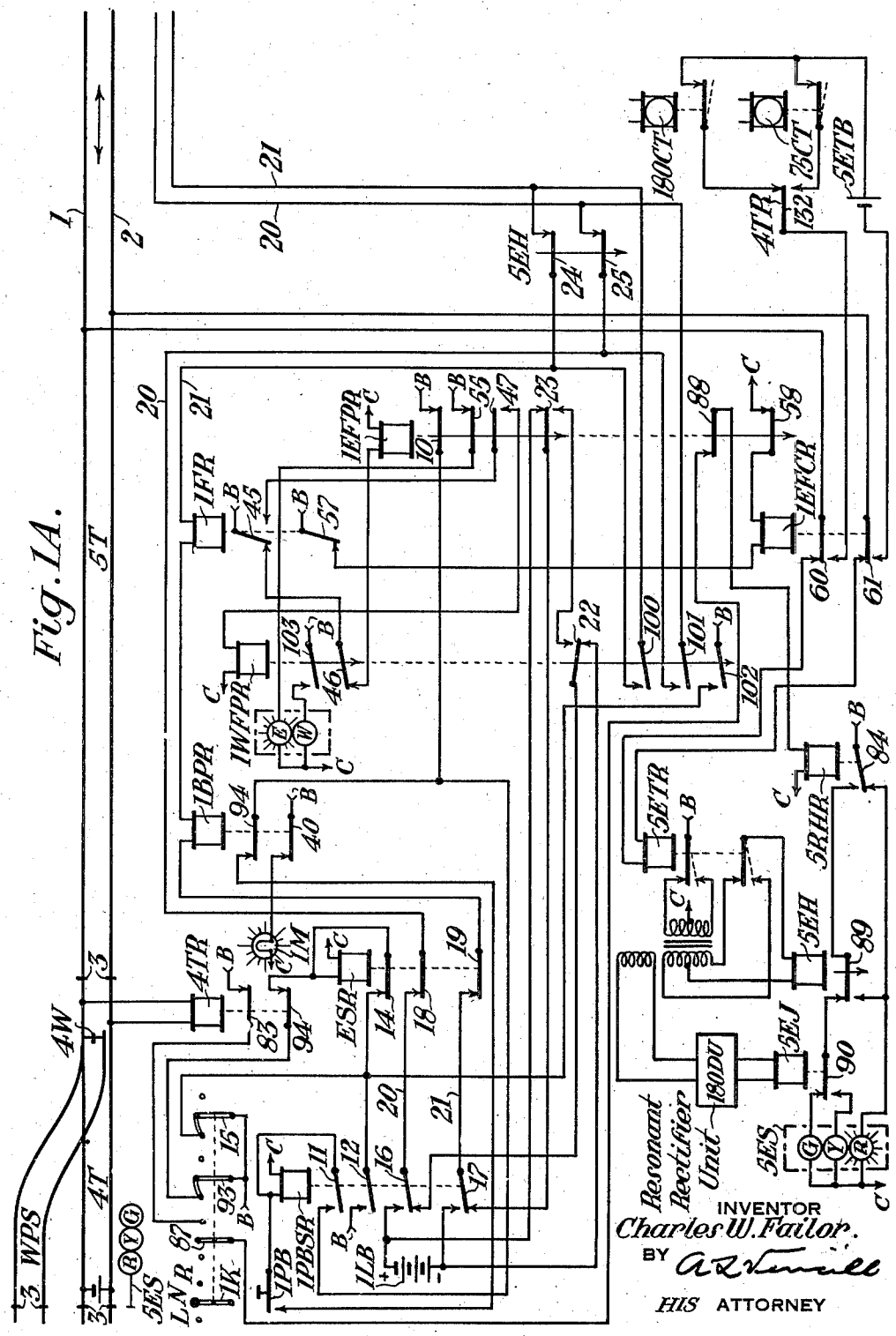
Jan. 9, 1945. C. W. FAILOR 2,366,776

RAILWAY TRAFFIC CONTROLLING APPARATUS

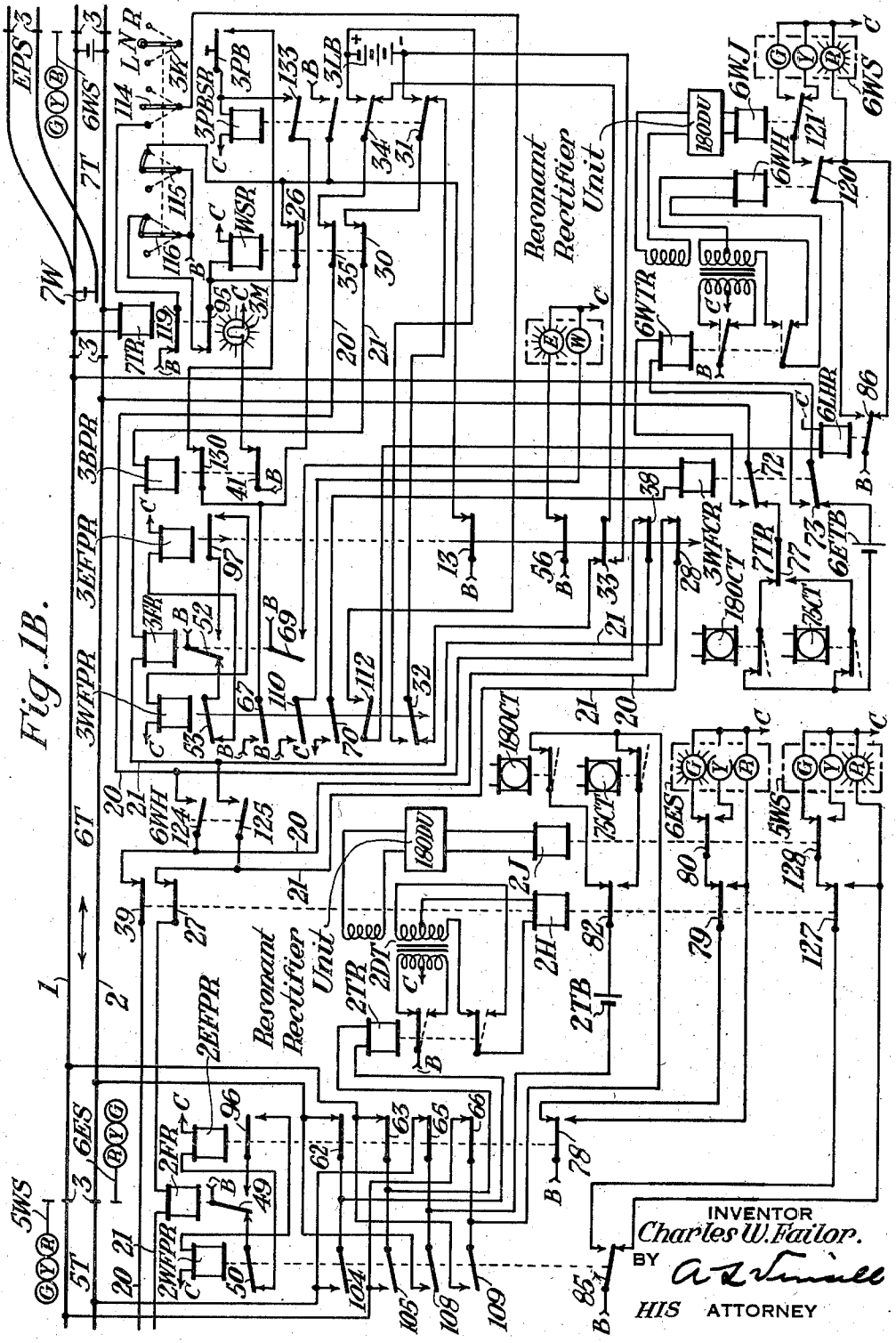
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RAILWAY TRAFFIC CONTROLLING APPARATUS

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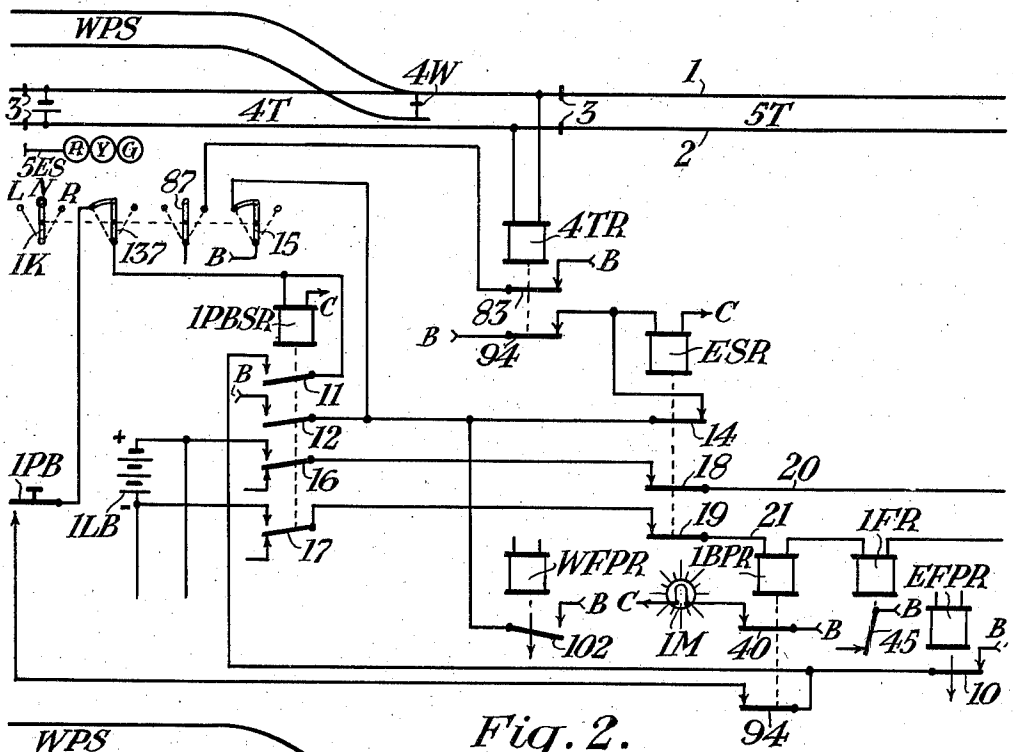


Fig. 2.

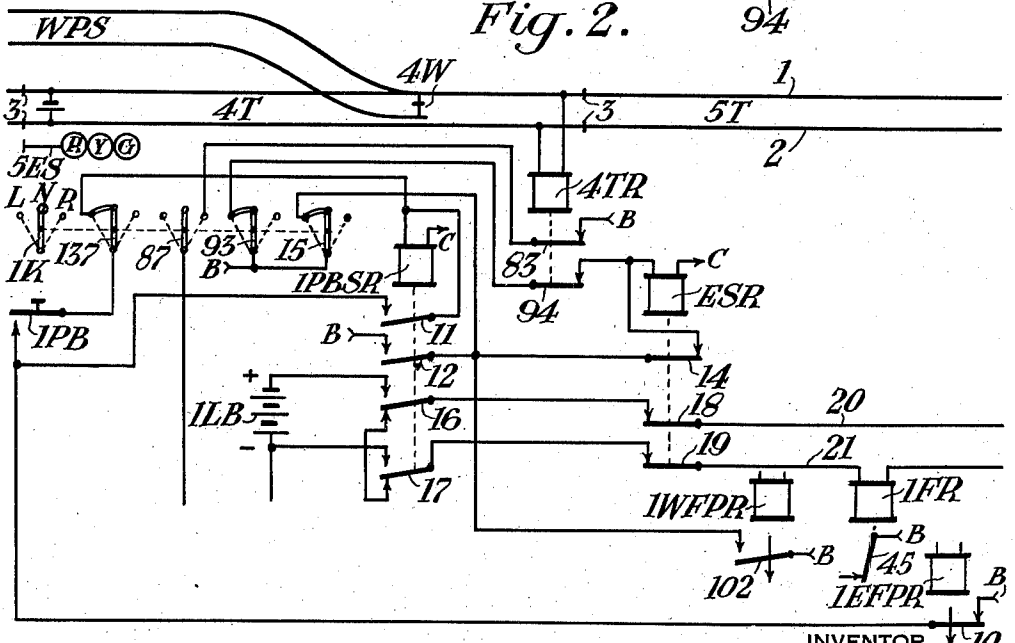


Fig. 3.

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Patented Jan. 9, 1945 2,366,776

UNITED STATES PATENT OFFICE

2,366,776

RAILWAY TRAFFIC CONTROLLING APPARATUS

Charles W. Failor, Forest Hills, Pa., assignor to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

Application September 16, 1943, Serial No. 502,586

17 Claims. (Cl. 246—26)

My invention relates to railway traffic controlling apparatus, and particularly to traffic locking apparatus.

When traffic is operated in either direction over a railway track extending between two spaced locations traffic locking apparatus may be provided which includes a traffic locking circuit controlled jointly by two operators, one at each end of the stretch of railway track. Such traffic locking circuit is arranged to prevent the manipulation of traffic governing signal levers or units for changing the direction of traffic on the stretch of track between such two spaced locations while the stretch is occupied, or while a signal is displayed for a train to proceed into such stretch. A traffic locking circuit similar to that shown in this application is shown in Letters Patent of the United States No. 2,354,023, issued July 18, 1944, to C. D. Ihrig.

An object of this invention is to provide improved apparatus of the type described which is arranged so that when traffic is established for either direction it can be changed only by the operator at the existing entrance end of the stretch.

A further object of the invention is to provide a system of the type described which is arranged so that once reversal of the established direction of traffic is initiated, functioning of the equipment to complete the reversal of traffic cannot be disturbed by the operator at either end of the single track stretch.

Another object of the invention is to provide traffic locking means governed over a line circuit controlled by the track circuit apparatus of the controlled stretch, the traffic locking means governing connection of the track circuit apparatus with the rails of the track sections in the controlled stretch.

A further object of the invention is to provide traffic locking apparatus of the type described which employs stick polar traffic locking relays which are energized over a line circuit, while the relays governing the line circuit are slow acting with the result that on a change in the polarity of the energy supplied to the line circuit the relays governing the line circuit maintain the line circuit for a period long enough to insure that the contacts of the polar relays will move from one position to the other before the line circuit is interrupted.

Another object of the invention is to provide traffic locking apparatus of the type described and incorporating indication relays energized by current supplied over the traffic locking circuit when the track stretch is vacant and controlling lamps which indicate to the operators at the ends of the stretch whether or not the controlled stretch is occupied.

A further object of the invention is to provide an improved traffic locking circuit.

Other objects of the invention and features of novelty will be apparent from the following description taken in connection with the accompanying drawings.

I shall describe one form of traffic locking apparatus embodying my invention, together with two modifications thereof which I may employ and shall then point out the novel features thereof in claims.

In the drawings

Figs. 1A and 1B, when placed together with Fig. 1B at the right, form a diagram showing a stretch of railway track equipped with traffic locking apparatus embodying my invention;

Fig. 2 is a fragmentary view showing how the system of Figs. 1A and 1B may be modified to maintain the supply of energy to the line circuit after a signal controlling entrance of trains into the single track stretch has been caused to provide a permissive indication, and thus continue energization of the block indication relays until a train enters the single track stretch, and

Fig. 3 is a fragmentary view showing how the system of Figs. 1A and 1B may be modified if the means for indicating occupancy of the single track stretch is not required.

In practicing my invention I provide a stick polar traffic locking relay at each end of the protected stretch and also at the ends of the track sections in the stretch, and I provide a line circuit over which energy of one polarity or the other may be supplied to the traffic locking relays in series. The equipment at each end of the line circuit is arranged so that when traffic is established for either direction the equipment at the exit end of the stretch establishes a connection between the line wires, and this connection cannot be interrupted by any manipulation of the equipment by the operator at that location. The equipment at the entrance end of the stretch is arranged so that the operator at that point may cause to be supplied to the line circuit energy of a polarity effective to cause the contacts of the polar traffic locking relays to move from one position to the other. The stick polar traffic locking relays govern control relays which reversibly connect the track circuit apparatus with the rails of the track sections, while the track circuit apparatus controls the line circuit to prevent supply

of energy over the line circuit when the protected stretch is occupied. The relays governing the line circuit are slow enough in releasing so that on a change in the polarity of the energy supplied to the line circuit, the line circuit will be maintained for a period long enough to insure that all of the traffic locking relays will respond to the energy supplied to the line circuit before the line circuit is interrupted.

Neutral block indication relays may be connected in series with the line circuit at each end thereof so as to be energized by current supplied over the line circuit to provide an indication whether or not the protected stretch is occupied. When these relays are employed the equipment at the ends of the stretch is arranged so that energy of the polarity effective to maintain the established direction of traffic is supplied to the line circuit at the entrance end of the stretch until it is desired to reverse the direction of traffic, at which time the polarity of the energy supplied to the line circuit is reversed.

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

Referring to Figs. 1A and 1B of the drawings there is shown therein a stretch of railway track having track rails 1 and 2 over which traffic may move in either direction. Adjacent the left-hand or west end of the single track stretch is a passing siding or branch track WPS, and adjacent the right-hand or east end of the single track stretch is a passing siding or branch track EPS. The passing sidings or branch tracks are connected with the main track by suitable track switches.

Although this system is illustrated in connection with a single track stretch joining two passing sidings or branch tracks, the system is not limited to use in situations of this kind and may be employed wherever traffic may move in either direction between two points, but only in one direction at one time.

The track rails 1 and 2 are divided by insulated joints 3 into track sections for signaling purposes. As shown there is a section 4T which includes the switch 4W connecting the passing siding WPS with the main track, and a section 7T which includes the switch 7W connecting the passing siding EPS with the main track. The single track stretch between sections 4T and 7T is divided into sections 5T and 6T, but it is contemplated that the single track stretch may include a larger number of track sections.

The track sections 5T and 6T of the single track stretch are provided with track circuit apparatus which may be of any appropriate type. As shown the track circuit equipment for these sections is of the coded type and makes use of coded energy of two code frequencies, while the traffic locking relays reversibly connect the track circuit apparatus with the section rails to condition the track circuits for movement of traffic through the single track portion in the selected direction.

The track sections 4T and 7T, which include the track switches 4W and 7W, are provided with suitable track circuit apparatus, and as shown these track circuits are of the steady energy type and each includes a track relay which is supplied with energy from a track battery over the section rails.

Movement of traffic along the main track from left to right is governed by signals 5ES and 6ES, while movement of traffic from right to left along the main track is governed by signals 6WS and 5WS. Movement of traffic between the main track and the passing sidings may be controlled by appropriate signals, not shown.

The signals 5ES, 6ES, 6WS and 5WS are shown as being of the color light type, and each has a red or stop lamp R, a yellow or caution lamp Y, and a green or clear lamp G. While the wayside signals are shown as being of the color light type, this system is not limited to the use of wayside signals of this type and any appropriate type of wayside signal may be employed.

Similarly, this traffic locking means is not limited to use in track stretches in which movement of traffic is governed by wayside signals, and is adapted for use in track stretches in which movement of traffic is controlled by cab signals, either alone or in conjunction with wayside signals.

The polarized traffic locking relays FR, which control the direction of traffic in the single track stretch, are energized in series over a line circuit extending between the passing sidings. A traffic locking relay is located at each end of the single track stretch, and, in addition, a traffic locking relay is located at the junction between track sections in the single track stretch. In the system shown in the drawings, a traffic locking relay 1FR is located at the west end of the single track stretch, a relay 2FR is located at the adjoining ends of sections 5T and 6T, and a relay 3FR is located at the east end of the single track stretch.

Each of the traffic locking relays has associated therewith a westbound control relay WFPR, and an eastbound control relay EFPR, while the equipment at each end of the single track stretch includes a block indication relay BPR, a directional stick relay SR, a push button stick relay PBSR, a repeater relay FCR, traffic direction lamps E and W, a block occupancy lamp M, a signal control or traffic lever K, a push button PB, and a line battery LB.

The signal levers K, the lamps F, W, and M, and the push buttons PB at the ends of the single track stretch may be mounted in interlocking towers located at the ends of the single track stretch, while the levers K and push buttons PB may be operated by attendants in these towers.

Although the system is illustrated and described in connection with a track stretch having interlocking towers at opposite ends of the single track stretch so that the signal control levers and the push buttons are manually controlled by operators in these towers, the system is not limited to use in such situations but is applicable also to track stretches governed by centralized traffic control or other remote control apparatus.

Each signal location is provided with a suitable source of direct current, such as a storage battery, not shown, the terminals of which are designated B and C in the drawings.

The signals 5ES and 6WS controlling movement of trains across the switches are governed by signal control relays 5RHR and 6LHR, respectively, which are governed by the traffic locking relays, the track relay of the associated detector section, and the traffic levers, while each of these relays may also be controlled in the manner well known in the art by the position of the associated track switch and by traffic conditions in the vicinity of the switch. One means for controlling the relays 5RHR and 6LHR is shown in Letters Patent of the United States No. 2,093,170 to Ronald A. McCann.

In most instances the relay contacts are shown directly under the relay winding, but in some cases in order to simplify the drawings relay contacts are shown separated from the relay

winding, and where this is done the relay with which the contacts are associated is identified by appropriate reference characters placed directly above the relay contacts.

The equipment is shown in the condition which it assumes when the traffic locking relays condition the track stretch for eastbound traffic, that is, for movement of traffic from left to right, and when signal control lever 1K is in its normal position N in which its contact 87 interrupts the circuit of signal control relay 5RHR and thus maintains the display of a stop indication by signal 5ES.

At this time relay 1PBSR is released, while energy is supplied to relay ESR over the stick circuit which includes front contact 14 of relay ESR and lever contact 15, which is closed when lever 1K is in its position L or its position N or is intermediate these positions.

Energy is also supplied to relay ESR over its pick-up circuit which includes front contact 94 of relay 4TR and lever contact 93, which is closed when the lever 1K is in its positions N or L or is intermediate these positions.

At this time relay WSR is energized by current supplied over the stick circuit which includes front contact 13 of relay 3FPR and front contact 26 of relay WSR so the contacts of relay WSR are picked up.

Energy is also supplied to relay WSR over the pick-up circuit including front contact 95 of relay 7TR and signal lever contact 116, and over the stick circuit which includes signal lever contact 115 and front contact 26 of relay WSR. The lever contacts 115 and 116 are closed when the lever 3K is in its positions R or N or is intermediate these positions.

As relay 1PBSR is released and ESR is picked up energy is supplied from line battery 1LB over back contacts 16 and 17 of relay 1PBSR, and front contacts 18 and 19 of relay ESR to the line wires 20 and 21 which extend throughout the single track stretch and over which energy is supplied to the relays FR and BPR in series.

As hereinafter explained, relay 5EH is picked up and its contacts 24 and 25 establish the circuit of line wires 20 and 21, while connection between line wires 20 and 21, is established at the east end of the single track stretch over a circuit including a front contact of relay 3EFPR and a back contact of relay 3WFPR. Accordingly, energy of normal polarity is supplied to the line circuit from battery 1LB over the circuit which is traced from the positive terminal of battery 1LB over front contact 23 of relay 1EFPR, back contact 17 of relay 1PBSR, front contact 19 of relay ESR, winding of relay 1BPR, winding of relay 1FR, wire 21, front contact 24 of relay 5EH, winding of relay 2FR, front contact 27 of relay 2H, front contact 28 of relay 3EFPR, winding of relay 3FR, winding of relay 3BPR, front contact 30 of relay WSR, back contact 31 of relay 3PBSR, back contact 32 of relay 3WFPR, front contact 33 of relay 3EFPR, back contact 34 of relay 3PBSR, front contact 35 of relay WSR, wire 20, front contact 38 of relay 3EFPR, front contact 39 of relay 2H, front contact 25 of relay 5EH, front contact 18 of relay ESR, back contact 16 of relay 1PBSR, and back contact 22 of relay 1WFPR to the negative terminal of the line battery 1LB.

As relays 1BPR and 3BPR are energized by current supplied over the line circuit, contact 40 of relay 1BPR establishes the circuit of lamp 1M, and contact 41 of relay 3BPR establishes the circuit of lamp 3M. Accordingly, the lamps 1M and 3M are lighted and indicate to the operators in the towers at opposite ends of the single track stretch that the single track stretch is vacant, and that the direction of traffic in the single track stretch may be reversed if desired.

As energy of normal polarity is supplied to the traffic locking relays 1FR, 2FR, and 3FR the polar contacts of each of these relays occupy their left-hand or normal positions with the result that energy is supplied to the eastbound control relays EFPR. The circuit for relay 1EFPR includes normal polar contact 45 of relay 1FR, and back contact 46 of relay 1WFPR, while contact 47 of relay 1EFPR interrupts the circuit of relay 1WFPR so that relay 1WFPR remains released.

Similarly, energy is supplied to relay 2EFPR over normal polar contact 49 of relay 2FR and back contact 50 of relay 2WFPR, while energy is supplied to relay 3EFPR over the circuit which includes normal polar contact 52 of relay 3FR and back contact 53 of relay 3WFPR.

As relay 1EFPR is energized its contact 55 establishes the circuit of the associated lamp E to indicate to the operator in the tower at the west end of the single track stretch that the single track stretch is conditioned for eastbound traffic. Likewise, contact 56 of relay 3EFPR establishes the circuit of the associated lamp E to indicate to the operator in the tower at the east end of the single track stretch that the single track stretch is conditioned for eastbound traffic.

At this time energy is supplied to relay 1EFCR over normal polar contact 57 of relay 1FR and front contact 58 of relay 1EFPR, and contacts 60 and 61 of relay 1EFCR connect track relay 5ETR across the rails of section 5T at the west end of the section, while contacts 60 and 61 interrupt the circuit for supplying energy from the track battery 5ETB to the rails of section 5T.

As relay 2EFPR is energized its front contacts 62 and 63 connect track relay 2TR across the rails of section 6T, while front contacts 65 and 66 of relay 2EFPR connect the track battery 2TB across the rails of section 5T.

At this time the circuit of relay 3WFCR is interrupted by polar contact 69 of relay 3FR and by contact 70 of relay 3WFPR, so contacts 72 and 73 of relay 3WFCR are released and interrupt the circuit of track relay 6WTR and connect track battery 6ETB across the rails of section 6T so that coded energy of a code frequency governed by traffic conditions in advance of section 6T is supplied to section 6T. As shown, selection between energy of 75 and 180 code frequency is controlled by track relay 7TR, but it is contemplated that the frequency of the energy supplied to section 6T may be controlled in the manner well known in the art by traffic conditions in section 8T as well as in section 7T, while it is also contemplated that the frequency of the energy supplied to section 6T may be controlled in accordance with the aspect displayed by the signal, not shown, governing movement of eastbound trains across the switch 7W, and also in accordance with the position of the switch 7W.

As section 7T is not occupied track relay 7TR is picked up and its contact 77 establishes the circuit including a contact of code transmitter 180CT for supplying energy from the battery 6ETB to the rails of section 6T. This energy feeds to track relay 2TR and operates it so that energy is supplied through the associated decod-

ing transformer 2DT to relay 2H, and through a resonant rectifier unit 180DU to relay 2J. As relays 2H and 2J are picked up energy is supplied over front contact 78 of relay 2EFPR, front contact 79 of relay 2H, and front contact 80 of relay 2J to the green or clear lamp G of signal 6ES.

As relay 2H is picked up its contact 82 establishes the circuit controlled by a contact of code transmitter 180CT for supplying energy from the track battery 2TB to the rails of section 5T. This energy feeds to track relay 5ETR and operates it so that energy is supplied through the associated decoding transformer to relay 5EH and through a resonant rectifier unit 180DU to relay 5EJ. Accordingly relays 5EH and 5EJ are picked up, but at this time relay 5RHR is released so energy is supplied over back contact 84 of relay 5RHR to the red or stop lamp R of signal 5ES.

At this time energy is supplied over back contact 85 of relay 2WFPR to the red lamp R of signal 5WS, while energy is supplied over back contact 86 of relay 6LHR to the red lamp R of signal 6WS.

As relay 2WFPR is released its contact 67 interrupts the pick-up and stick circuits for relay 3PBSR so that this relay will remain released even though the push button 3PB should be depressed. Accordingly, contacts 31 and 34 of relay 3PBSR maintain the connection traced above between line wires 20 and 21 so that energy of normal polarity for battery 1LB may be supplied over the line wires to the relays FR and BRP, while contacts of relay 3PBSR cannot be picked up to establish the circuit to supply energy of reverse polarity from battery 3LB to the line wires 20 and 21.

If the operator at the west end of the single track stretch wishes to clear the signal 5ES to permit an eastbound train to enter the single track stretch he may do so by moving the control lever 1K from its position N to its position R. On this movement of the lever, the lever contact 87 establishes the circuit including front contact 83 of track relay 4TR and front contact 88 of relay 1EFPR for supplying energy to relay 5RHR, so that contact 84 of relay 5RHR is picked up and interrupts the circuit of the red lamp R of signal 5ES and establishes the circuit including front contact 89 of relay 5EH and front contact 90 of relay 5EJ for supplying energy to the green lamp G of signal 5ES. Accordingly, signal 5ES displays a proceed indication and authorizes an eastbound train to enter the single track stretch.

When the lever 1K is moved to its right-hand position contact 93 interrupts the pick-up circuit for relay ESR, while contact 15 interrupts the stick circuit for relay ESR. Accordingly, relay ESR releases and its contact 14 additionally interrupts the stick circuit of relay ESR, while its contacts 18 and 19 interrupt the circuit of the line wires 20 and 21 so that the block indication relays 1BPR and 3BPR release and interrupt the circuits of the lamps 1M and 3M. These lamps, therefore, are extinguished and indicate to the operators at both ends of the single track stretch that the direction of traffic cannot be changed.

On release of relay ESR and resultant interruption of the circuit of line wires 20 and 21, the relays 1FR, 2FR and 3FR are deenergized, but the operating characteristics of these relays are such that their contacts remain in the position which they already occupy. Accordingly, the circuits of relays EFPR and the circuit of relay 1EFCR are maintained and these relays maintain the track circuit apparatus in the condition described in detail above.

When a train moving in the normal direction of traffic enters section 4T track relay 4TR releases and its contact 83 interrupts the circuit of relay 5RHR so that contact 84 of relay 5RHR releases and causes signal 5ES to display its red or stop indication. In addition, contact 94 of relay 4TR interrupts the pick-up circuit of relay ESR to insure that relay ESR remains released and interrupts the line wires 20 and 21 and thus prevents a change in the established direction of traffic when section 4T is occupied.

When the train advances into section 5T the track relay 5TR is shunted and ceases to follow code so that relays 5EH and 5EJ release to prevent the display of a permissive indication by signal 5ES, while contacts 24 and 25 of relay 5EH additionally interrupt the circuit of the line wires 20 and 21 and thus prevent a change in the established direction of traffic.

When the train advances into section 6T the track relay 2TR is shunted and ceases to follow code so that relays 2H and 2J release and cause signal 6ES to display its stop indication, while contact 82 of relay 2H changes the energy supplied from battery 2TB to the rails of section 5T from 180 to 75 code frequency.

When the train advances into section 7T track relay 7TR releases and its contact 95 interrupts the pick-up circuit for relay WSR but this relay remains energized by current supplied over its own front contact 26 and front contact 13 of relay 3EFPR. On release of relay 7TR its contact 77 changes the coded energy supplied to the rails of section 6T from 180 to 75 code frequency.

When the train vacates section 4T track relay 4TR picks up and its front contacts 83 and 94 are closed to permit energy to be supplied to relays 5RHR and ESR, respectively. Under normal conditions when an eastbound train accepts the proceed indication provided by signal 5ES as a result of movement of lever 1K to its position R and enters the single track stretch, the operator will return the lever 1K to its normal or intermediate position N.

Accordingly, lever contact 87 interrupts the circuit of relay 5RHR so that on picking up of relay 4TR energy will not be supplied to relay 5RHR and its contact 84 remains released and maintains the display of the stop indication by signal 5ES.

If the lever 1K is left in its position R so that lever contact 87 is closed energy will be supplied to relay 5RHR and its contact 84 will be picked up to permit signal 5ES to provide a permissive indication. If the lever 1K is left in its position R lever contact 93 will interrupt the pick-up circuit of relay ESR so that on picking up of relay 4TR relay ESR will remain released and will interrupt the circuit of line wires 20 and 21 so that the established direction of traffic cannot be changed.

If the lever 1K is returned to its normal position N energy will be supplied to relay ESR over lever contact 93 and front contact 94 of relay 4TR when section 4T is vacated. Accordingly, relay ESR picks up and its contact 14 establishes a stick circuit for the relay, while contacts 18 and 19 which control the circuit of line wires 20 and 21 are closed.

When the train vacates section 5T coded energy feeds to track relay 5ETR and operates it

so that relay 5EH picks up and its contacts 24 and 25 are closed to permit the circuit of the line wires 20 and 21 to be established.

When the train vacates section 6T coded energy feeds to relay 2TR and operates it so that energy is supplied to relay 2H with the result that signal 6ES displays its caution indication, while contact 82 of relay 2H changes the energy supplied to the rails of section 5T from 75 to 180 code frequency, and contacts 27 and 39 of relay 2H are closed to permit the circuit of line wires 20 and 21 to be established.

When the signal control lever 1K is returned to its intermediate or normal position N and section 4T is vacated, contact 93 of the signal lever 1K and contact 94 of track relay 4TR establish the pick-up circuit for relay ESR and its contacts 18 and 19 are picked up so that the battery 1LB is connected to the line wires 20 and 21. As long as either section 5T or 6T is occupied the circuit of the line wires 20 and 21 is interrupted and the traffic locking relays FR and the indication relays BPR are deenergized.

When the train advances far enough to vacate sections 5T and 6T so that relays 5EH and 2H are picked up, the circuit of line wires 20 and 21 is complete and energy from the battery 1LB is supplied over the line wires 20 and 21 to energize the traffic locking relays FR and the indication relays BPR in series. Accordingly, the contacts of relays 1BPR and 3BPR pick up and establish the circuits of the indication lamps 1M and 3M, respectively, to indicate to the operators at both ends of the single track stretch that the direction of traffic in the single track stretch may be reversed if desired.

It is to be observed that the circuit of the line wires 20 and 21 is complete as soon as section 6T is vacated. This permits traffic to be reversed while a train is in section 7T and makes it unnecessary to wait for section 7T to be vacated.

When the train vacates section 7T track relay 7TR picks up and its contact 77 changes the energy supplied to section 6T from 75 to 180 code frequency so that relay 2TR is operated at a rate such as to cause relay 2J as well as relay 2H to be picked up so that signal 6ES displays its green or clear indication.

Operation of equipment to reverse the established direction of traffic

This system is arranged so that when the single track stretch is unoccupied and the signals governing entrance of trains into the single track stretch are displaying their stop indications the direction of traffic in the single track stretch may be reversed.

When the single track stretch is vacant, the signal control lever 1K is in its normal position, and eastbound traffic is established, energy from battery 1LB is supplied to line wires 20 and 21 over back contacts 16 and 17 of relay 1PBSR and front contacts of relays 1EFPR and ESR. The connections from the battery to the line wires are arranged so that the positive terminal of the battery is connected to line wire 21, while energy of this polarity supplied to the traffic locking relays FR causes their contacts to occupy their left-hand or normal positions.

As pointed out above, at this time relay 3PBSR is released and cannot be picked up so it maintains connection between wires 20 and 21 to permit energy from battery 1LB to be supplied over the line wires, while relay 3PBSR prevents supply of energy from battery 3LB to the line wires as long as the stretch is conditioned for eastbound traffic.

When it is desired to reverse traffic the operator at the end of the single track stretch at which trains are permitted to enter the stretch must depress the push button at his location, thereby indicating that he is willing to surrender control of the single track stretch.

When traffic is to be changed from eastbound to westbound the push button 1PB at the west end of the stretch is depressed, thereby establishing a pick-up circuit for relay 1PBSR. This circuit includes front contact 10 of relay 1EFPR, front contact 94 of relay 1BPR and push button 1PB, while when relay 1PBSR picks up its contact 11 establishes a stick circuit to keep the relay energized as long as relay 1EFPR is energized.

The stick circuit which relay 1PBSR establishes for itself when it is picked up insures that once the push button 1PB is depressed to pick up relay 1PBSR and initiate reversal of the established direction of traffic, the relay 1PBSR will remain picked up until this reversal of traffic is completed.

In addition when relay 1PBSR picks up its contact 12 establishes a stick circuit for relay ESR including its own front contact 14 to insure that relay ESR will remain picked up and maintain the circuit of the line wires 20 and 21.

On picking up of relay 1PBSR its contacts 16 and 17 interrupt the previously traced circuit for connecting the battery 1LB with the wires 20 and 21, and connect this battery to these wires with the positive terminal of the battery connected to wire 20 so that there is a reversal in the polarity of the energy supplied to the line wires.

On this change in the polarity of the energy supplied to the line wires 20 and 21 the polar contacts of the traffic locking relays 1FR, 2FR and 3FR shift from their normal to their reverse positions so that the circuits of the relays EFPR are interrupted, while circuits are established for the relays WFPR after the relays EFPR release. The circuit for supplying energy to relay 1WFPR includes reverse polar contact 45 of relay 1FR and back contact 47 of relay 1EFPR, while the circuit for supplying energy to relay 2WFPR includes reverse polar contact 49 of relay 2FR and back contact 96 of relay 2EFPR. The circuit for supplying energy to relay 3WFPR includes reverse polar contact 52 of relay 3FR and back contact 97 of relay 3EFPR. When the relays WFPR pick up they interrupt the circuits of the associated relays EFPR, and insure that they will remain released.

On release of relay 3EFPR and picking up of relay 3WFPR the connection between line wires 20 and 21 established by front contact 33 of relay 3EFPR and back contact 32 of relay 3WFPR is interrupted, while wire 20 is connected over back contact 34 of relay 3PBSR and back contact 33 of relay 3EFPR to the negative terminal of the battery 3LB, and wire 21 is connected over back contact 31 of relay 3PBSR and front contact 32 of relay 3WFPR to the positive terminal of battery 3LB. Accordingly, energy is supplied from the battery 3LB to the wires 20 and 21, while the polarity of this energy is such that energy from the battery 3LB assists the energy from battery 1LB in maintaining the contacts of the traffic locking relays FR in their reverse positions.

On movement of the contacts of the traffic locking relay 3FR and resultant release of the eastbound control relay 3EFPR the circuit of line wires 20 and 21 is interrupted until relay 3WFPR picks up.

The control relays 3EFPR and 3WFPR are of a type which are slow to release so that on movement of the contacts of the traffic locking relay 3FR and resultant interruption of the supply of energy to a control relay, the contacts of the control relay remain picked up for a short period and cause the circuit of the line wires 20 and 21 to be maintained so that energy continues to be supplied over these wires to the relays FR to insure that the contacts of all of the relays FR will complete their movement from one position to the other before the supply of energy to the traffic locking relays is interrupted.

On movement of the contacts of relay 1FR to their reverse position contact 57 interrupts the circuit of relay 1EFCR, while the circuit of this relay is additionally interrupted by contact 58 of relay 1EFPR when that relay releases. On release of relay 1EFCR its contacts 60 and 61 interrupt the circuit of track relay 5ETR and establish the circuit for supplying coded energy from the battery 5ETB to the rails of section 5T. Accordingly, relay 5ETR ceases to follow code and relays 5EH and 5EJ release. The relay 5EH is of a type the contacts of which are slow to release so that contacts 24 and 25 maintain the circuit of the line wires 20 and 21 for a period subsequent to movement of contact 45 of relay 1FR so that energy continues to be supplied over these wires to the traffic locking relays FR to insure that the contacts of all of the relays FR will complete their movement from one position to the other.

On release of the relay 1EFPR its contact 10 interrupts the pick-up and stick circuits for relay 1PBSR so that its contacts release and contacts 16 and 17 interrupt the supply of energy from the battery 1LB to the line wires 20 and 21 and establish a connection between these wires which is traced from wire 20 over back contact 16 of relay 1PBSR, front contact 22 of relay 1WFPR, back contact 33 of relay 1EFPR, and back contact 17 of relay 1PBSR to wire 21. Accordingly, energy supplied from battery 3LB to the wires 20 and 21 flows over the circuit provided by these wires and energizes the relays FR to maintain their contacts in their reverse positions, while the contacts of relays 1BPR and 3BPR are picked up and establish the circuits of the indication lamps 1M and 3M to indicate that the single track stretch is unoccupied.

On release of relay 1 PBSR its contact 12 interrupts one stick circuit for relay ESR, but this relay continues to be energized by current supplied over its pick-up and stick circuits controlled by contacts of lever 1K, and over the stick circuit established by front contact 102 of relay 1WFPR. The relay ESR, therefore, remains picked up and its contacts 16 and 17 maintain the circuit of the line wires 20 and 21. The stick circuit for relay ESR established by contact 102 of relay 1WFPR on picking up of relay 1WFPR prevents release of the relay ESR if the signal control lever 1K is moved to its position R while the single track stretch is conditioned for westbound traffic.

On picking up of relay 1WFPR its front contacts 100 and 101 are closed and maintain the circuit of line wires 20 and 21 after release of contacts 24 and 25 of relay 5EH. If the relay 5EH releases before the relay 1WFPR picks up the circuit of the line wires 20 and 21 will be momentarily interrupted, but this interruption of the circuit of these wires is without effect other than momentary release of the relays BPR since the polar contacts of relays FR will have already completed their movement to their reverse positions and will remain in their reverse positions during interruptions in the supply of energy to their windings.

On release of relay 1EFPR the associated lamp E is extinguished, while on picking up of relay 1WFPR the associated lamp W is lighted by energy supplied over front contact 103 of relay 1WFPR.

On release of relay 2EFPR it contacts 62 and 63 disconnect relay 2TR from the rails of section 6T, while its contacts 65 and 66 disconnect the battery 2TB from the rails of section 5T. In addition, on release of relay 2EFPR its contact 78 prevents the supply of energy to the yellow and green lamps of signal 6ES and establishes the circuit of the red lamp R of that signal.

On picking up of relay 2WFPR its contacts 104 and 105 connect the track relay 2TR across the rails of section 5T so that the relay 2TR is operated by energy supplied from battery 5ETB at the west end of the section, while contact 85 of relay 2WFPR interrupts one circuit for supplying energy to the red lamp R of signal 5WS and establishes the circuit controlled by contacts of relays 2H and 2J for supplying energy to the lamps of signal 5WS. In addition, on picking up of relay 2WFPR its contacts 108 and 109 connect the battery 2TB across the rails of section 6T so that coded energy is supplied to section 6T at the west end of the section.

When relay 3WFPR picks up its contact 110 establishes the circuit of the associated lamp W, while the circuit of the lamp E is interrupted by contact 56 of relay 3EFPR. Accordingly, the lamps W at both ends of the single track stretch are lighted to indicate that the stretch is conditioned for westbound traffic.

At this time contact 112 of relay 3WFPR is closed to permit energy to be supplied to relay 6LHR on movement of lever 3K to its position L.

In addition, at this time energy is supplied over reverse polar contact 69 of relay 3FR and front contact 70 of relay 3WFCR. Accordingly, contacts 72 and 73 of relay 3WFCR are picked up to cut off the supply of energy from battery 6ETB to the rails of section 6T, and to connect the relay 6WTR across the rails of section 6T so that it is operated by energy supplied from battery 2TB to the section rails. As a result of operation of relay 6WTR relay 6WH picks up, while relay 6WJ may also pick up. However, as long as signal control lever 3K is in its intermediate position N the contact 114 interrupts the circuit of relay 6LHR and its contact 86 is released and establishes the circuit of the red lamp R of signal 6WS to prevent a westbound train from entering the single track stretch.

When relay 6WH picks up its contacts 124 and 125 are closed to permit energy to be supplied over the line wires 20 and 21. In the period from release of the contacts of relay 3EFPR until picking up of relay 6WH the circuit of wires 20 and 21 is interrupted, but this is without consequence except for release of relays 1BPR and 3BPR since the contacts of all of the traffic locking relays FR will complete their movement before the circuit of the line wires 20 and 21 is interrupted.

At this time contact 13 of relay 3EFPR interrupts one stick circuit for relay WSR, but this relay is energized by current supplied over its pick-up circuit which includes signal lever contact 116 and front contact 95 of track relay 7TR, while energy is also supplied to relay WSR

over its own front contact 26 and signal lever contact 115. Accordingly, the contacts 30 and 35 of relay WSR are picked up and maintain the circuit of line wires 20 and 21 so that energy from the battery 3LB is supplied to the traffic locking relays FR and to the indication relays BPR.

The circuit for supplying energy from the battery 3LB is traced from the positive terminal of the battery over front contact 32 of relay 2WFPR, back contact 31 of relay 3PBSR, front contact 30 of relay WSR, wire 21, windings of relays 3BPR and 3FR, front contact 125 of relay 6WH, front contact 27 of relay 2H, winding of relay 2FR, front contact 24 of relay 5EH, windings of relays 1FR and 1BPR, front contact 19 of relay ESR, back contact 17 of relay 1PBSR, back contact 23 of relay 1EFPR, front contact 22 of relay 1WFPR, back contact 16 of relay 1PBSR, front contact 18 of relay ESR, wire 20, front contact 25 of relay 5EH, front contact 39 of relay 2H, front contact 124 of relay 6WH, front contact 35 of relay WSR, back contact 34 of relay 3PBSR, and back contact 33 of relay 3EFPR to the negative terminal of the battery.

As relay 1EFPR is released its contact 10 interrupts the pick-up and stick circuits for relay 1PBSR and it remains released so that its contacts 16 and 17 maintain the connection between wires 20 and 21 through front contact 22 of relay 1WFPR and back contact 23 of relay 1EFPR.

If the operator at the east end of the single track stretch wishes to cause signal 6WS to display a proceed indication, and thus authorize a westbound train to enter the single track stretch, he may do so by moving the lever 3K to its position L so that lever contact 114 establishes the circuit including front contact 119 of track relay 7TR and front contact 112 of relay 3WFPR for supplying energy to the relay 6LHR. Accordingly, contact 86 of relay 6LHR is picked up and interrupts one circuit for supplying energy to the red lamp R of signal 6WS and establishes the circuit controlled by contacts of relays 6WH and 6WJ for supplying energy to the lamps of signal 6WS. At this time sections 5T and 6T are vacant and relay 6WTR will be operated at the 180 code rate so relays 6WH and 6WJ are both picked up and on picking up of relay 6LHR energy is supplied over front contact 86 of relay 6LHR, front contact 120 of relay 6WH, and front contact 121 of relay 6WJ to the green lamp G of signal 6WS. The signal 6WS, therefore, displays its clear indication to authorize a westbound train to enter the single track stretch.

When the lever 3K is moved to its position L contact 116 interrupts the pick-up circuit for relay WSR, while contact 115 interrupts the stick circuit for relay WSR and its contacts release so that contact 10 additionally interrupts the relay stick circuit, and contacts 30 and 35 interrupt the circuit of line wires 20 and 21 to thereby cut off the supply of energy from battery 3LB to these wires. As a result relays 1BPR and 3BPR release and interrupt the circuits of the lamps 1M and 3M and thus indicate to the operators at both ends of the single track stretch that the direction of traffic in the single track stretch cannot be changed.

At this time the relays FR are deenergized but the operating characteristics of the relays are such that their contacts remain in their reverse positions and thus maintain the circuits of relays WFPR to thereby condition the single track stretch for westbound traffic.

When a westbound train accepts signal 6WS and enters section 7T track relay 7TR releases and its contact 119 interrupts the circuit of relay 6LHR so that its contact 86 releases and establishes the circuit of the red lamp R of signal 6WS. In addition, contact 95 of relay 7TR interrupts the pick-up circuit of relay WSR to insure that it will remain released and interrupt the circuit of line wires 20 and 21 and thereby prevent a change in the established direction of traffic.

When the train enters section 6T the track relay 6WTR ceases to follow code and relay 6WH releases and its contacts 124 and 125 interrupt the circuit of the line wires 20 and 21 and thus prevent a change in the established direction of traffic. When the train advances into section 5T, track relay 2TR is shunted and relay 2H releases and its contact 127 establishes the circuit of the red lamp R of signal 5WS, while its contact 82 changes the energy supplied to section 6T from 180 to 75 code frequency. In addition, contacts 27 and 39 of relay 2H interrupt the circuit of line wires 20 and 21.

When the train advances into section 4T track relay 4TR releases and its contact 94 interrupts the pick-up circuit of relay ESR, but this relay is maintained energized by current supplied over its stick circuit which includes its own front contact 14 and front contact 102 of relay 1WFPR. In addition, contact 132 of relay 4TR changes the energy supplied to section 5T from 180 to 75 code frequency.

As shown selection between 75 and 180 code energy supplied to the west end of section 5T is controlled by track relay 4TR, but the frequency of this energy may also be controlled by traffic in the section in advance and by the position of the switch 4W and the aspect displayed by the westbound signal associated with switch 4W.

When the train vacates section 7T track relay 7TR picks up and if signal control lever 3K has been restored to its center or normal position N, energy will be supplied to relay WSR over its pick-up circuit which includes lever contact 116 and front contact 95 of relay 7TR. Accordingly, the contacts of relay WSR pick up and contacts 30 and 35 are closed to permit energy to be supplied over wires 20 and 21.

When track relay 7TR picks up its contact 119 is closed to permit energy to be supplied to relay 6LHR, but if lever 3K has been returned to its normal position, as is customary, the lever contact 114 will interrupt the circuit of relay 6LHR and its contact 86 remains released and maintains the display of the stop indication by signal 6WS.

In addition when lever 3K is returned to its normal position N and track relay 7TR picks up energy is supplied to relay WSR over its pick-up circuit which includes lever contact 116 and track relay contact 95 so relay WSR picks up.

When the train vacates section 6T coded energy feeds to track relay 6WTR and operates it so that relay 6WH is picked up and its contacts 124 and 125 are closed to permit energy to be supplied over line wires 20 and 21.

When the train vacates section 5T coded energy feeds to track relay 2TR and operates it so that relay 2H picks up with the result that its contact 127 establishes the circuit including back contact 128 of relay 2J for supplying energy to the yellow lamp Y of signal 5WS, while contact 82 changes the energy supplied to section 6T from 75 to 180 code frequency. In addition, con-

tacts 27 and 39 of relay 2H are closed to permit energy to be supplied over line wires 20 and 21. The circuit of the line wires 20 and 21 is now complete and energy from battery 3LB is supplied over the wires 20 and 21 to the relays FR and BPR over the circuit traced above. Accordingly, the relays 1BPR and 3BPR are picked up and cause lamps 1M and 3M to be lighted to indicate that traffic in the single track stretch may be reversed if desired.

In addition, contact 130 of relay 3BPR is closed so that energy may be supplied to relay 3PBSR over its stick circuit on closing of the push button 3PB. This permits traffic to be reversed as soon as section 5T is vacated.

When section 4T is vacated track relay 4TR picks up and its contact 132 changes the energy supplied to section 5T from 75 to 180 code frequency and contact 128 of relay 2J picks up and interrupts the circuit of the yellow lamp Y and establishes the circuit of the green lamp G of signal 5WS.

Operation of equipment to change from westbound to eastbound traffic

The equipment is arranged so that the direction of traffic in the single track stretch may be changed from westbound to eastbound if the single track stretch is unoccupied and the control lever 3K is in its normal position N. Under these conditions energy from battery 3LB is supplied to the line wires 20 and 21, while the circuit connections are such that the positive terminal of the battery is connected to wire 21. Energy supplied from the battery 3LB over the line wires 20 and 21 energizes the relays FR and BPR. As the contact 130 of relay 3BPR is picked up the pick-up circuit of relay 3PBSR may be established when the push button 3PB is depressed.

At this time the pick-up and stick circuits for relay 1PBSR are interrupted by contact 10 of relay 1EFPR so that relay 1PBSR is certain to remain released even if the push button 1PB should be depressed.

In order to change from westbound to eastbound traffic the operator at the east end of the stretch depresses the push button 3PB, thereby establishing the pick-up circuit for relay 3PBSR and its contacts pick up and its contact 133 establishes a stick circuit to maintain the relay picked up as long as relay 3WFPR is energized.

On picking up of relay 3PBSR its contact 34 transfers connection of wire 20 from the negative to the positive terminal of the battery 3LB, while contact 31 transfers connection of wire 21 from the positive to the negative terminal of the battery 3LB. Accordingly, there is a change in the polarity of the energy supplied to line wires 20 and 21 with the result that the contacts of the traffic locking relays FR shift from their reverse to their normal positions to interrupt the circuits of the westbound control relays WFPR and to establish the circuits of the eastbound control relays EFPR.

As a result of release of relays WFPR and picking up of relays EFPR energy is supplied from battery 1LB to the line wires 20 and 21 while the supply of energy from the battery 3LB to the line wires is cut off, and connection is established between the lines wires at the east end of the stretch. In addition, the track circuit and other apparatus is conditioned for eastbound traffic while the equipment assumes the condition originally described.

This system is arranged so that irregular manipulation by the operators of the equipment at the ends of the single track stretch cannot create a condition in which traffic is established for one direction in one part of the track stretch and in the opposite direction in the other part of the track stretch. If such a situation were to occur the circuit of line wires 20 and 21 might be interrupted and it would be impossible to supply energy over the circuit of these wires to the traffic locking relays FR to bring them into correspondence. This would make it necessay to have a maintainer inspect all of the traffic locking relays and place their contacts in correspondence.

When the equipment is conditioned for eastbound traffic energy is supplied from battery 1LB to the line wires 20 and 21 over back contacts of relay 1PBSR, while connection is established between wires 20 and 21 over back contacts of relay 3PBSR. The pick-up and stick circuits of relay 3PBSR are interrupted by contact 67 of relay 3WFPR so that closing of push button 3PB is without effect. The relay WSR is energized by current supplied over the stick circuit which includes front contact 13 of relay 3EFPR and front contact 10 of relay WSR so that no movement of the lever 3K can cause release of relay WSR with resultant interruption of the line circuit. Accordingly, when the stretch is conditioned for eastbound traffic, no operation of the push button 3PB or lever 3K at the east end of the stretch can disturb the established direction of traffic.

When the direction of traffic is to be reversed push button 1PB is depressed and relay 1PBSR picks up and reverses the connections from battery 1LB to the line wires 20 and 21. When relay 1PBSR picks up it establishes a stick circuit to maintain itself energized as long as relay 1EFPR is picked up, while it also establishes a stick circuit for relay ESR. Accordingly, once the push button 1PB has been depressed to pick up relay 1PBSR, release of the push button or movement of the control lever 1K will not affect either relay 1PBSR or relay ESR, and the contacts of these relays will remain picked up and maintain the supply of energy from battery 1LB to the wires 20 and 21 of the polarity effective to move the contacts of the traffic locking relays FR to their reverse position.

As explained above, the relays governing the line wires 20 and 21 are sufficiently slow in releasing to maintain the circuit of the wires 20 and 21 for a period, and thus permit energy to be supplied over these wires to the traffic locking relays FR long enough to insure that the contacts of all of the relays will complete their movement from one position to the other. This insures that the equipment at all of the locations will be conditioned to change the established direction of traffic. After the contacts of relays FR move from one position to the other they will remain in the position to which they have been moved even though the line circuit is interrupted and the supply of energy to the relays is cut off.

Modification shown in Fig. 2

As explained above, when the control lever K at either end of the single track stretch is moved to the position to clear the signal governing entrance of a train into the single track stretch, the pick-up and stick circuits for the associated directional stick relay ESR or WSR are interrupted

and its contacts release and interrupt the circuit of line wires 20 and 21 with the result that the indication relays BPR at the ends of the line circuit release and extinguish the lamps M.

It may be preferred to have the equipment operate so that the lamps M will be lighted at all times when the single track stretch is vacant, and Fig. 2 shows how the system of Fig. 1 may be modified to prevent release of the relays WSR and ESR on movement of the associated control lever until a train enters the single track stretch.

Except for modification of the pick-up circuit for relay ESR by elimination of lever contact 93 therein, and the addition of lever contact 137 in the pick-up circuit of relay 1PBSR, the equipment is the same as that shown in Fig. 1, while it is to be understood that similar modifications are made in the equipment at the other end of the line circuit.

In operation, when eastbound traffic is established energy is supplied from battery 1LB to wires 20 and 21 over back contacts 16 and 17 of relay 1PBSR and front contacts 18 and 19 of relay ESR as explained in connection with Fig. 1.

When it is desired to cause signal 5ES to display a permissive indication to permit an eastbound train to enter the single track stretch, lever contact 15 interrupts one stick circuit for relay ESR. At this time relay ESR is maintained energized by current supplied over its pick-up circuit which includes front contact 94 of track relay 4TR. Accordingly, contacts 18 and 19 of relay ESR maintain the circuit of line wires 20 and 21 and energy from battery 1LB supplied to line wires 20 and 21 energizes relays BPR so that contact 40 of relay 1BPR maintains the circuit of the lamp 1M, while the relay 3BPR, not shown, at the east end of the single track stretch maintains the circuit of the lamp 3M. The block indication lamps 1M and 3M, therefore, remain lighted after movement of lever 1K to its position R and indicate that the single track stretch is not occupied.

At this time lever contact 137 interrupts the pick-up circuit of relay 1PBSR and prevents energization of relay 1PBSR if the push button 1PB should be depressed while the lever 1K is in its position R. This prevents interference with the established direction of traffic after the lever K has been moved to the position R to cause signal 5ES to display a permissive indication and authorize a train to enter the single track stretch.

When an eastbound train accepts signal 5ES and enters section 4T the track relay 4TR releases and its contact 94 interrupts the pick-up circuit for relay ESR so that relay ESR releases and its contact 14 interrupts the stick circuits for the relay and thereby prevents picking up of the relay until section 4T is vacated. In addition, on release of the relay ESR its contacts 18 and 19 interrupt the circuit of line wires 20 and 21 and thus cut off the supply of energy over these wires to the block indication relays BPR with the result that they release and extinguish the indication lamps M to thereby indicate to the operators in the towers at both ends of the single track stretch that the stretch is occupied.

When the train vacates section 4T track relay 4TR picks up and energy is supplied to relay ESR over front contact 94 of relay 4TR. The relay ESR, therefore, picks up and its contacts 18 and 19 are closed to permit energy to be supplied over wires 20 and 21 when sections 5T and 6T are vacated. Accordingly, as soon as sections 5T and 6T are vacated energy from battery 1LB is supplied over the line wires 20 and 21 and picks up the relays 1BPR and 3BPR so that they establish the circuits of the lamps 1M and 3M and cause these lamps to be lighted to indicate to the operators at both ends of the track stretch that the stretch is again vacant.

The modification shown in Fig. 2 operates in the same manner as that shown in Fig. 1 during a reversal of the established direction of traffic, and when the stretch is conditioned for westbound traffic.

Modification shown in Fig. 3

In Fig. 3 of the drawings there is shown means to modify the equipment at an end of the line circuit if the block indication relays of the system of Fig. 1 are not required. The system shown in Fig. 3 is similar to that shown in Fig. 1, but differs therefrom in that the block indication relays BPR and the lamps M are omitted, while the circuits for supplying to the line circuit at the entrance end of the stretch energy of the polarity effective to maintain the established direction of traffic are also omitted, and a connection between the line wires is substituted.

Only the equipment at the left-hand or west end of the stretch is shown in Fig. 3, but it is to be understood that the equipment at the right-hand or east end of the stretch is modified in the same manner.

The equipment of Fig. 3 is shown in the condition which it assumes when the track stretch is conditioned for eastbound traffic, the stretch is vacant, and lever 1K is in its normal position N.

At this time the polar contacts of the traffic locking relays FR occupy their left-hand or normal positions so that control relays EFPR are energized and condition the stretch for eastbound traffic. The contacts of these relays were moved to this position when energy was supplied over the line circuit to establish eastbound traffic. After the direction of traffic is established the supply of energy to the line wires is cut off, but because of the operating characteristics of the relays their contacts remain in the position which they then occupy.

The relay 1PBSR is released and a connection between line wires 20 and 21 is established over back contacts 16 and 17 of relay 1PBSR. The relay 3PBSR, not shown, at the other end of the line circuit is also released so that connection is established between line wires 20 and 21 over its back contacts.

If it is desired to permit an eastbound train to enter the track stretch, the lever 1K is moved to its position R with the result that contact 93 interrupts the pick-up circuit for relay ESR and contact 15 interrupts the stick circuit for relay ESR. Accordingly, the contacts of relay ESR release and contacts 18 and 19 interrupt the line wires 20 and 21 to prevent a change in the established direction of traffic.

In addition, on this movement of lever 1K contact 87 establishes a circuit like that shown in Fig. 1, to energize a relay RHR to permit the display of a proceed indication by signal 5ES, while when a train accepts this signal and enters section 4T the track relay 4TR releases and its contact 94 interrupts the pick-up circuit of relay ESR, while its contact 83 interrupts the circuit of the signal control relay RHR and thus puts signal 5ES to stop.

When the lever 1K is returned to its normal position and section 4T is vacated energy is sup-

plied to relay ESR over its pick-up circuit which includes lever contact 93 and front contact 94 of relay 4TR. Accordingly, relay ESR picks up and its contact 14 establishes the stick circuit for the relay, while its contacts 18 and 19 are closed to permit energy to be supplied over line wires 20 and 21.

When it is desired to change from eastbound to westbound traffic the operator at the west end of the stretch can effect this change by depressing push button 1PB, providing lever 1K is in its normal position, and the track stretch is vacant.

When the push button 1PB is depressed energy is supplied to relay 1PBSR over its pick-up circuit which includes front contact 10 of relay 1EFPR, push button 1PB, and lever contact 137, while when relay 1PBSR picks up its contact 11 establishes a stick circuit including front contact 10 of relay 1EFPR to maintain itself energized after the push button is released. In addition, its contact 12 establishes a stick circuit for relay ESR to insure that its contacts 18 and 19 will remain picked up and maintain the circuit of the line wires 20 and 21.

When relay 1PBSR picks up its contacts 16 and 17 interrupt the connection between wires 20 and 21, while contact 16 connects wire 20 to the positive terminal of the battery 1LB and contact 17 connects wire 21 to the negative terminal of the battery. Accordingly, energy of reverse polarity is supplied to the line wires 20 and 21, and if the track stretch is vacant so that the circuit of line wires 20 and 21 is complete, energy will be supplied to the traffic locking relays FR in series and their contacts will be moved from their normal to the reverse positions with resultant release of the eastbound control relays EFPR and picking up of westbound control relays WFPR.

On release of relay 1EFPR its contact 10 interrupts the stick circuit for relay 1PBSR and its contacts 16 and 17 cut off the supply of energy from battery 1LB to wires 20 and 21 and reestablish the connection between these wires. Because of the slow releasing characteristic of relay 1EFPR, interruption of the stick circuit of relay 1PBSR is delayed long enough to insure that energy will be supplied from battery 1LB to wires 20 and 21 for a period sufficient to insure that all of the traffic locking relays FR will respond to the energy from battery 1LB.

Contact 10 of relay 1EFPR also interrupts the pick-up circuit of relay 1PBSR so that the contacts of relay 1PBSR will remain released and will maintain the connection between line wires 20 and 21 if the push button 1PB should be depressed when the single track stretch is conditioned for westbound traffic.

In addition, on release of relay 1EFPR the circuit of relay RHR controlling signal 5ES is interrupted, as is shown in Fig. 1, so that the signal 5ES governing entrance of eastbound trains into the single track stretch cannot be caused to display a permissive indication when the single track stretch is conditioned for westbound traffic.

On picking up of relay 1WFPR its contact 102 establishes a stick circuit to maintain relay ESR energized when section 4T is occupied, or if lever 1K is moved to its position R so that contacts 15 and 93 interrupt the circuits which they control for supplying energy to relay ESR. Accordingly, contacts 18 and 19 of relay ESR remain picked up and maintain the circuit of line wires 20 and 21 so that energy may be supplied over these line wires to change from westbound to eastbound traffic.

As a result of release of eastbound control relays EFPR and picking up of westbound control relays WFPR the track circuit apparatus is connected to the rails of the track sections in the manner appropriate for westbound traffic, while the equipment at the east end of the stretch is conditioned to permit the operator at that point to cause the signal governing entrance of westbound trains into the track stretch to display a permissive indication.

The equipment operates in substantially the same manner on a change from westbound to eastbound traffic and its operation need not be traced in detail.

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

Having thus described my invention, what I claim is:

1. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, means effective only when the contacts of said first polar relay are in their normal position to permit said first signal to provide a permissive indication, a second polarized relay at said second location, means effective only when the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication, a line circuit over which said polarized relays may be energized in series, means at said first location for supplying energy of reverse polarity to said line circuit, means at said second location for supplying energy of normal polarity to said line circuit, means effective only when the contacts of said first polarized relay are in their normal position to energize said polarized relays in series with energy of normal polarity supplied to said line circuit at said first location, and means effective only when the contacts of said second polarized relay are in their reverse position to energize said polarized relays in series with energy of reverse polarity supplied to said line circuit at said second location.

2. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, means effective only when the contacts of said first polar relay are in their normal position to permit said first signal to provide a permissive indication, a second polarized relay at said second location, means effective only when the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication, a line circuit over which said polarized relays may be energized in series, a first control relay at the first location effective when energized to cause

energy of reverse polarity to be supplied to said line circuit, a second control relay at the second location effective when energized to cause energy of normal polarity to be supplied to said line circuit, means for supplying energy to said first control relay provided the contacts of said first polarized relay are in their normal position, and means for supplying energy to said second control relay provided the contacts of said second polarized relay are in their reverse position.

3. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, means effective only when the contacts of said first polar relay are in their normal position to permit said first signal to provide a permissive indication, a second polarized relay at said second location, means effective only when the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication, a pair of line wires over which said polarized relays may be energized in series, means at said first location effective when the contacts of said first polarized relay are in their reverse position to establish connection between said line wires, means at said second location effective when the contacts of said second polarized relay are in their normal position to establish connection between said line wires, means effective only when the contacts of said first polarized relay are in their normal position to energize said polarized relays in series with energy of reverse polarity supplied to said line circuit at said first location, and means effective only when the contacts of said second polarized relay are in their reverse position to energize said polarized relays in series with energy of normal polarity supplied to said line circuit at said second location.

4. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, means effective only when the contacts of said first polar relay are in their normal position to permit said first signal to provide a permissive indication, a second polarized relay at said second location, means effective only when the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication, a pair of line wires over which said polarized relays may be energized in series, a first control relay at said first location effective when released to establish connection between said line wires and effective when energized to cause energy of reverse polarity to be supplied to said line wires, a second control relay at said second location effective when released to establish connection between said line wires and effective when energized to cause energy of normal polarity to be supplied to said line wires, a circuit for supplying energy to said first control relay provided the contacts of said first polarized relay are in their normal position, and a circuit for supplying energy to said second control relay provided the contacts of said second polarized relay are in their reverse position.

5. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, means effective only when the contacts of said first polar relay are in their normal position to permit said first signal to provide a permissive indication, a second polarized relay at said second location, means effective only when the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication, a pair of line wires over which said polarized relays may be energized in series, a first control relay at said first location effective when released to establish connection between said line wires and effective when energized to cause energy of reverse polarity to be supplied to said line wires, a second control relay at said second location effective when released to establish connection between said line wires and effective when energized to cause energy of normal polarity to be supplied to said line wires, a pick-up and a stick circuit for said first control relay governed by a normal polar contact of said first polarized relay, a pick-up and a stick circuit for said second control relay governed by a reverse polar contact of said second polarized relay, means for establishing the pick-up circuit for said first control relay, and means for establishing the pick-up circuit for said second control relay.

6. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, means effective only when the contacts of said first polar relay are in their normal position to permit said first signal to provide a permissive indication, a second polarized relay at said second location, means effective only when the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication, a pair of line wires over which said polarized relays may be energized in series, a first control relay at said first location effective when released to establish connection between said line wires and effective when energized to cause energy of reverse polarity to be supplied to said line wires, a second control relay at said second location effective when released to establish connection between said line wires and effective when energized to cause energy of normal polarity to be supplied to said line wires, means for establishing a pick-up circuit for said first control relay provided the contacts of said first polarized relay are in their normal position, said first control relay when energized being effective to establish a stick circuit to maintain itself energized as long as the contacts of said first polarized relay remain in their normal position, and means for establishing a pick-up circuit for said second control relay

provided the contacts of said second polarized relay are in their reverse position, said second control relay when energized being effective to establish a stick circuit to maintain itself energized as long as the contacts of said second polarized relay remain in their reverse positions.

7. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, means effective only when the contacts of said first polar relay are in their normal position to permit said first signal to provide a permissive indication, a second polarized relay at said second location, means effective only when the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication, a pair of line wires over which said polarized relays may be energized in series, a first control relay at said first location effective when picked up to cause energy of reverse polarity to be supplied to said line wires, said first control relay being effective when released to establish connection between said line wires if the contacts of said first polarized relay are in their reverse position and to cause energy of normal polarity to be supplied to said line wires if the contacts of said first polarized relay are in their normal position, a second control relay at said second location effective when picked up to cause energy of normal polarity to be supplied to said line wires, said second control relay being effective when released to establish connection between said line wires if the contacts of said second polarized relay are in their normal position and to cause energy of reverse polarity to be supplied to said line wires if the contacts of said second polarized relay are in their reverse position, a circuit governed by a normal polar contact of said first polarized relay for supplying energy to said first control relay, and a circuit governed by a reverse polar contact of said second polarized relay for supplying energy to said second control relay.

8. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, means effective only when the contacts of said first polar relay are in their normal position to permit said first signal to provide a permissive indication, a second polarized relay at said second location, means effective only when the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication, a pair of line wires over which said polarized relays may be energzed in series, a first control relay at said first location effective when picked up to cause energy of reverse polarity to be supplied to said line wires, said first control relay being effective when released to establish connection between said line wires if the contacts of said first polarized relay are in their reverse position and to cause energy of normal polarity to be supplied to said line wires if the contacts of said first polarized relay are in their normal position, a second control relay at said second location effective when picked up to cause energy of normal polarity to be supplied to said line wires, said second control relay being effective when released to establish connection between said line wires if the contacts of said second polarized relay are in their reverse position and to cause energy of reverse polarity to be supplied to said line wires if the contacts of said second polarized relay are in their normal position, means effective only when the contacts of said first polarized relay are in their normal positions for supplying energy to said first control relay, and means effective only when the contacts of said second polarized relay are in their reverse positions for supplying energy to said second control relay.

9. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, means effective only when the contacts of said first polar relay are in their normal position to permit said first signal to provide a permissive indication, a second polarized relay at said second location, means effective only when the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication, a line circuit over which said polarized relays may be energized in series, a first indication relay at said first location and a second indication relay at said second location, each of said indication relays having its winding connected in series with said line circuit and controlling an indication device, means at said first location for supplying energy of reverse polarity to said line circuit, and means at said second location for supplying energy of normal polarity to said line circuit.

10. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, means effective only when the contacts of said first polar relay are in their normal position to permit said first signal to provide a permissive indication, a second polarized relay at said second location, means effective only when the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication, a pair of line wires over which said polarized relays may be energized in series, a first control relay at said first location effective when picked up to cause energy of reverse polarity to be supplied to said line wires, said first control relay being effective when released to establish connection between said line wires if the contacts of said first polarized relay are in their reverse position and to cause energy of normal polarity to be supplied to said line wires if the contacts of said first polarized relay are in their normal position, a second control relay at said second location effective when picked up to cause energy of normal polarity to be supplied to said line wires, said second control relay being effective when released to establish connection between said line wires if the contacts of said

second polarized relay are in their normal position and to cause energy of reverse polarity to be supplied to said line wires if the contacts of said second polarized relay are in their reverse position, a first indication relay at said first location and a second indication relay at said second location, each of said indication relays having its winding connected in series with said line circuit and being responsive to energy of either polarity supplied over said line circuit and controlling an indication device, means effective only when the contacts of said first polarized relay are in their normal position for supplying energy to said first control relay, means effective only when the contacts of said second polarized relay are in their reverse position for supplying energy to said second control relay, and means governed by traffic in said track stretch and controlling the circuit of said line wires.

11. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, means effective only when the contacts of said first polar relay are in their normal position to permit said first signal to provide a permissive indication, a second polarized relay at said second location, means effective only when the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication, a pair of line wires governed by traffic in said track stretch and over which said polarized relays may be energized in series, a first control relay at said first location effective when picked up to cause energy of reverse polarity to be supplied to said line wires, said first control relay being effective when released to establish connection between said line wires if the contacts of said first polarized relay are in their reverse position and to cause energy of normal polarity to be supplied to said line wires if the contacts of said first polarized relay are in their normal position, a second control relay at said second location effective when picked up to cause energy of normal polarity to be supplied to said line wires, said second control relay being effective when released to establish connection between said line wires if the contacts of said second polarized relay are in their normal position and to cause energy of reverse polarity to be supplied to said line wires if the contacts of said second polarized relay are in their reverse position, a first auxiliary relay at said first location and a second auxiliary relay at said second location, each of said auxiliary relays having its winding connected in series with one of said line wires, means for supplying energy to said first control relay provided the contacts of said first polarized relay are in their normal position and the contacts of said first auxiliary relay are picked up, and means for supplying energy to said second control relay provided the contacts of said second polarized relay are in their reverse position and the contacts of said second auxiliary relay are picked up.

12. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, a second polarized relay at said second location, a pair of line wires governed by traffic in said track stretch and over which said polarized relays may be energized in series, a first control relay at said first location effective when picked up to cause energy of reverse polarity to be supplied to said line wires, a first control member movable between a first and a second position, means for supplying energy to said first control relay providing said first control member is in its first position and the contacts of said first polarized relay are in their normal position, means effective only when said first control member is in its second position and the contacts of said first polarized relay are in their normal position to permit said first signal to provide a permissive indication, a second control relay at said second location effective when picked up to cause energy of normal polarity to be supplied to said line wires, a second control member movable between a first and a second position, means for supplying energy to said second control relay providing said second control member is in its first position and the contacts of said second polarized relay are in their reverse position, and means effective only when said second control member is in its second position and the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication.

13. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, a second polarized relay at said second location, a pair of line wires governed by traffic in said track stretch and over which said polarized relays may be energized in series, a first control member movable between a first and a second position, means for supplying energy of reverse polarity to said line wires providing said first control member is in its first position and the contacts of said first polarized relay are in their normal position, means effective only when said first control member is in its second position and the contacts of said first polarized relay are in their normal position to permit said first signal to provide a permissive indication, a second control member movable between a first and a second position, means for supplying energy of normal polarity to said line wires providing said second control member is in its first position and the contacts of said second polarized relay are in their reverse position, and means effective only when said second control member is in its second position and the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication.

14. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, a second polarized relay at said second location, a pair of line wires governed by

traffic in said track stretch and over which said polarized relays may be energized in series, a first control relay at said first location effective when picked up to cause energy of reverse polarity to be supplied to said line wires, a first control member movable between a first and a second position, means for supplying energy to said first control relay providing said first control member is in its first position and the contacts of said first polarized relay are in their normal position, a contact of said first control relay being effective when picked up to establish a stick circuit for the relay as long as the contacts of said first polarized relay are in their normal position, means effective only when said first control member is in its second position and the contacts of said first polarized relay are in their normal position to permit said first signal to provide a permissive indication, a second control relay at said second location effective when picked up to cause energy of normal polarity to be supplied to said line wires, a second control member movable between a first and a second position, means for supplying energy to said second control relay providing said second control member is in its first position and the contacts of said second polarized relay are in their reverse position, a contact of said second control relay being effective when picked up to establish a stick circuit for the relay as long as the contacts of said second polarized relay are in their reverse position, and means effective only when said second control member is in its second position and the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication.

15. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a first polarized relay at said first location, a second polarized relay at said second location, a pair of line wires governed by traffic in said track stretch and over which said polarized relays may be energized in series, a first control relay at said first location effective when picked up to cause energy of reverse polarity to be supplied to said line wires, said first control relay being effective when released to establish connection between said line wires if the contacts of said first polarized relay are in their reverse position and to cause energy of normal polarity to be supplied to said line wires if the contacts of said first polarized relay are in their normal position, a second control relay at said second location effective when picked up to cause energy of normal polarity to be supplied to said line wires, said second control relay being effective when released to establish connection between said line wires if the contacts of said second polarized relay are in their normal position and to cause energy of reverse polarity to be supplied to said line wires if the contacts of said second polarized relay are in their reverse position, a first auxiliary relay at the first location and a second auxiliary relay at the second location, each of said auxiliary relays having its winding connected in series with one of said line wires, a first control member movable between a first and a second position, a second control member movable between a first and a second position, means for supplying energy to said first control relay provided said first control member is in its first position, the contacts of said first polarized relay are in their normal position and the contacts of said first auxiliary relay are picked up, means effective only when said first control member is in its second position and the contacts of said first polarized relay are in their normal position to permit said first signal to provide a permissive indication, means for supplying energy to said second control relay provided said second control member is in its first position, the contacts of said second polarized relay are in their reverse position and the contacts of said second auxiliary relay are picked up, and means effective only when said second control member is in its second position and the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication.

16. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, the rails of said track stretch being divided into a plurality of track sections each of which is provided with a track circuit for each direction of traffic, each of said track circuits comprising a source of energy connected across the section rails at the exit end of the section and a track relay connected across the section rails at the entrance end of the section, a first polarized relay at the first location, a second polarized relay at the second location, and a polarized relay at each point of division between the track sections in said track stretch, a line circuit over which all of said polarized relays may be energized in series, the track circuit apparatus at each end of each track section being governed by the polarized relay at that end of the track section in such manner that the apparatus for the track circuits employed for traffic movement from the first to the second location are connected with the section rails when and only when the polarized relay contacts occupy their normal position and so that the apparatus for the track circuits employed for traffic movements from the second to the first location are connected with the section rails when and only when the polarized relay contacts occupy their reverse position, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, means at said first location for supplying energy of reverse polarity to said line circuit, means at said second location for supplying energy of normal polarity to said line circuit, means governed by the track relay at the adjacent end of the track section in advance of said first signal and effective only when the contacts of said first polarized relay are in their normal position to permit said first signal to provide a permissive indication, and means governed by the track relay at the adjacent end of the track section in advance of said second signal and effective only when the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication.

17. In combination, a stretch of railway track extending between a first and a second location and over which traffic may move in either direction between said two locations, the rails of said track stretch being divided into a plurality of track sections each of which is provided with a track circuit for each direction of traffic, each of said track circuits comprising a source of energy connected across the section rails at the

exit end of the section and a track relay connected across the section rails at the entrance end of the section, a first polarized relay at the first location, a second polarized relay at the second location, and a polarized relay at each point of division between the track sections in said track stretch, the track circuit apparatus at each end of each track section being governed by the polarized relay at that end of the track section in such manner that the apparatus for the track circuits employed for traffic movement from the first to the second location are connected with the section rails when and only when the polarized relay contacts occupy their normal position and so that the apparatus for the track circuits employed for traffic movements from the second to the first location are connected with the section rails when and only when the polarized relay contacts occupy their reverse position, a first signal at said first location governing entrance of trains into said track stretch, a second signal at said second location governing entrance of trains into said track stretch, a line circuit controlled by the track circuit apparatus for said track sections and over which all of said polarized relays may be energized in series, means at said first location for supplying energy of reverse polarity to said line circuit, means at said second location for supplying energy of normal polarity to said line circuit, means effective only when the contacts of said first polarized relay are in their normal position to permit said first signal to provide a permissive indication, and means effective only when the contacts of said second polarized relay are in their reverse position to permit said second signal to provide a permissive indication.

CHARLES W. FAILOR.