted for the sake of simplicity. It will be understood, however, that the invention requires no change in the standard control that may be employed for such signals. The signals and circuits here shown are deemed sufficient to illustrate a preferred manner in which apparatus of the present invention may be associated with any standard signal system for a stretch of multiple trackway.

At location X there are provided two signals R3A and R3B, while at location Y there are provided two signals L3A and L3B. As will subsequently appear, the signals R3A and L3B are remotely controlled, in part at least, and are employed in governing traffic in opposite directions over track N; while the signals R3B and L3A are, in part at least, remotely controlled and are employed in governing traffic in opposite directions over track M. This affords what is commonly known to the art as reverse signaling for a double track stretch.

There are also provided signals L6A and L6B at location X for governing traffic over the switch 1SW and signals R6A and R6B for governing traffic over the switch 2SW in accordance with the usual practice in such layouts. These signals are also of the semi-automatic type, being in part at least controlled by the operator having control of other signals in their vicinity. The intervening signals L4, R4, L5 and R5 are of the usual full automatic non-stick type.

The switches 1SW and 2SW may be hand operated, or they may be remotely controlled through the medium of any well-known form of switch operating mechanism.

Two signal control relays, R3HS and L3HS, at location X and two similar relays R10HS and L10HS are manually controlled by operators having control of the signals at the respective switch locations X and Y. The apparatus for controlling the relays at either location forms no part of the invention; it may be in accordance with any one of several well-known centralized traffic control systems, or it may consist of simple cir-

cuits governed by levers in a nearby tower. As diagrammatically illustrated, the control relays L10HS and R10HS at location Y are shown as controlled by an operator through the medium of a centralized traffic control system. One form of such a system is disclosed in a booklet published by the Union Switch and Signal Company, of Swissvale, Pennsylvania, and entitled Centralized Traffic Control System, Time Code Scheme, Manual No. 502, and a copy of which will be found in the Congressional Library. Certain numerals in the drawing within small squares correspond to terminals of the field equipment of the centralized traffic control system shown in the above reference and may be the ones connected with in case that system is the one employed. The control of relays R3HS and L3HS at location X are illustrated as being controlled by levers in a tower usually in the vicinity of the switch ISW.

The relays R3HS and L3HS are normally deenergized and are adapted when energized by movement of lever L1 by the lever operator, as will shortly be made clear, to enable the centralized traffic control operator, hereinafter referred to as the CTC operator, to clear one of the signals L3B or L3A, when conditions are favorable. In like manner, the relays R10HS and L10HS are normally deenergized and are adapted when energized by the transmission of the appropriate code by the CTC operator, to enable the lever operator to clear one of the signals R3A or R3B when conditions are favorable.

It is believed that an understanding of the invention can best be had by describing the operations as they occur in practice.

With the stretch unoccupied and with the directional stick relay L3FS energized, as shown, the lever operator is advised by the active directional indication signal XME that with traffic conditions favorable and switch ISW reversed, he has control of signal R3B. With switch ISW reversed and the remaining circuits in the condition shown, he can set the signal R3B to "caution" position for an eastbound train by moving his lever L2 to the right. The lever L2 in such position closes a circuit from the B terminal of a current source through the lever and its right-hand contact, contacts 17 of relay L3FS, contacts 36 of track relay CTR, 46 and 47 of switch ISW and through the winding of signal relay R3BH to a C terminal of the current source. The relay R3BH, in operating, at its contacts closes a circuit through the armature and back contact of relay R3BD and through the R3B signal mechanism 20 to effect movement of the signal to its "caution" position in well-known manner. It will be obvious that, in case signal R6B is in its "clear" or "caution" position, relay R3BD will be energized over a circuit including contacts 77, 76 and 176 of track relays DTR, ETR and FTR, respectively, and contacts R6B1 of signal R6B. Under such circumstances, the circuit to signal mechanism 20 will be via the armature and front contact of relay R3BD and will be effective to move the signal to its "clear" position.

With the directional stick relay R10FS energized, as shown, the CTC operator may in a similar manner control signal L3B by transmission of the necessary control code for effecting the closure of CTC controlled contacts 100.

In order to explain the operations over the traffic locking circuits which are necessary when it is desired to reverse the direction of traffic

over tracks M and N it will first be assumed that the lever operator desires to clear the signal R3A, governing eastbound traffic over track N. The lever operator cannot effect the clearance of signal R3A with the circuits in the condition shown, for the reason that a point in the control circuit of this signal includes the open contacts 13 of a directional control stick relay R3FS. He accordingly communicates with the CTC operator having control of the signals at the Y location and advises him of the clearance he desires to effect.

The CTC operator accordingly transmits a code appropriate for connecting the B side of the current source to terminal 5 to operate the relay R10HS. The relay R10HS, on operating, at contacts 80 opens the stick circuit of directional control stick relay R10FS and at contacts 56 closes a stick circuit for itself including contacts 64 of relay L10HS, 54 of relay 10THS and the B terminal of the current source supplied at this point from a terminal 6 of the CTC system. The relay R10HS, at contacts 57, interrupts a point in a similar stick circuit for relay L10HS, thereby insuring against L10HS and R10HS ever being energized at the same time. The relay R10HS also closes a circuit from the B terminal of the current supply through armature 65 of relay L10HS, front contact and armature 158 and the armature 53 of relay 10THS and its back contact through the winding of thermal relay V2 to a C terminal of the current source, and at contacts 59 connects a B terminal of the current source via contacts 55 of relay 10THS to one terminal of the D. C. side of an alternator U2, the other terminal of which is connected to a C terminal of the current source. Finally, the relay R10HS at armature 157 opens a point in the operating circuit of directional control relay R10FR and closes a point in a traffic locking circuit which will subsequently be traced.

The relay R10FS, on restoring, at contacts 82 interrupts a point in the L3B signal control circuit thereby preventing the CTC operator from being able to clear this signal by transmitting the code necessary for effecting the closure of the associated CTC controlled contacts 100, and at contacts 83 connects a B terminal of the current source to the terminal 9 of the CTC system to effect the transmission thereby of a code effective to retire direction indicating signal XNW and for displaying signal XNE. The relay R10FS finally, at contacts 63, connects the right-hand winding of insulating transformer T3 in bridge of the A. C. terminals of the now active alternator U2. This circuit extends from the left A. C. terminal, through contacts 63 of relay R10FS, 60 of relay R10FR through contacts 70 of the usually provided approach locking relay L3MR, the front contact and armature 157 of relay R10HS, contacts 71 of track relay GTR, the right-hand winding of transformer T3 and back to the right-hand terminal of the A. C. side of U2, via the common conductor Z3.

Since the control circuits of approach locking relays are well-known and form no part of the present invention, the control circuits of relays L3MR and R3MR have not been shown. It will be observed, however, that the traced alternating current circuit may be completed independently of the contacts 70 of the approach locking relay L3MR and of contacts 71 of the detector section track relay GTR via contacts 98—99 and 69—170 of switch 2SW if the switch 2SW is in its normal position, for, under such circumstances an ap-

proaching westbound train will move over the track M instead of over track N, and there is no reason for preventing the clearance of signal R3A under such circumstances.

5 With the contacts 74 and 75 of track relays E1TR and F1TR closed, the alternating current induced in the left-hand winding of transformer T3, as a result of that flowing through its right-hand winding, now flows in the loop circuit including the left-hand winding of T3, the con-
10 tacts 75 and 74, the right-hand winding of transformer T4 and the common conductor Z². Because of the inductive relation of the windings of transformer T4, alternating current now also
15 flows through the circuit, including the left-hand winding of T4, contacts 42 of relay D1TR; through contacts 37 of track relay CTR only if switch ISW is in its normal position and section C is unoccupied; or through contacts 51
20 and 52 only, if the switch ISW is in its reverse position and section C is occupied. In the latter instance the train occupying section C will be one routed over track M and there is no reason for under such circumstances preventing the clear-
25 ance of signal R3A to route a following train over track N. The circuit from this point extends through the armature 38 of relay R3HS and its back contact, through the winding of directional relay R3FR and over the common conductor Z¹
30 to the upper terminal of the left-hand winding of transformer T4.

The directional relay R3FR, in operating, at contacts 81 closes an obvious circuit for its associated directional stick relay R3FS and at
35 contacts 32 opens a point in the lever operator's control branch of the traffic locking circuit of track N. The relay R3FS, in operating, completes a stick circuit for itself including its con- tacts 12 and the back contact and armature 27
40 of relay R3HS. The relay R3FS also, at contacts 34, opens a second point in the lever operator's control branch of the traffic locking circuit of track N, and at contacts 13 closes a point in the operating circuit of signal relay R3AH. The
45 relay R3FS finally, at armature 14, opens the circuit heretofore established through indicator XNW, thereby retiring it and closes a circuit through the indicator XNE which now serves to advise the lever operator that the direction of
50 eastbound traffic over track N is now under his control. The lever operator may accordingly now move the lever L2 to the left-hand position to clear the signal R3A.

It will be recalled that the relay R10HS, on
55 operating, closed a circuit through the winding of thermal device V2. This device, at the expiration of approximately five seconds, closes a circuit through the winding of relay 10THS. This circuit extends from a terminal B of the current
60 source through the armature 65 of relay L10HS and its back contact, the front contact and armature 158 of relay R10HS, the contacts of V2, and through the winding of relay 10THS to a terminal C of the current source. The relay 10THS
65 accordingly operates and at its armature 53 interrupts the circuit of V2 and completes a stick circuit for itself. The relay 10THS at contacts 54 opens the stick circuit of control relay R10HS, and at contacts 55 opens the circuit through the
70 D. C. side of the alternator U2, thereby causing the cessation of alternating current flow therefrom. The relay R10HS in restoring, at its armature 158, opens the stick circuit of relay 10THS, which accordingly now restores. At location X
75 the relay R3FR now also restores, due to the

cessation of alternating current flow, and at its contacts 32 recloses one point in the lever operator's branch of this traffic locking circuit.

With the lever L2 placed in its left-hand position a circuit for signal relay R3AH extends from
5 a terminal B of the current source through lever L2 and its left contact, contacts 13 of relay R3FS, 35 of track relay CTR, 45 and 44 of switch ISW closed in the normal position of the switch,
10 contact 11 of track relay D1TR, and through the winding of relay R3AH to a C terminal of the current source.

If automatic signal R4 is set at "clear" or "caution" relay R3AD is at this time energized
15 over a circuit extending from a B terminal of the current source, signal operated contacts R4—1 of signal R4, and the winding of relay R3AD to a C terminal of the current source. With the relay R3AD energized the relay R3AH, in operating, completes a circuit from a B terminal
20 of the current source through its contacts, the armature and front contact of relay R3AD to the signal operating mechanism 106 of signal R3A to, in well-known manner, set the signal in its "clear" position. It will be obvious that in
25 case signal R4 is in its "stop" position, relay R3AD will be in the position shown and the circuit completed through mechanism 106 will be effective to position signal R3A at "caution."

If subsequently the CTC operator desires to
30 clear signal L3B for a westward traffic movement over track N he so advises the lever operator. Assuming conditions are favorable to such a move the lever operator at X effects the ener-
35 gization of relay R3HS by moving his lever L1 to the right. The relay R3HS, on energizing, at armature 27 interrupts the stick circuit relay R3FS. The relay R3FS accordingly restores and at its contacts 13 reopens a point in the previously prepared circuit which enabled the lever
40 operator to clear signal R3A, thereby rendering the clearance of this signal impossible without the cooperation of the CTC operator. The relay R3HS also at armature 38 and its back contact interrupts a point in the circuit of directional
45 control relay R3FR employed in enabling the lever operator to clear signal R3A, and at armature 38 and its front contact closes a point in the operating circuit of directional control relay R10FR. Relay R3HS also, at contacts 86 opens
50 a point in the operating circuit of relay L3HS and at armature 27 and its front contact, closes a circuit through the winding of the thermal device V1. This circuit extends from a B terminal of the current source, through armature 27 and
55 its front contact, the armature 25 of relay 3THS and its back contact, and the winding of V1 to a C terminal of the current source. The relay R3HS finally, at contacts 26, closes a circuit through the D. C. side of the alternator U1. This circuit
60 extends from a B terminal of the current source through contacts 26 of relay R3HS, contacts 23 of relay 3THS to the right D. C. terminal of U1 and through U1 to a C terminal of the current
65 source.

The alternating current now produced by the alternator U1 effects the energization of the di-
70 rectional relay R10FR in the same manner as the energization of R3FR was brought about by alternating current generated by alternator U2. The circuit extends from the right A. C. terminal of the alternator U1, through contacts 34 of relay R3FS, 32 of relay R3FR and 28 only of the approach locking relay R3MR, if switch ISW is at the time in its normal position, or through
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contacts 102 and 103 of switch 1SW if such switch is in its reverse position, the front contact and armature 38 of relay R3HS, through contacts 37 of track relay CTR only if switch 1SW is in its normal position or through contacts 51 and 52 of such switch in its reverse position. The circuit from this point extends through the contacts 42 of track delay D1TR, the left-hand winding of insulating transformer T4, and to the other A. C. terminal of alternator U1 via common conductor Z1. With the contacts 74 and 75 of the track relays E1TR and F1TR closed, current is induced in the hereinbefore described loop circuit and the current flow in the left-hand winding of T3 induces a similar current flow in the right-hand winding of this transformer. The current flow in this latter winding passes directly to one terminal of relay R10FR via the common conductor Z3 and to the other terminal of this relay via contacts 69 and 170 of switch 2SW independently of contacts 71 of track relay GTR in case such switch is in its normal position to route any traffic over track M, and through contacts 71 of track relay GTR only if the switch 2SW is in its reverse position, to route westbound traffic over track N. From this point the circuit extends through armature 157 of relay R10HS and its back contact to the other terminal of relay R10FR.

The directional relay R10FR, upon operating, at contacts 30 closes an obvious circuit for its associated directional stick relay R10FS and at contacts 60 opens a point in the branch of the N track traffic locking circuit employed by the CTC operator to energize relay R3FR. The relay R10FS, in operating, at contacts 81 completes a stick circuit for itself including contacts 80 of relay R10HS. The relay R10FS also at contacts 63 opens a second point in the operating circuit of relay R3FR and at contacts 32 closes a point in the control circuit of signal L3B to enable the CTC operator to, by transmission of the required code, close contacts 100 and thereby clear signal L3B providing switch 2SW is in its reverse position and the traffic controlled circuits are in the proper condition. The complete control circuits of signal L3A and L3B have not been shown as they form no part of the invention and further will be obvious in the light of the complete disclosure of the control circuits of signals R3A and R3B. The relay R10FS finally, at contacts 83, effects the circuit change necessary to the transmission of the code in the CTC system which is effective to retire directional indicator YNE and to display indicator YNW, thereby advising the CTC operator that the lever operator has again placed the L3B signal circuits under his control.

It will be recalled that the relay R3HS, on operating, closed a circuit through the winding of thermal device V1. This device, after approximately five seconds, closes its contacts thereby completing an obvious circuit for relay 3THS. The relay 3THS, in operating, at its armature 25 transfers the connection of the B side of the current source from the winding of V1 to its own winding to complete a stick circuit for itself, and at its contacts 23 opens the circuit through the D. C. side of the alternator U1. The relay 3THS finally, at contacts 24, closes a circuit through lamp W which serves to advise the lever operator that the initiated traffic reversing operation has been completed and that he may now restore the lever L1 to its central position. Upon restoration of L1, relay R3HS again restores and

at its armature 38 recloses a point in the operating circuit of relay R3FR. The relay R3HS also, at contacts 86, again closes a point in the operating circuit of relay L3HS and at armature 27 interrupts the stick circuit of relay 3THS. This latter relay accordingly restores and retires the lamp W. The circuits are now in the normal condition in which they are shown.

It will be obvious that the circuit for relay R3FR can only be completed providing the opposing directional control relay R10FR has its contacts 60 closed, and that likewise a circuit for relay R10FR can only be completed providing the opposing directional control relay R3FR has its contacts 32 closed, thereby precluding the possibility of both of these directional control relays being simultaneously operated. It will further be observed that the traced circuit for relay R3FR requires that directional stick relay R10FS be deenergized and its contacts 63 closed and that similar protection is afforded against the improper operation of relay R10FR by contacts 34 of relay R3FS, thereby precluding the possibility of the simultaneous clearance of opposing signals L3B and R3A. It will further be seen that in order to operate the directional control relay R3FR to enable the clearance of signal R3A while the switch 2SW is in its reverse position, approach locking relay L3MR must be energized to close its contacts 70, thus providing the usual approach locking protection in event of signal L3B having been cleared for westward traffic via track N. With section G occupied and the switch 2SW in its reverse position, closure of the circuit of relay R3FR is prevented by contacts 71 of track relay GTR, as under these circumstances section G is occupied by a train entering the track N via switch 2SW.

On the other hand, if the switch 2SW is in its normal position at the time the CTC operator attempts to effect the operation of relay R3FR, he can do so even though there may be a westbound train approaching section G or even though a train has entered this section, because, with switch 2SW in its normal position its contacts 98 and 99 shunt contacts 70 of the approach locking relay L3MR, while its contacts 69 and 170 shunt the contacts of track relay GTR. Under these circumstances the route set up is via track M and therefore will not interfere with the eastbound movement of traffic over track N just entering the stretch. Arrangements of the contacts of switch 1SW and approach locking relay R3MR are similar to those just described and provide the same protection against the improper operation of directional control relay R10FR by the lever operator.

It will now be assumed that the CTC operator desires to route a westbound train over track M and accordingly so advises the lever operator at location X. Assuming conditions are favorable to such a move, the lever operator will move lever L1 to the left, thereby completing a circuit through control relay L3HS. This relay accordingly operates and opens a second point in the operating circuit of control relay R3HS at contacts 85. The relay L3HS at armature 21 and its back contact opens the stick circuit of relay L3FS and at its front contact closes a circuit through the winding of thermal device V1, via contacts 25 of relay 3THS. The relay L3HS also, at armature 39, opens another point in the operating circuit of the directional control relay L3FR and closes a further point in the operating circuit, about to be described, of directional control

relay L10FR. The relay L3HS finally, at contacts 22, connects a B terminal of the current source to the right terminal of the D. C. side of alternator U1, via contacts 23 of relay 3THS. Alternating current now delivered by the alternator U1 flows through the left-hand winding of transformer T2, via contacts 33 of relay L3FS, 31 of relay L3FR, contacts 29 of the approach locking relay R3MR, or alternatively through contacts 37 and 38 of switch 1SW if such switch is in its normal position, the front contact and armature 39 of relay L3HS, contacts 41 of track relay CTR, or alternatively through contacts 50 and 49 of switch 2SW if such switch is in its normal position and a train has entered section C, through the left-hand winding of T2 and to the left A. C. terminal of alternator U1 via the conductor Z1.

It will be apparent, in view of the previous description, that with track relays DTR and ETR energized and their contacts 78 and 79 closed, alternating current flowing through the left-hand winding of transformer T2 will induce a similar current into its right-hand winding and that this current will, in flowing through the loop including the left-hand winding of T1 by the transformer action of T1, induce a similar current flow in the right-hand winding of T1. The current induced in the right-hand winding of T1 passes from the lower terminal of this winding, via contacts 89 of track relay FTR; contacts 72 of track relay GTR when switch 2SW is in its normal position and section G is unoccupied, or alternatively via contacts 91 and 92 of switch 2SW if such switch is in its reverse position and section G is occupied; and thence via armature 58 and its back contact to a terminal of the relay L10FR, through this relay to the conductor Z3 and back to the upper terminal of the right-hand winding of T1.

The relay L10FR, upon operating, at contacts 81 opens a point in the operating circuit of directional control relay L3FR, and at contacts 93 closes a circuit through its stick relay L10FS. This latter relay, in operating, at contacts 94 closes an obvious stick circuit for itself, and at contacts 95 closes a point in the control circuit of signal L3A to enable the CTC operator to exercise control over this signal. The relay L10FS finally, at armature 96, performs the circuit changes necessary for the transmission of the code required to retire indicator YME and for displaying the indicator YMW to advise the CTC operator that he has obtained control of the L3A signal.

The thermal device V1 functions in the same manner as previously described, to after five seconds complete a circuit for relay 3THS. The relay 3THS functions as before to light lamp W and so advise the lever operator to restore lever L1 to its normal position. The relay 3THS also sticks up as previously, but in this instance via the front contact and armature 21 of relay L3HS. Finally, the relay 3THS at contacts 23 interrupts the circuit through the D. C. side of the alternator U1 so that the transmission of alternating current to relay L10FR is discontinued even should the lever operator fail to restore the lever to its normal position. Upon restoration of lever L1 relay L3HS restores and thereby permits the restoration of relay 3THS in the same manner as did relay R3HS in the previous example.

It will now be assumed that the lever operator desires to have the reverse direction of traffic over track M re-established and, accordingly, so

advises the CTC operator. Assuming conditions are favorable to such a change, the CTC operator will transmit the code required to effect the operation of control relay L10HS. This relay accordingly operates, at its contacts 67, opens the stick circuit of relay L10FS, at contacts 66 closes a circuit, via contacts 55 of relay 10THS, through the D. C. side of alternator U2, and at armature 65 and its front contact closes a circuit through the thermal device V2, substantially like the one completed for it by relay R10HS. The relay L10HS also, at contacts 64, opens a second point in the stick circuit of relay R10HS to positively insure that R10HS is in a deenergized condition at this time. Finally, relay L10HS closes a stick circuit for itself at its contacts 68. This latter circuit includes contacts 57 of relay R10HS, contacts 54 of relay 10THS and a B terminal of the current source at terminal 6 of the code system. The alternator U2 now transmits alternating current via contacts 62 of relay L10FS and over circuits which will be apparent in view of the preceding description to the winding of directional control relay L3FR. The relay L3FR accordingly operates and at its contacts 15 again picks up the stick relay L3FS. The relay L3FS modifies the display condition of its associated M track directional indicators XMW and XME and at contacts 17 again places the R3B signal relay R3BH under the control of the lever operator. It is believed that the subsequent operation of relay 10THS and the consequent restoration of relays L10HS, L3FR, and 10THS will be quite clear in the light of the preceding description and therefore need not be repeated at this time.

It will be obvious that the circuit for relay L3FR can only be completed providing the opposing directional control relay L10FR is deenergized and that, likewise, a circuit for relay L10FR can only be completed providing the opposing directional control relay L3FR is deenergized, thereby precluding the possibility of both the directional control relays being simultaneously operated. It will further be observed that the completion of a circuit through the relay L3FR requires that directional stick relay L10FS be deenergized and that similar protection is afforded against the improper energization of relay L10FR.

It will further be seen that in order to operate relay L3FR to enable the clearance of signal R3B, the switch 2SW must be in its reverse position, or if in its normal position the approach locking relay L3MR must be energized and the detector section G must be unoccupied; while switch 1SW must be in its normal position, or if in its reverse position section C must be unoccupied. The improper operation of relay L10FR is in like manner guarded against since, in order to operate it, to enable the CTC operator to clear signal L3A, switch 1SW must be in its normal position to route eastbound traffic over track N, or if switch 1SW is in its reverse position the approach locking relay R3MR must be energized and detector section C itself must be unoccupied.

From the foregoing it will be appreciated that the invention covers a simple form of traffic locking system requiring only one wire per track and an existing common return; and that if this common happens to be made up of a plurality of cut sections provides a simple means for making such sections continuous for traffic locking purposes.

It will be further observed that traffic relays

R3FR, L3FR, R10FR and L10FR are A. C. relays and may be of the inductive vane type or other types which may be operated by alternating current and cannot be operated by direct current, thus providing protection against crosses or grounds in the D. C. signal circuit which may be operated over common wires Z¹, Z² or Z³ in any way causing an improper energization of the traffic relays.

Although the invention as herein shown and described only covers one example of its application, it is to be understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention, what is claimed is:

1. In combination, a stretch of railway track, signals for governing traffic in opposite directions through the stretch, a sectionalized line wire adapted for use as the common line wire in the control of said signals, a traffic locking circuit for the stretch having as one conductor the different sections of said sectionalized line wire, directional means at each end of the stretch to govern traffic entering the stretch at its end and arranged to be at times controlled by the traffic locking circuit, a current source at each end of the stretch adapted to at times supply current to the traffic locking circuit for controlling the directional means at the opposite end of the stretch, and repeating means at each sectionalized location of said line wire comprising a transformer through the medium of which current transmitted to one end of sectionalized line wire is induced in the adjacent section in either direction to thereby carry through from end to end of the stretch the control effected by the connection of the current source at one end to the directional means at the other end in either direction.

2. In combination, a stretch of railway track, signals for governing traffic in opposite directions through the stretch, a sectionalized line wire adapted for use as the common line wire in the control of said signals, a traffic locking circuit for the stretch having as one conductor the different sections of said sectionalized common wire, directional means at each end of the stretch to govern traffic entering the stretch at its end of the stretch and each arranged to be at times controlled by the traffic locking circuit, a current source and a relay at each end of the stretch, manually controlled means at each end adapted to include either the relay or the current source at its end in the traffic locking circuit, repeating means at each sectionalized location of the common line wire including a transformer through the medium of which current applied to one end of the common wire is repeated through the respective sections from either end to the other to carry through the influence effected by the application of current to the traffic locking circuit at one end to the relay at the other end, one of said signals at each end of the stretch for governing the movement of traffic into the stretch, and means controlled by the relay at the same end of the stretch for enabling said signal to be cleared.

3. In combination, a stretch of railway track, signals located at intervals to govern traffic in one direction through the stretch, other signals to govern traffic in the opposite direction through the stretch, a sectionalized line wire adapted for

use as the common line wire in the control of said signals, a traffic locking circuit for the stretch having as one conductor the different sections of said sectionalized common wire, an alternating current source and an alternating current directional control relay at each end of the stretch to govern traffic entering the stretch at its end and arranged to be at times controlled by the traffic locking circuit, manually controlled means at each end adapted to include either the relay or the current source at its end in the traffic locking circuit, and means at each sectionalized location of the common line wire for transmitting electrical energy applied to one end of the common wire through the respective sections thereof from either end to the other to carry through the influence effected by the application of current to the traffic locking circuit at one end to the relay at the other end in either direction.

4. In combination, a stretch of railway track, signals located at opposite ends of the stretch to govern traffic in opposite directions through the stretch, a sectionalized line wire for the stretch adapted for use as the common line wire in the control of said signals, a traffic locking circuit for the stretch arranged into a plurality of sections each section of which includes a corresponding section of said common line wire, an alternating current relay and an alternating current source at each end of the stretch, manually controlled means at each end adapted to include either the relay or the current source at its end in the traffic locking circuit, means at each junction of adjacent sections of the traffic locking circuit for transmitting alternating current energy from one section of the traffic locking circuit to another to carry through the influence effected by applying current to the traffic locking circuit at either end of the stretch to feed the alternating current to the relay at the other end, and means controlled by the relay at the same end of the stretch at which the signal governing traffic entering that end is located for enabling said signal to be cleared.

5. In combination, a stretch of railway track, signals to govern traffic in opposite directions through the stretch, a sectionalized line wire for the stretch adapted for use as the common line wire in the control of said signals, a traffic locking circuit for the stretch arranged into a plurality of sections each section of which includes a corresponding section of said common line wire, means at each end of the stretch adapted to at times supply alternating current to the traffic locking circuit, a relay at each end of the stretch each controlled by the traffic locking circuit and arranged when energized to enable one of said signals to be cleared to permit traffic to enter the stretch, and a transformer at each junction of adjacent sections of the traffic locking circuit for repeating the alternating current supplied to either adjacent section from other adjacent sections to thereby feed current to the relay at either end of the stretch in response to current supplied to the traffic locking circuit at the end opposite that relay.

6. In combination, a stretch of railway track arranged into track sections each of which is provided with the usual track circuit including a track relay, a traffic locking circuit extending along the stretch arranged into a plurality of different sections with each section including a front contact of each track relay of the track sections adjacent that section of the traffic locking circuit, a source of current and a directional relay

at each end of the stretch, manually controlled means at each end to include either the current source or the relay at its end in the traffic locking circuit, means at each junction of adjacent sections of said traffic locking circuit for inducing a current supply into either adjacent section when there is alternating current flowing in the other adjacent section whereby under favorable traffic conditions the relay at either end of the stretch will become energized in response to current supplied to the traffic locking circuit at the other end, a signal at each end of the stretch to govern the movement of traffic into the stretch, and means controlled by the relay at the same end of the stretch for enabling said signal to be cleared.

7. In combination, a stretch of railway track divided into track sections each of which is provided with the usual track circuit including a track relay, signals located at opposite ends of the stretch arranged to govern traffic in opposite directions through the stretch, a sectionalized line wire for the stretch adapted for use as a common line wire in the control of said signals, a traffic locking circuit for the stretch arranged into a plurality of sections each section of which includes a corresponding section of the sectionalized line wire and a front contact of the track relay of each track section adjacent that section of the traffic locking circuit, means at each end of the stretch adapted to at times supply an alternating control current to the traffic locking circuit, an alternating current directional relay at each end of the stretch controlled by the traffic locking circuit, and transformer couplings between adjacent sections for inducing a current in one adjacent section when there is current flowing in the other adjacent section whereby the relay at the one end of the stretch opposite that at which alternating current is supplied to the traffic locking circuit is energized, and means for clearing the said signal at one end of the stretch when the relay at its end of the stretch becomes energized.

8. In combination, a stretch of railway track divided into sections, a track circuit including a normally energized track relay for each section, a line circuit for the stretch divided into sections each including front contacts of the track relays of the track section adjacent such line circuit section, a source of alternating current and an alternating current directional relay at each end of the line circuit, manually controlled means at each end of the stretch for selectively including in its end section of the line circuit the source of alternating current or the directional relay at that end of the line circuit, inductive couplings between adjoining sections whereby current flow resulting from the inclusion of the source of alternating current in one end of said line circuit will effect the energization of the alternating current directional relay at the opposite end of said line circuit irrespective of the end of the line circuit in which the alternating current is included providing said track relays are all energized, a signal at each end of the stretch to govern the movement of traffic through the stretch, and means controlled by the directional relay at the same end for controlling said signal.

9. In combination, a stretch of railway track, a signal at each end of the stretch to govern the movement of traffic through the stretch, a line circuit for the stretch divided into sections, a source of alternating current and an alternating current directional relay at each end of the stretch, manually controlled means at each end

of the stretch for selectively including in the end section of the line circuit adjacent said means its source of alternating current or directional relay, means at each junction of adjoining sections of the line circuit effective to transmit from either of said sections at the end adjacent such junction into the adjoining section electrical energy therein resulting from the inclusion of the alternating current source in either end section, to thereby operate the relay at the opposite end of the line circuit, and means controlled by each directional relay for enabling the signal at the same end of the stretch to be cleared.

10. In combination, a stretch of track arranged into track sections each of which is provided with a track circuit, a traffic locking circuit for the stretch controlled by the track circuit of each section of the stretch, a current source at each end of the stretch normally disconnected from the traffic locking circuit, two directional relays one at each end of the stretch to govern traffic in opposite directions through the stretch, manually controlled means at each end of the stretch adapted when energized to temporarily supply current from the source at its end of the stretch to the directional relay located at the opposite end of the stretch; a directional stick relay, for each directional relay, having a pick-up circuit closed in response to the operation of its associated directional relay and being operated to establish the direction of traffic; and stick circuits for the respective directional stick relays governed by the manually controlled means at their respective ends of the stretch.

11. In combination, a stretch of railway track arranged into track sections each of which is provided with a track circuit, a traffic locking circuit for the stretch controlled by the track circuit of each track section, a source of current at each end of the stretch, a directional control relay located at each end of the stretch, a manually controlled relay at each end of the stretch adapted when energized to temporarily supply current from the source at that end of the stretch to said traffic locking circuit to operate the directional relay at the opposite end of the stretch, a directional stick relay, for each directional control relay, having a pick-up circuit closed in response to the operation of its associated directional control relay and operated to enable the direction of traffic movement in a given direction; and a stick circuit for each of said directional stick relays including back contacts of the manually controlled relay at the associated end of the stretch.

12. In combination with a stretch of double track railway one end of which converges into a stretch of single track railway and in which one track of the first stretch has signals associated therewith for governing movement of traffic in either direction thereover, a traffic locking circuit extending between the respective ends of the first stretch, relays employed in the control of traffic over such one track having contacts included in said circuit; a directional control relay at each end of the first stretch for, upon operation, enabling clearance of signals governing traffic entering the one track of the first stretch from opposite directions; means at the end of such stretch remote from either of said relays for effecting the operation of such relay over said circuit providing the one track is unoccupied, a switch at the end of the stretch where the tracks thereof converge into a single trackway, and means for enabling the directional re-

lay thereat to be operated even though the portion of the track in which the switch enters the stretch is occupied providing such switch is in a position to route opposing traffic over the other track of the double track stretch.

13. In combination with a stretch of track divided into a plurality of electrically insulated sections each provided with a track relay and with signals at the ends of said stretch for governing traffic entering the stretch, a traffic locking circuit extending between the ends of said stretch comprising but a single individual conductor and a conductor which may be employed in common with other circuits, a directional relay at each end of said stretch each for governing traffic entering the stretch at the locations of the respective directional relays, means associated with each directional relay for operating the other directional relay over said traffic locking circuit, contacts on said track relays for preventing such operation in case any section of said stretch is occupied, a track switch in one or more of said insulated sections, means controlled by each of said track switches for rendering the contact of the track relay for its section ineffective to prevent operation of said directional relays if the associated switch is in a position to divert traffic movements from a portion of said stretch of track, and means controlled by each of said directional relays in the energized condition for clearing the signal at the same end of said stretch.

14. In combination with a stretch of railway track equipped with signals at the respective ends of the stretch for governing traffic movements thereover in opposite directions, a two conductor traffic locking circuit extending between the ends of the stretch, a normally inactive alternator at each end of the stretch on one terminal of which one conductor of said traffic locking circuit terminates; a directional control relay at each end of the stretch, for enabling a dispatcher at its end to clear the signal at its end, connected to the conductors of said traffic locking circuit and adapted to be at times operated thereover by current supplied by the alternator at the opposite end of the stretch; manually controlled means at each end of the stretch for transferring a conductor of said locking circuit from a terminal of the associated directional control relay to the other terminal of the associated alternator and for rendering active such alternator, and means for automatically rendering such alternator again inactive after its operation for a period sufficient to operate the directional control relay at the opposite end of the stretch.

15. In combination with a stretch of double track railway equipped with signals for normally governing traffic over the respective tracks of the stretch in opposing directions, the provision of signals associated with the respective tracks at the ends of the stretch for governing traffic movements over the respective tracks in the directions opposite to normal, traffic locking circuits extending between the ends of the stretch, and means at each end of the stretch which may be manually controlled from the opposite end of the stretch over the respective traffic locking circuits to enable the movement of traffic over the respective tracks in the direction opposite to normal, said means including alternating current relays at opposite ends of the stretch operated over the traffic locking circuits from sources of alternating current located at the ends of the stretch opposite to them.

16. In combination with a double track stretch of track divided into sections and connecting two single track stretches, signals at opposite ends of the stretch for governing the movement of traffic entering the two tracks of the stretch at their respective locations, switches at the opposite ends of the double track stretch for enabling the selective routing of traffic over either track thereof, traffic locking circuits extending between the opposite ends of the double track stretch for governing the movement of traffic into the stretch through the medium of said signals, means at each end of such stretch controlled over one of said traffic locking circuits when the route set up at the opposite end of the stretch is via the track over which such traffic locking circuit has control for enabling the clearance of the appropriate signal thereat only if the adjacent single track section and all sections of the track of the double track section over which it has control are unoccupied, and means for also enabling the clearance of such signal when the route set up at the opposite end of the stretch is via the other track irrespective of whether the adjacent single track or the adjoining section of double track is occupied.

17. In combination with a double track stretch of railway track converging at its ends via suitable railway switches into a single track stretch, signals at the opposite ends of the double-track portions of said stretch for governing the movement of traffic over both tracks of such stretch, traffic locking circuits for each track of the double track portion of the stretch, a traffic control relay at each end of the stretch for enabling the clearance of one signal at its end of the stretch, means at each end of the stretch for operating the traffic control relay at the opposite end of the stretch over the one traffic locking circuit, a second traffic control relay at each end of the stretch for enabling the clearance of the other signal at its end of the stretch, a second means at each end of the stretch for operating the second traffic control relay at the opposite end of the stretch over the other traffic locking circuit, and a third means at each end of the double track stretch for selectively actuating said first or second means at its end of the stretch.

18. In combination, a stretch of railway track, a signal at each end of the stretch to govern the movement of traffic through the stretch, a traffic locking circuit for the stretch divided into sections, a source of current and a directional relay at each end of the stretch, manually controlled means at each end of the stretch for selectively including in the end section of the traffic locking circuit adjacent said means its source of current or directional relay, circuit coupling means for transmitting electrical energy from a section included in circuit with one of said sources to the adjoining section to effect the operation by such energy of the directional relay included in the section at the opposite end of the stretch, and means controlled by each directional relay for making it possible to clear the signal at the same end of the stretch.

19. In combination, a stretch of railway track, a source of current and a directional control relay located at each end of the stretch, a traffic locking circuit for the stretch, a manually controlled relay at each end of the stretch adapted when energized to temporarily supply current from the source at that end of the stretch to said traffic locking circuit to operate the directional relay at the opposite end of the stretch; a di-

rectional stick relay for each directional control relay having a pickup circuit closed in response to the operation of its associated directional control relay and operated to arrange for a traffic move in a given direction, and a stick circuit for each of said directional stick relays governed by the manually controlled means at the associated end of the stretch.

20. In combination, a stretch of railway track; a source of current and a directional control relay located at each end of the stretch, a traffic locking circuit for the stretch, a manually controlled relay at each end of the stretch adapted when energized to supply current from the source at its end of the stretch to said traffic locking circuit to operate the directional relay at the opposite end of the stretch; a directional stick relay, for each directional control relay, having a pickup circuit closed by its directional control relay and operated to arrange for a traffic move in a given direction; timing means at each end of the stretch governed by the manually controlled relay at its end of the stretch for discontinuing the supply of current to said traffic locking circuit after the directional stick relay at the opposite end of the stretch has had time to pick up, and a stick circuit for each of said directional stick relays governed by the manually controlled means at the associated end of the stretch.

21. In combination, a stretch of railway track, a traffic directional control system comprising a first and a second end circuit and one or more intermediate circuits, a first and a second circuit coupling device for each of said intermediate circuits by each of which each of said intermediate circuits at times receives energy from one of said end circuits or from another intermediate circuit and at other times transmits energy to the same end circuit or to the same other intermediate circuit, a first and a second manually controllable device, means controlled by said first manually controllable device for at times supplying electrical energy to said first end circuit which then transmits energy by said coupling devices consecutively through said intermediate circuits to said second end circuit, means controlled by said second manually controllable device for at times supplying electrical energy to said second end circuit which then transmits energy by said coupling devices consecutively through said intermediate circuits to said first end circuit, and means controlled by said traffic directional system for governing traffic movements over said stretch in one direction or the other according as said circuits are energized by current supplied first to said first end circuit or to said second end circuit respectively.

22. In combination, a stretch of railway track,

a traffic directional control system comprising a first and a second end circuit and one or more intermediate circuits intercontrolled by circuit coupling means, manually controllable means for at times supplying electrical energy to said first end circuit which then by said circuit coupling means supplies electrical energy to said intermediate and second end circuits consecutively, other manually controllable means for at times supplying electrical energy to said second end circuit which then by said circuit coupling means supplies electrical energy to said intermediate and first end circuits consecutively, and means controlled by said traffic directional control system for governing traffic movements in a first or a second direction over said stretch according as said circuits are energized by said first or said other manually controllable means.

23. In combination, a stretch of railway track, a traffic directional control system comprising a first and a second end circuit and one or more intermediate circuits consecutively intercontrolled by circuit coupling means preventing the flow of constant direct current from each of said circuits to another, manually controllable means for at times supplying electrical energy to said first end circuit which then by said circuit coupling means supplies electrical energy to said intermediate and second end circuits consecutively, other manually controllable means for at times supplying electrical energy to said second end circuit which then by said circuit coupling means supplies electrical energy to said intermediate and first end circuits consecutively, and means controlled by said traffic directional control system for governing traffic movements in a first or a second direction over said stretch according as said circuits are energized by said first or said other manually controllable means.

24. In combination, a stretch of railway track, a traffic directional control system including a first and a second circuit intercontrolled by circuit coupling means, manually controllable means for at times supplying electrical energy to said first circuit and thence through said coupling means to said second circuit and for at other times supplying electrical energy to said second circuit and thence through said coupling means to said first circuit, and means controlled by said directional control system for governing traffic movements in a first or a second direction over said stretch according as said second circuit is energized by current from said first circuit or said first circuit is energized by current from said second circuit.

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