

July 16, 1946.

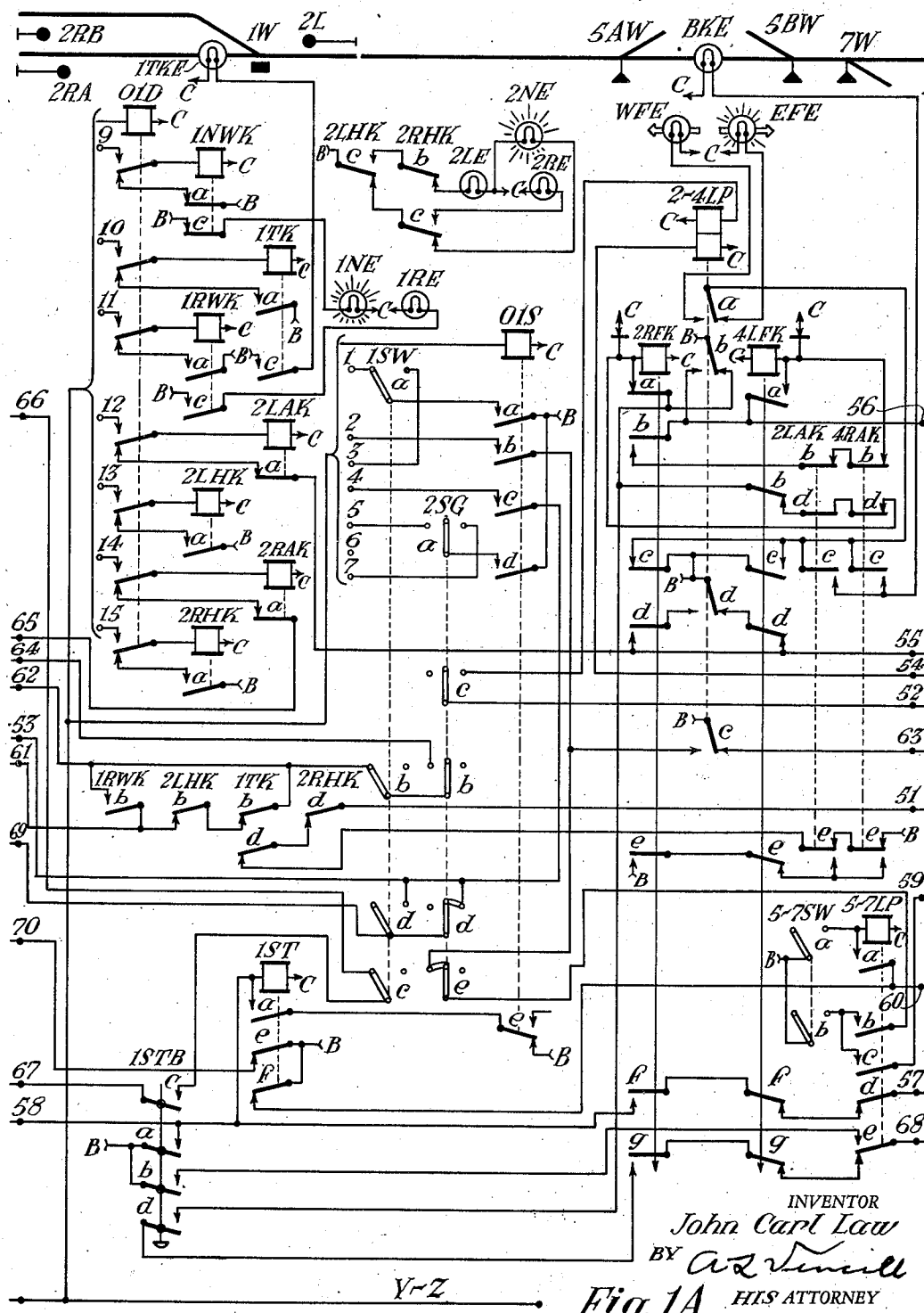
J. C. LAW

2,404,303

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed June 10, 1944

8 Sheets-Sheet 1



July 16, 1946.

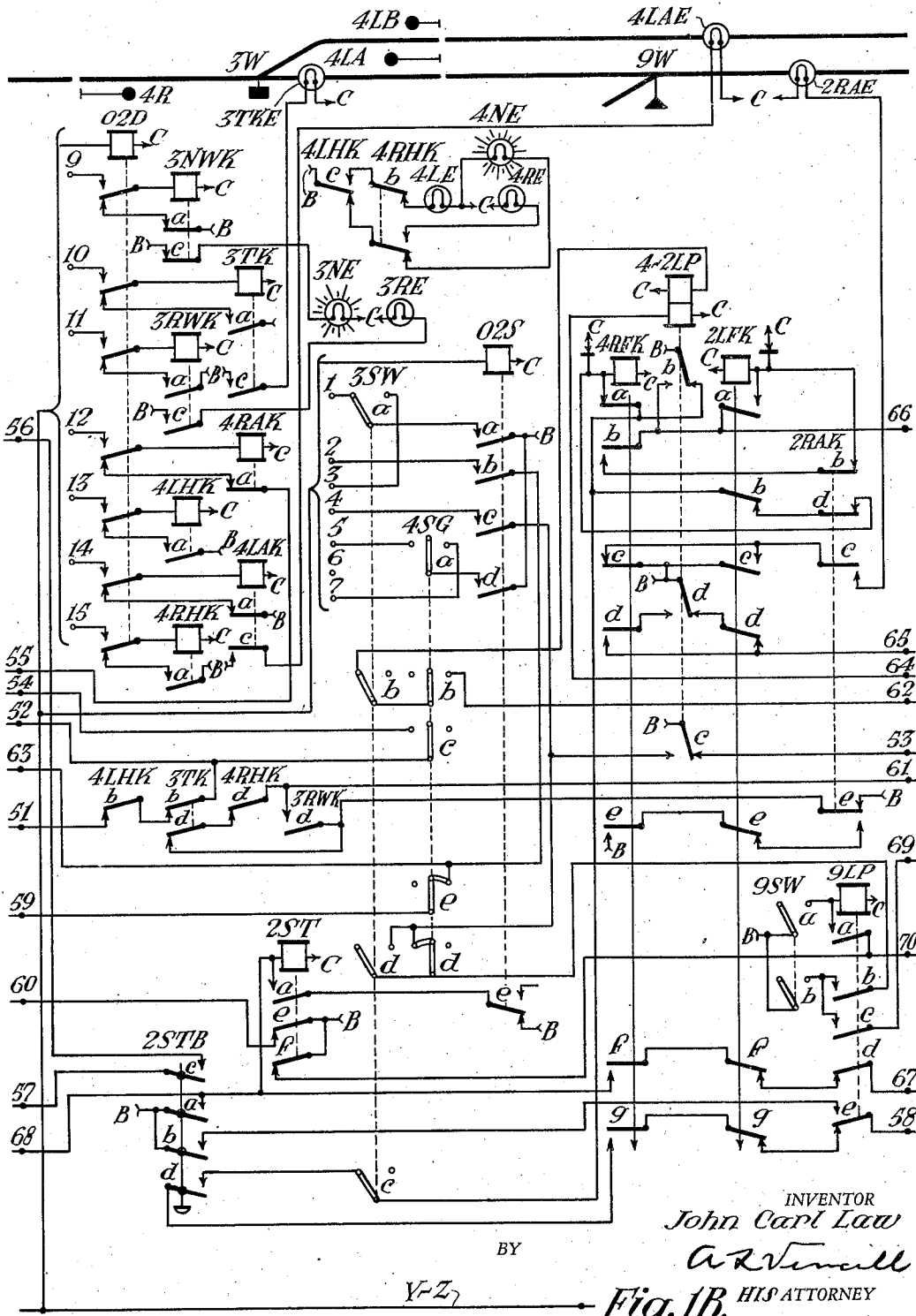
J. C. LAW

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RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed June 10, 1944

8 Sheets-Sheet 2



July 16, 1946.

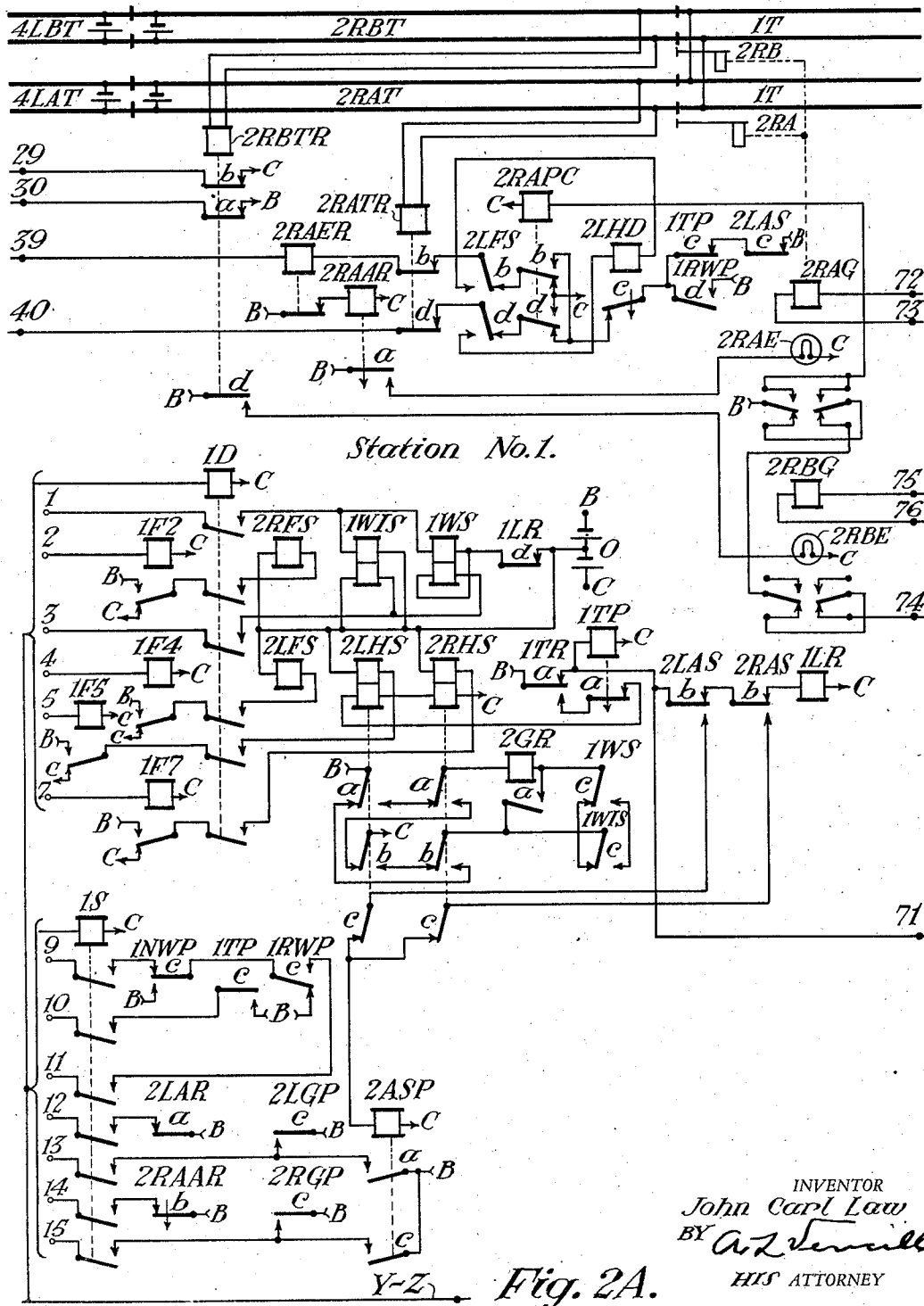
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2,404,303

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed June 10, 1944

8 Sheets-Sheet 3



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July 16, 1946.

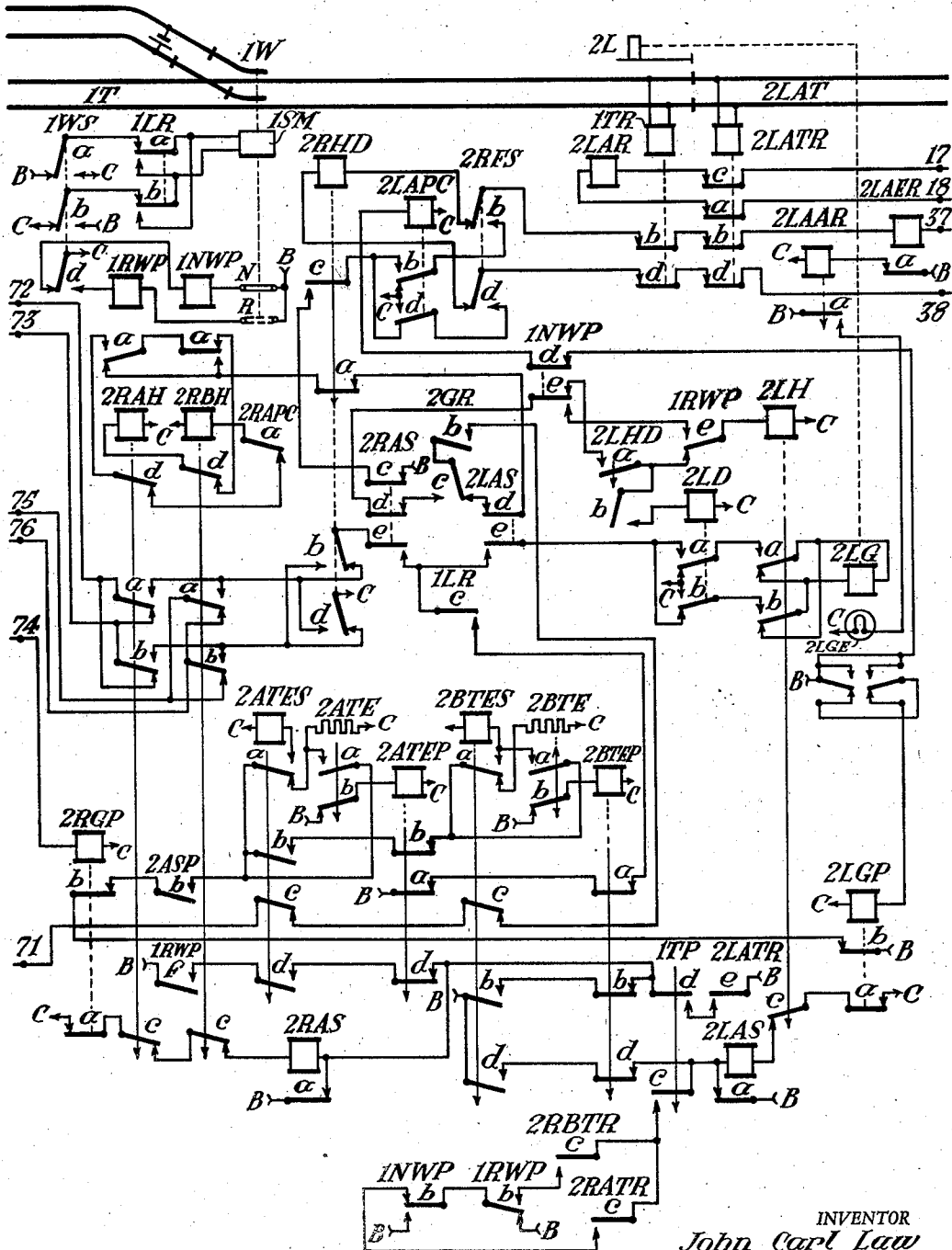
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2,404,303

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed June 10, 1944

8 Sheets-Sheet 4



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Fig. 2B HIS ATTORNEY

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July 16, 1946.

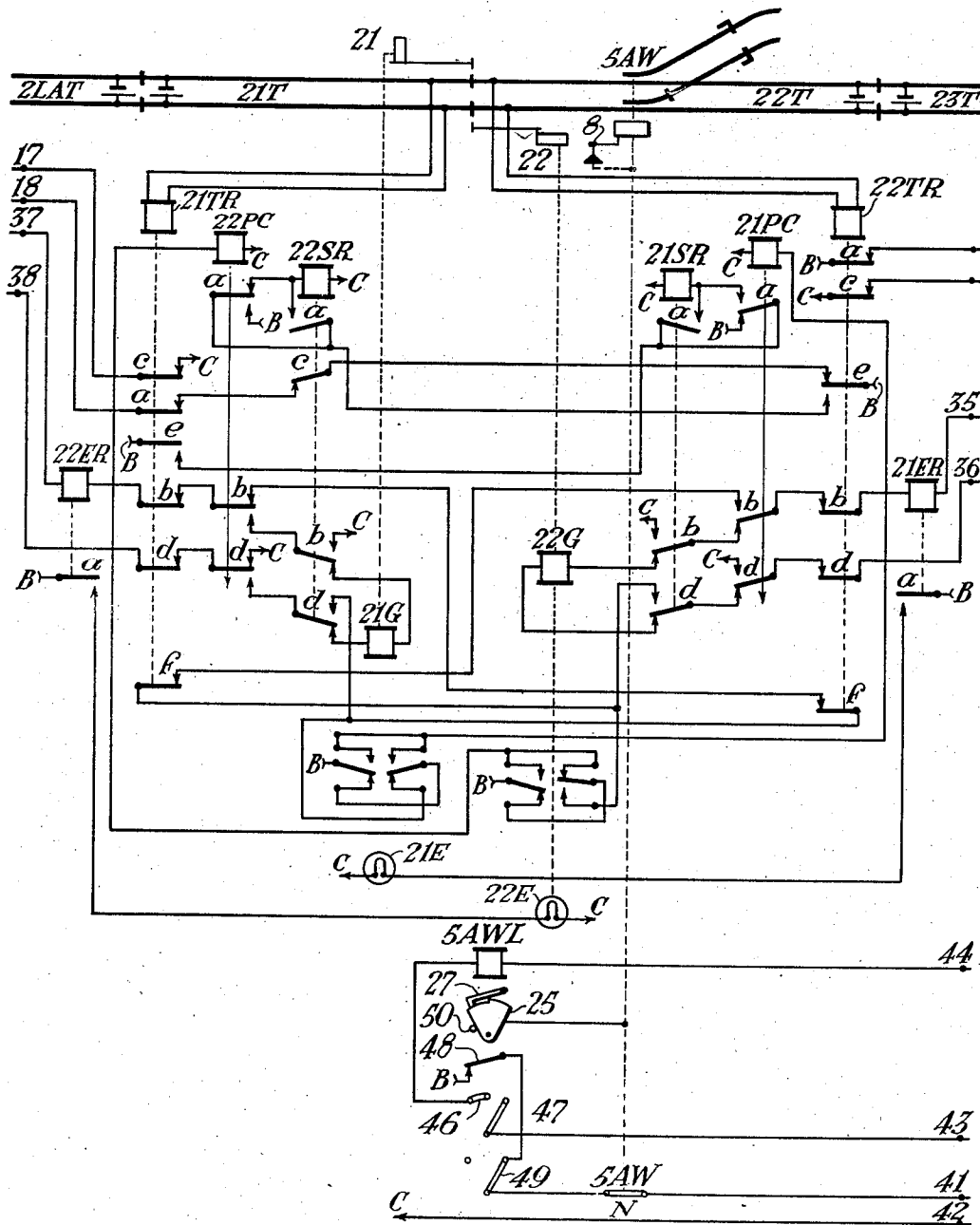
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RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed June 10, 1944

8 Sheets-Sheet 5



BY

Y-Z

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Fig. 2C. HIS ATTORNEY

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RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed June 10, 1944

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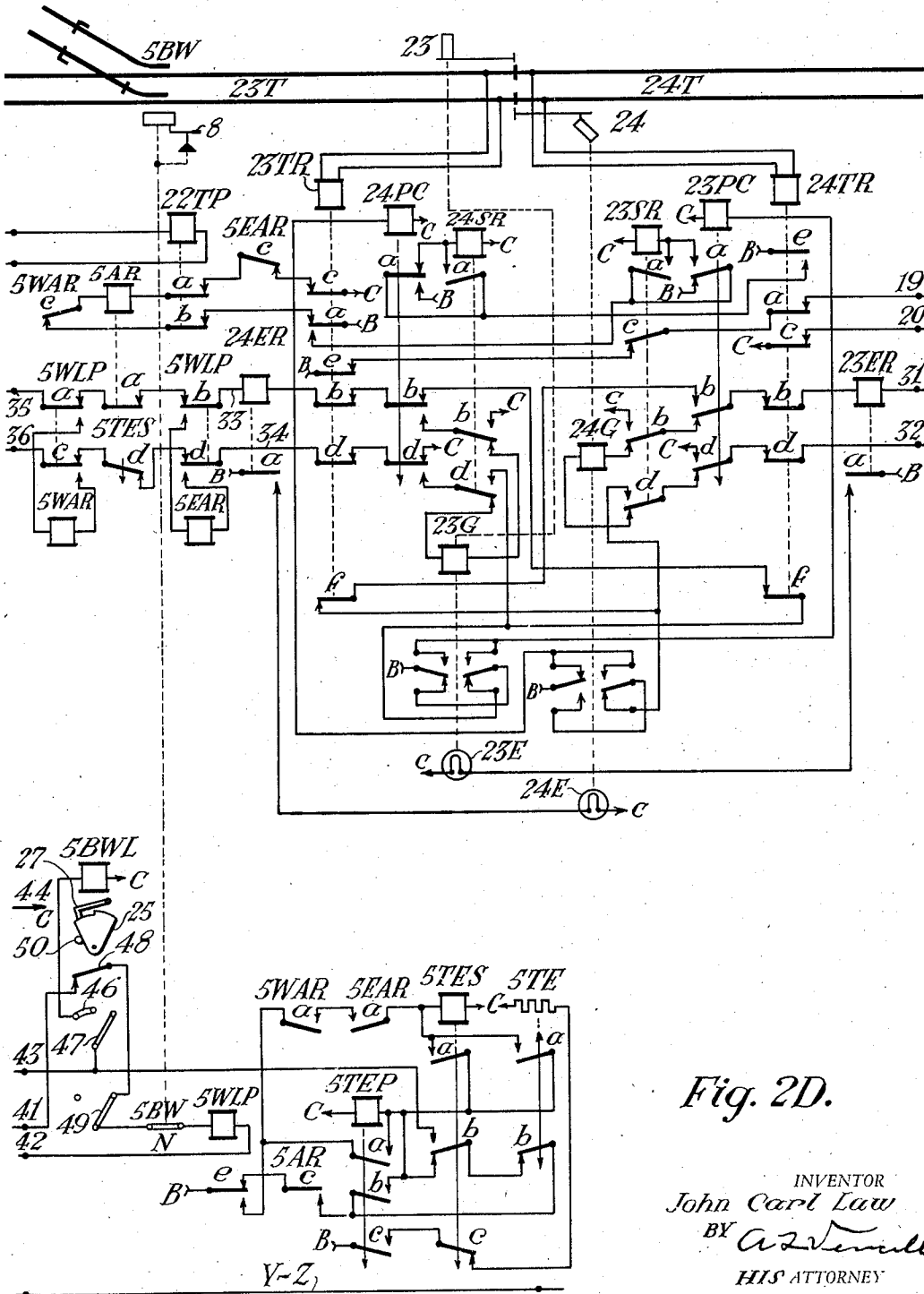


Fig. 2D.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed June 10, 1944

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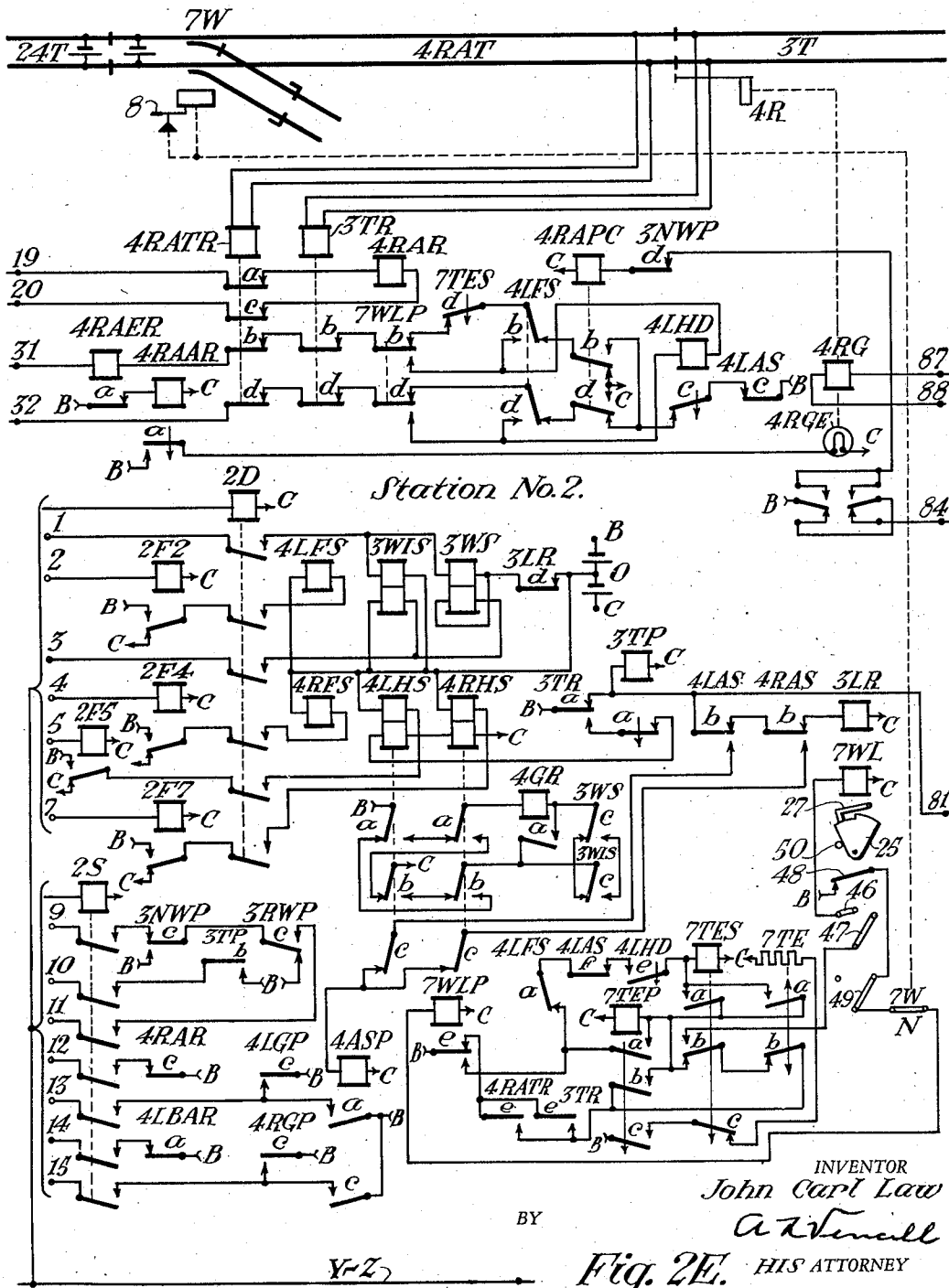


Fig. 2E.

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Fig. 2E

HIS ATTORNEY

UNITED STATES PATENT OFFICE

2,404,303

RAILWAY TRAFFIC CONTROLLING
APPARATUS

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Application June 10, 1944, Serial No. 539,619

15 Claims. (Cl. 246—3)

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My invention relates to railway traffic controlling apparatus, and more particularly to a centralized traffic control system for governing train movements over a single track railway.

My invention contemplates the provision of power operated track switches at various locations to give access to suitably spaced passing sidings, together with an absolute permissive block system having automatic signals at spaced locations in the single track stretches, and with manually controllable head block signals at the power switch locations, for governing traffic movements in both directions. The signals are governed automatically in accordance with traffic conditions over a manually reversible line circuit system employing but two line wires and controlled by the track relays of various track sections, continuous track circuits being provided for all main track, and also for the passing tracks.

The system of my invention is provided with a suitable communication system, preferably of the impulse code type, having a station coding unit at each of a plurality of stations each of which comprises a power switch location. Each such coding unit provides means for manually controlling the track switch and the adjacent head block signals, for both directions, from a central point such as a train dispatcher's office, and for controlling the reversible line circuit system to set up the desired direction for traffic movements in the adjoining blocks. The communication system serves also to indicate the condition of the track switches and headblock signals at the control office, and further, to indicate the presence of a train at any point in the controlled territory by the lighting of suitable lamps on a track diagram at the office, the diagram containing a lamp for each detector section including a power operated track switch, a lamp for each single track stretch, and lamps for the main and passing tracks of the double track portions.

A feature of my invention is the provision of electrically interlocked circuits at the control office for governing the reversible line circuit system. In respect to this feature, my invention is an improvement upon that disclosed in a pending application for Letters Patent of the United States, Serial No. 501,254, filed September 4, 1943, by Henry S. Young, for Railway traffic controlling apparatus.

As herein disclosed, the apparatus at the control office includes a series of directional relays, one for each block, each of which governs the transmission of codes for controlling the direction of traffic to be set up in its block, by control-

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ling the direction of energization of the corresponding portion of the line circuit system. Whereas in the Young system directional control is provided only for the single track blocks, in the system of my invention it is extended to include all main track. The communication system includes the usual code starting push buttons for initiating code transmission, one for each station corresponding to a power switch location, and the control of the traffic direction in each block is governed in a novel manner by the operation of one or the other of the two starting buttons for the stations at the opposite ends of the block, depending upon the direction to be set up.

One object of my invention is the provision of improved circuits for electrically interlocking a remotely controlled power operated track switch and the signals which govern traffic movements over the switch, which includes means for preventing the incorrect routing of a train as the result of the transmission of codes for operating the track switch and for clearing a signal when the switch assumes a new position, which is effective in the event the switch is electrically locked and thereby prevented from responding to the code.

Another object of my invention is the provision of improved arrangements for the control of electric switch locks. The railway systems to which my invention is applicable include numerous switches giving access to the main track which are intended primarily for operation by the crews of trains doing local switching, such as those leading to industrial sidings or the like or to additional passing tracks used but infrequently, for which the provision of power switch machines is unwarranted, but for which locking is required for the protection of main line train movements. In such cases the track switch is preferably operated by a hand throw mechanism having its operating lever locked in its normal position by an electric lock adapted to be released by energizing a magnet. My invention includes improved circuits for controlling such electric locks, including time control means controlled by an approaching main line train for enabling the switch to be unlocked to permit the train to enter the side track, together with means controllable by the central office operator for distinctively controlling the reversible line circuit system for the block containing the hand throw switch, to enable the switch to be unlocked for a movement out of the side track, provided no train is approaching from either direction. In respect to this feature, my

invention is an improvement upon that disclosed in a pending application for Letters Patent of the United States, Serial No. 462,354, filed October 17, 1942, by Harvey A. Haines, for Railway traffic controlling apparatus, now Patent No. 2,367,723, issued January 23, 1945.

Other objects, purposes and features of my invention will be pointed out as the description proceeds.

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

Referring to the accompanying drawings, Figs. 1A and 1B, taken together, illustrate two adjacent panels of a control board located at a central office and arranged for the centralized control of the trackway apparatus of my invention, the later being shown in Figs. 2A to 2F, inclusive. It is to be understood that the control board in its entirety comprises a number of such panels, alternate panels being generally similar to Fig. 1A and the intervening panels to Fig. 1B.

Figs. 1A and 1B, taken together, with Fig. 1A at the left, show the office circuits for the control of a typical single track block, such as is illustrated by the miniature track diagram shown thereon. This block extends from a head block signal 2RA or 2RB, at the left-hand end of the detector track section for the power operated track switch 1W, through the single track stretch to the opposing head block signal 4LA or 4LB, at the right-hand end of the detector track section for a similar switch 3W. The track diagram also shows a number of electrically locked hand throw switches in various typical locations designated 5AW, 5BW, 7W and 9W, respectively.

Figs. 2A to 2F, inclusive, arranged side by side with Fig. 2A at the left, show the track plan and circuits associated with the single track block. Figs. 2A and 2B taken together show the local circuits for switch 1W, located in the detector track section 1T, and for the adjacent head block signals 2RA, 2RB and 2L. This group of traffic governing devices is manually governed from the office by the operation of a coding unit designated "Station No. 1," shown in Fig. 2A.

Fig. 2C shows the local circuits for a typical pair of automatic signals identified by the reference characters 21 and 22 and located within the single track stretch. Fig. 2D shows circuits for similar signals 23 and 24 at a second location within the stretch. Figs. 2E and 2F, taken together, show the circuits for the control of a group of devices corresponding to those of Figs. 2A and 2B, comprising the power operated track switch 3W located in a detector track section 3T, and the associated head block signals 4R, 4LA and 4LB, which group of devices is manually governed from the office by the operation of a coding unit designated "Station No. 2," shown in Fig. 2E.

The circuits for controlling the electric locks for the hand throw switches vary in some respects in accordance with the location of the switch with respect to the signals, and accordingly a number of circuit arrangements are shown to illustrate different situations. These include circuits for two hand throw switches designated 5AW and 5BW, located at different points in an intermediate block section of the single track stretch and arranged to provide an additional passing track for emergency use, and also include a switch 7W located in an end section of the single track stretch and a switch 9W located in the main track of the double track stretch.

The drawings may also be arranged in a different manner to facilitate the tracing of the circuits involved in the control of traffic movements through a double track block containing a passing siding. When Fig. 1A is placed at the right of Fig. 1B, these views together show the track diagram for the block having the signals 4R and 2L at its opposite ends, and also show the office circuits for the control of these signals in connected form.

The track plan and trackway circuits for the signals 4R and 2L controlling movements into the passing tracks may be similarly shown in connected form, together with the circuits for their respective approach sections, by arranging Figs. 2A-2F side by side in the order 2D, 2E, 2F, 2A, 2B, 2C. The main track block extends from signal 4R, at its left-hand end, through sections 3T, 4LAT, 2RAT and 1T to signal 2L. Sections 4LBT and 2RBT are also provided with track circuits which serve to indicate the occupancy of the passing track by the lighting of a lamp on the track diagram of Fig. 1B, and also provide approach lighting control for signals 4LB and 2RB.

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

The code system employed for communication between the office and stations may be of any suitable type, and as a consideration of its detailed mode of operation is not needed for an understanding of my invention, this is illustrated herein only in diagrammatic form. As shown herein it is assumed that this comprises the remote control system of Letters Patent of the United States No. 2,197,130, issued April 16, 1940, to Lloyd V. Lewis, having coding units at the office and at the several field stations connected by line wires Y-Z as indicated diagrammatically on the drawings, over which control codes are transmitted at times from the office to a selected station to position a group of polar stick control relays at that station, while at other times indication codes are transmitted over the same line wires from the different stations, one station at a time, to position a group of indication stick relays associated with an individual control panel for the station transmitting the code.

It is to be understood that each such code includes a distinctive combination of elements for selecting the desired station and the corresponding office panel to temporarily establish a group of seven channels for communication between such station and panel. For simplicity the channels are indicated conventionally on the drawings as individual circuits, the control channels being represented by a group of wires 1-7, and the indication channels by another group of wires 9-15, each adapted to be energized from the positive or supply terminal B of a suitable local source of current at one end and having a connection to the negative or common return terminal c of such source at the other end. Channel 6 is not used in connection with my invention and is not shown.

Each control code is initiated manually, by momentarily operating a starting push button, after placing the control levers of the panel in the desired positions. Fig. 1A shows the control panel for the control of the track switch 1W and the signals at Station No. 1, and when the starting button 1STB shown in this view is operated, a starting relay 1ST becomes energized, initiating a code which operates a selector relay OIS and thereby extends the channels 1-7

from the office to Station No. 1, Fig. 2A, to energize selected register relays 1F2, 1F4, etc., included in certain of the channels. At the end of this control code, a delivery relay 1D is momentarily energized, thereby positioning various stick polar control relays to normal or reverse in accordance with the condition of energization of the channels. It is to be understood that as shown herein the normal position of each polarized relay is taken as the left-hand position and that it closes its normal or left-hand contacts when current from terminal B flows from left to right through its winding to terminal C, and that it closes its right-hand or reverse contacts when the flow of current from terminal B through its winding is from right to left. The stick polar control relays at Station No. 1 include a switch control relay 1WS and an auxiliary relay 1WIS, operable to normal or reverse over channel 1 or 3 in accordance with the position of the switch lever 1SW, Fig. 1A, two signal control relays 2LHS and 2RHS, operated to reverse over channel 5 or 7 when the signal lever 2SG of Fig. 1A is placed in its left-hand or right-hand reverse position, respectively, and to normal when lever 2SG is placed in its normal center position, and two traffic relays 2RFS and 2LFS controlled over channels 2 and 4. Relay 2RFS is controlled by a directional relay 2—4LP of the stick polar type, shown in Fig. 1A, the position of which designates the direction for traffic movements into the block, contact *a* of relay 2—4LP controlling direction indicating lamps WFE and EFE mounted below the track diagram. Relay 2LFS is controlled by the directional relay 4—2LP located in the adjoining panel at the left of Fig. 1A. Fig. 1B shows the control panel for the switch 3W and the signals at Station No. 2. The operation of the starting button 2STB shown in this view energizes a starting relay 2ST and a selector relay O2S, thereby extending channels 1—7 to Station No. 2, to energize the register relays 2F2, 2F4, etc. At the ends of each control code delivered by relay O2S a delivery relay 2D is momentarily energized to operate the polar stick control relays of Fig. 2E to normal or reverse in accordance with the condition of energization of channels 1—7. The switch control relays 3WS and 3WIS are controlled in accordance with the position of the switch lever 3SW, and the signal control relays 4LHS and 4RHS in accordance with the position of the signal lever 4SG. The traffic relay 4RFS is controlled by the directional relay 4—2LP shown in Fig. 1B and relay 4LFS by the similar relay 2—4LP of the adjoining panel at the left.

It is to be understood that each station coding unit is arranged to initiate an indication code in response to each change in position of any of the indicating relays which govern the energization of channels 9—15 and also in response to a received control code, even if no such change occurs. Each code initiated at Station No. 1 causes the energization of a selector relay 1S, Fig. 2A, and at the end of such code a delivery relay O1D, Fig. 1A, is momentarily energized, causing the associated indication relays K to assume energized or released positions in accordance with the condition of energization of channels 9—15.

Relays 1NWK and 1RWK are controlled over channels 9 and 11 by the switch indication relays 1NWP and 1RWP, Fig. 2B, which reflect the position of switch 1W, and serve to light lamp 1NE or 1RE to indicate the position of switch

1W. Relays 2LHK and 2RHK are controlled over channels 13 and 15 by the signal indication relays 2LGP and 2RGP so as to light lamp 2NE when the signals at Station No. 1 are at stop, to light lamp 2LE when signal 2L is cleared, and to light lamp 2RE when signal 2RA or 2RB is cleared. Indication codes initiated at Station No. 2 cause the energization of the selector relay 2S, Fig. 2E and of the delivery relay O2D, Fig. 1B, to effect a similar control, over channels 9, 11, 13 and 15, of the lamps associated with levers 3SW and 4SG in accordance with the condition of switch 3W and of signals 4LA, 4LB and 4R.

The remaining indication stick relays of Figs. 1A and 1B control the lamps of the track diagram in such a manner as to continuously indicate the presence of a train by the lighting of one or more lamps, wherever the train may be in the controlled territory. Relays 1TK and 3TK control the lamps 1TKE and 3TKE, and are controlled over channel 10 by repeating relays 1TP and 3TP of the track relays for the detector track sections 1T and 3T, in the usual manner.

The block indication relay 2LAK, Fig. 1A, and relay 4RAK, in Fig. 1B at the right jointly cause lamp BKE to be lighted to indicate the presence of a train in the single track stretch, and are controlled over channel 12 by approach relays 2LAR and 4RAR, respectively. Relay 2LAR, shown in Fig. 2B, is controlled over a circuit extending from one terminal B of a local source of current at front contact *e* of the track relay 22TR, Fig. 2C, over back contact *c* of a directional stick relay 22SR, which as hereinafter described, is energized when a train moving from left to right occupies section 22T or 23T, and over contact *a* of the track relay 21TR, wire 18, contact *a* of the track relay 2LATR, through the winding of relay 2LAR, and over contact *c* of relay 2LATR, and line wire 17 to terminal C of the same source at contact *c* of relay 21TR.

Relay 4RAR, shown in Fig. 2E, is controlled over a similar circuit including line wires 19 and 20 and the front contacts of the track relays 4RATR, 24TR and 23TR, its circuit also including a back contact of a directional stick relay 23SR which is energized when a train moving from right to left occupies section 23T or 22T.

The block indication relay 2RAK, Fig. 1A, controls a block indicator lamp 2RAE in the track diagram of the adjoining panel at the left, to indicate the occupancy of the main track of the double track stretch. Relay 2RAK is controlled over channel 14 by relay 2RAAR, Fig. 2A, which in turn is controlled by a signal lighting relay 2RAER in series in the reversible line circuit including line wires 39 and 40, hereinafter described. Since this line circuit includes front contacts *b* and *d* of the track relays 2RATR and 4LATR, relay 2RAAR reflects the condition of track sections 2RAT and 4LAT.

The block indication relay 4LAK, Fig. 1B, controls lamp 4LAE to indicate the presence of a train in the upper passing track of the double track stretch. Relay 4LAK is controlled over channel 14 from Station No. 2 by relay 4LBAR, shown in Fig. 2F, which relay is energized over line wires 29 and 30, and front contacts *a* and *b* of the track relays 4LBTR and 2RBTR from terminals B and C of the local source at Station No. 1.

The polar stick relay 2—4LP, in Fig. 1A, serves as a directional relay for controlling the direction of traffic movements in the single track block and controls the traffic relays 2RFS and

4LFS, which govern the reversible line circuit system for the single track stretch, by the operation of its contact *c*, which controls the energization of channel 2 in each control code transmitted to Station No. 1 or No. 2. Relays 2RFK and 4LFK in Fig. 1A are slow release directional stick relays controlled by relay 2-4LP and by the block indication relays 2LAK of the same panel and 4RAK of the next panel at the right. Relay 2RFK or 4LFK picks up over contact *b* of relay 2-4LP in response to the energization of both block indication relays, completing a circuit at its front contact *c* over contact *a* of relay 2-4LP to light lamp WFE or EFE to indicate the traffic direction established by relay 2-4LP. Relay 2-4LP is controlled by the track, signal and block indication relays and signal lever of the same panel and of the next panel to the right. When the single track block is vacant and the head block signals are at stop, as indicated by the indication relays, if the contacts of relay 2-4LP point to the right as shown they may be operated to the left to set up the right-to-left traffic direction by placing lever 4SG of the next panel at the right in its left-hand reverse position, as hereinafter pointed out in detail. The opening of the right-hand contacts *b* and *d* of relay 2-4LP releases relays 2RFK, 2LAK and 4RAK, extinguishing lamp EFE. If the starting button 2STB is now operated, relay 2ST is energized over contact *a* of button 2STB, and a code is transmitted to Station No. 2 to reverse relay 4LFS, which controls signals 4LA and 4LB, and since the right-hand contact *c* of relay 2-4LP is open, this code also operates the traffic relay 4LFS at Station No. 2 to normal to thereby establish the right-hand end of the block as the entrance end. The operation of relay 2-4LP to its left-hand position, followed by the release of relay 2RFK, prepares a circuit from terminal B at the left-hand contact *b* of relay 2-4LP over wire 56, contact *c* of button 2STB, wire 57, back contact *d* of relay 5-7LP and back contacts *f* of relays 2RFK and 4LFK, whereby the starting relay 1ST, at the left, is energized along with relay 2ST, to transmit a second code to Station No. 1 to operate relay 2RFS to reverse over channel 2, which is now energized over the left-hand contact *c* of relay 2-4LP, and thereby establish the left-hand end of the block as the exit end. The block indication relays 2LAK and 4RAK are then reenergized by indication codes which follow these control codes, thereby energizing relay 4LFK to light lamp WFE and to terminate the control of relay 1ST by the starting button 2STB.

Under similar conditions, if the contacts of relay 2-4LP point to the left, they may be operated to the right by placing lever 2SG of the same panel in its right-hand reverse position, thereby releasing relays 4LFK, 2LAK and 4RAK and extinguishing lamp WFE. This prepares a circuit for relay 2ST of the adjoining panel at the right, which extends from terminal B at the right-hand contact *b* of relay 2-4LP over contact *d* of button 1STB and back contacts *g* of relays 4RFK and 2LFK, back contact *e* of relay 5-7LP, and wire 68, rendering button 1STB effective to initiate the transmission of codes to both stations, whereby relay 2RFS is operated to normal to establish Station No. 1 as the entrance end of the block, and relay 4LFS to reverse to establish Station No. 2 as the exit end. These control codes are followed by indication codes which reenergize the block indication relays 2LAK and 4RAK, and thereby energize relay

2RFK to terminate the control of relay 2ST by button 1STB and to light lamp EFE.

Relay 4-2LP, in Fig. 1B, similarly controls the traffic relays 4RFS and 2LFS, which govern the reversible line circuit for the main track block extending from the signal 4R to signal 2L, by the operation of its contact *c*, which governs the energization of channel 4 in each control code transmitted to Station No. 1 or No. 2. Relays 4RFK and 2LFK, in Fig. 1B, are slow release directional stick relays controlled by the indication relay 2RAK of the adjoining panel at the right, which indicates the condition of the main track block, and these relays when released render the starting button for the entrance end of this block, as determined by the position of relay 4-2LP, effective to transmit codes to both ends of the block. Under proper conditions relay 4-2LP is operable to the left to set up the right-to-left traffic direction by placing lever 2SG of the adjoining panel at the right in its left-hand reverse position, or to the right to set up the left-to-right traffic direction by placing lever 4SG of the same panel in its right-hand reverse position.

Fig. 1A also includes an electric switch lock control lever 5-7SW and a repeating relay 5-7LP therefor by means of which the traffic relays 2RFS and 4LFS may be reversed to establish both ends of the single track block as exit ends to render the signal line circuits available for indicating that the block is unoccupied at the location of any hand throw switch in the block. By this means the crew of a train on a side track leading to the main track of the single track block over a hand throw switch may unlock the switch under proper traffic conditions when authorized to do so by the central office operator.

Fig. 1B includes similar arrangements including the electric lock control lever 9SW and the repeating relay 9LP, for controlling the traffic relays 4RFS and 2LFS which govern the reversible line circuit for the block comprising the main track of the double track stretch to provide means for releasing the electric locks of hand throw switches located in that block.

Each block signal shown in Figs. 2A to 2F is of the searchlight type having a three position mechanism G adapted to indicate caution or proceed when energized in a normal or reverse direction, respectively, and to indicate stop when deenergized, such as is shown in Reissued Letters Patent of the United States No. 14,940, of August 31, 1920, granted to E. J. Blake. Each mechanism has a circuit controller having front contacts over which a repeating relay such as relay 2RAPC or 22PC may be energized when the signal indicates caution or proceed to govern the polarity of the current controlling the next signal in the rear, for the same traffic direction, and also has back contacts closed only when the signal indicates stop over which a signal indication relay such as relay 2RGP or 2LGP may be energized or which may be included in the circuit for an opposing signal as illustrated by mechanism 21G or 22G.

Each intermediate signal in the single track block, such as signal 21 or 22, has a directional stick relay 21SR or 22SR which picks up when a train passes the signal at caution or proceed to supply current of the proper polarity to the line circuit for the next signal in the rear to operate such signal to its normal or caution position for the control of a following train.

The reversible line circuit system for the single track block comprises a series of tandem connected line circuits each of which may be energized at either end by connections to the terminals B and C of a local current source. The system provides circuits for energizing either the line relay 2RHD, Fig. 2B, for signals 2RA and 2RB, or the line relay 4LHD, Fig. 2E, for signals 2LA and 4LB, and for energizing the mechanisms for the intermediate signals 22 and 24, or 21 and 23, and in addition provides circuits available at times for the release of electric switch locks. As shown, the system is set up for the left-to-right traffic direction with the traffic relay 2RFS normal and relay 4LFS reversed. Mechanism 24G, Fig. 2D, is energized in the normal direction in series with the approach lighting relays 23ER and 4RAER over line wires 31 and 32, its circuit including back contacts *b* and *d* of relays 23SR and 23PC for the opposing signal 23; front contacts *b* and *d* of the track relays 24TR, 4RATR and 3TR, and of an indication relay 1WLP for switch 1W, back contact *d* of a stick relay 1TES associated with switch 1W, the reverse contacts *b* and *d* of the traffic relay 4LFS, contacts *b* and *d* of the pole changer relay 4RAPC for signal 4R, and contacts *c* of the line relay 4LHD and of an approach locking relay 4LAS for signals 4LA and 4LB.

Mechanism 22G, Fig. 2C, is energized in the reverse direction in series with the approach lighting relays 21ER and 24ER over line wires 35 and 36 extending to the location of switch 5BW and over line wires 33 and 34 extending from that point to the location of signal 24, its circuit including back contacts *b* and *d* of relays 21SR and 21PC for the opposing signal 21, front contacts *b* and *d* of the track relays 22TR and 23TR, and a front contact *a* of a relay 5AR adjacent switch 5BW controlled by these track relays; front contacts *a*, *b*, *c* and *d* of an indication relay 5WLP for switches 5AW and 5BW, and a back contact *d* of a stick relay 5TES associated therewith, front contacts *b* and *d* of relay 24PC for signal 24, a front contact *f* of the track relay 24TR and contacts closed by mechanism 23G when signal 23 indicates stop. The line relay 2RHD, Fig. 2B, is energized reverse in series with the approach lighting relays 2LAER and 22ER over line wires 37 and 38, its circuit including the normal contacts *b* and *d* of the traffic relay 2RFS, front contacts *b* and *d* of the track relays 1TR, 2LATR and 21TR, and of the relay 22PC for signal 22, a front contact *f* of the track relay 22TR and contacts closed by mechanism 21G when signal 21 indicates stop.

It follows that signal 24 indicates caution and signal 22 indicates proceed, but signals 2RA and 2RB are at stop because their local circuits are open.

The reversible line circuit system for the single track stretch may be set up for traffic movements in the opposite direction, that is to say, from right to left, by operating relay 2RFS to its reverse position and relay 4LFS to normal, in which case mechanism 21G will become energized in the normal direction and mechanism 23G and relay 4LFD in the reverse direction by the energization of circuits similar to those just traced, as will be apparent from the drawings.

Traffic movements over the main track of the double track portion are controlled over a reversible line circuit system similarly arranged for energization at either end by the operation of the traffic relays 4RFS and 2LFS. This sys-

tem provides circuits for the line relays 4RHD and 2LHD, which govern the opposing head block signals 4R and 2L for main line movements only; these signals being operable to indicate caution, to govern train movements into the upper passing track, independently of the line relays. As shown, the reversible line circuit system for the main track stretch is set up for the left to right traffic direction with the traffic relay 4RFS normal and relay 2LFS reversed. The line relay 4RHD is energized in the normal direction in series with the approach lighting relays 4LAER and 2RAER over line wires 39 and 40, its circuit including the normal contacts *b* and *d* of relay 4RFS, a back contact *d* of a stick relay 9TES associated with switch 9W, front contacts *b* and *d* of an indication relay 9WLP for switch 9W, and of the track relays 4LATR and 2RATR, the reverse contacts *b* and *d* of relay 2LFS, contacts *b* and *d* of relay 2RAPC controlled by signals 2RA and 2RB, back contact *c* of the opposing line relay 2LHD and front contacts *c* of a repeating relay 1TP for the track relay 1TR of section 1T and of an approach locking relay 2LAS for signal 2L, the contacts of relays 1TP and 2LAS in this circuit being bridged by a front contact *d* of a switch indication relay 1RWP closed when switch 1W is reversed. It will be seen that the control limits for signal 4R as established when switch 3W is normal, extend to signal 2RA if switch 1W is reversed, and through section 1T to signal 2L if switch 1W is normal.

This line circuit system is set up for movements from right to left by operating relay 4RFS to reverse and relay 2LFS to normal in which case relay 2LHD may be energized over similar circuits including the same line wires 39 and 40.

Each signal is lighted by a lamp E contained in its mechanism, which as shown is normally dark, becoming lighted to cause the signal to display its indications when one or more track sections in approach to the signal are occupied.

The lamp 21E for signal 21, Fig. 2C, for example, is lighted by the release of the lighting relay 21ER, which is in series in the reversible line circuit for mechanisms 22G and 23G. The lighting of signals 22, 23 and 24 is controlled by the similarly arranged relays 22ER, 23ER and 24ER, respectively. In the case of the head block signal 2L, Fig. 2B, the circuit for lamp 2LGE is controlled by a slow release repeater relay 2LAAR, of the lighting relay 2LAER, provided in order to prevent a momentary interruption of the lamp circuit during the reversal of the line polarity by relay 2LAPC. The lighting circuits for signal 4R, and also for signals 2RA and 4LA, are similar to that for signal 2L, while those for signals 2RA and 4LB are controlled by the track relays 2RBTR and 4LBTR of the corresponding approach sections in the upper passing track.

Each power operated track switch such as 1W is operated by a suitable switch machine such as 1SM, Fig. 2B, having a control circuit reversibly energized over the polar contacts *a* and *b* of the corresponding code controlled relay 1WS and including front contacts *a* and *b* of a switch locking relay 1LR, Fig. 2A, which relay when energized indicates that conditions are proper for the operation of the track switch. The position of switch 1W is indicated by the normal and reverse switch indication relays 1NWP and 1RWP, which are energized over a switch circuit controller contact N or R, respectively, and over

contact *d* of relay *IWS*, only when the switch is locked mechanically by the switch machine and is in agreement with the normal or reverse position of its control relay *IWS*.

The code controlled relays as shown in Fig. 2A include an auxiliary relay *IWIS*, which is operated to normal or reverse over channels 1 and 3 in parallel with relay *IWS*. The circuits for relay *IWS* include a contact *d* of relay *ILR*, so that although the auxiliary relay *IWIS* is free to respond to the switch control elements of each control code, the switch control relay *IWS* responds only if the switch is free to be operated at the time the code is received, thereby avoiding "switch control storage" and the consequent operation of the track switch without manual supervision, following the energization of relay *ILR*.

The local circuits for the head block signals at Station No. 1 are manually governed by means of a polar neutral signal control relay *2GR* shown in Fig. 2A, in accordance with a feature of my invention. Relay *2GR* is deenergized when relays *2LHS* and *2RHS* are normal, as shown, and is energized normal or reverse in response to the reversal of relay *2LHS* or *2RHS*, respectively, over a pick-up circuit including corresponding normal or reverse contacts *c* of relays *IWIS* and *IWS*, and when relay *2GR* becomes energized, over a stick circuit including its own front contact *a*.

It will be understood that relays *IWIS* and *IWS* assume dissimilar positions in response to a code received when relay *ILR* is released, provided the code includes elements for changing the position of switch *IW*, since under this condition relay *IWIS* will respond but relay *IWS* will remain in its last operated position corresponding to that of switch *IW*. It follows that relay *2GR* will not become energized in response to a code for clearing the signal for a route over switch *IW* which differs from the one already established, if such code is received when relay *ILR* is released and the switch is thereby electrically locked against operation to the position required for the different route, and the inadvertent clearing of the signal for the already established alternative route under this condition is prevented.

The manually controllable relay *2GR* and the line relays *2LHD* and *2RHD* jointly control a route circuit network, shown in Fig. 2B, comprising circuits selected according to the position of switch *IW* by the relays *INWP* and *IRWP* for controlling the route relays *2LH*, *2LD*, *2RAH* and *2RBH* which in turn control the head block signal mechanisms *2LG*, *2RAG* and *2RBG*. The display of stop indications by the signals is manifested by the energization of signal indication relays *2LGP* and *2RGP*, governing the approach locking stick relays *2LAS* and *2RAS*, which together with relay *ILR* serve to electrically interlock the switch and signals in the following manner: Relay *2LAS*, controlled by signal *2L*, is released in response to the energization of the route relay *2LH* for that signal and has a back contact *e* in the circuit for mechanism *2LG* for signal *2L*, a front contact *d* in the circuits for relays *2RAH* and *2RBH* controlling the opposing signals at the same station, a front contact *c*, Fig. 2A, in the circuit including line wires 39 and 40 for controlling the opposing signal *4R* at the opposite end of the block, and a front contact *b*, Fig. 2A, in the circuit for the switch locking relay *ILR*.

Relay *2RAS*, controlled by signals *2RA* and *2RB*, is released in response to the energization

of the route relay *2RAH* or *2RBH*, and has a back contact *e* in the circuits for the mechanisms *2RAG* and *2RBG* for these signals, a front contact *d* in the circuit for relay *2LH* controlling the opposing signal *2L* at the same station, a front contact *c* in the circuit including line wires 37 and 38 for controlling the opposing signals *21*, *23*, *4LA* and *4LB* for the single track block, and a front contact *b*, Fig. 2A, in the circuit for relay *ILR*, while relay *ILR* has front contacts *a* and *b* in the operating circuit for switch *IW*, and a back contact *c* in the circuit for the mechanism for each signal governing traffic movements over switch *IW*.

Relays *2RAS* and *2LAS* are controlled by time measuring apparatus in a well-known manner, so as to delay their energization for a suitable time interval following the manual restoration of a signal to stop. This apparatus as shown in Fig. 2B includes a thermal relay *2ATE*, a stick relay *2ATES* and a checking relay *2ATEP*, controlling a circuit including contact *f* of relay *IRWP* over which relay *2RAS* is energized at the end of a relatively short time interval following the return of signal *2RB* to stop, provided switch *IW* is reversed, and these relays together with the similar relays *2BTE*, *2BTES* and *2BTPEP* provide an appropriately longer time interval at the end of which relay *2RAS* or *2LAS* becomes energized, following the manual return of signal *2RA* or *2L* to stop, when switch *IW* is normal. The time measuring apparatus is set into operation by the energization of a repeating relay *2ASP*, Fig. 2A, controlled by the approach locking relays *2LHS* and *2RHS*, and by the signal control relays *2RHS* and *2LHS*, and has checking contacts in circuits controlling the signals to insure that the time measuring apparatus is in its normal position when a signal is put to stop to initiate its operation, comprising a back contact *b* of the thermal relay such as relay *2ATE* in the circuit for its checking relay *2ATEP*, a front contact *a* of relay *2ATEP* in the circuits for the mechanisms *G*, and a back contact *c* of the associated stick relay such as relay *2ATES* in the circuits for the route relays *RH* and *LH*.

Circuits are also provided for reenergizing the approach locking stick relays automatically, following the restoration of the corresponding signals to stop by a passing train, which depend for their operation upon the release of the track relays for two different track sections. When a train enters section *IT*, for example, the track relay *ITR* releases, deenergizing a slow release repeating relay *ITP*, Fig. 2A. Relay *ITR* interrupts the signal circuit by opening its front contact *a*, Fig. 2A, to restore the cleared signal to stop and thereby energize the signal indication relay *2RGP* or *2LGP*. The closing of back contact *a* of relay *ITR* completes a circuit momentarily over front contact *a* of relay *ITP* to restore the operated signal control relay *2RHS* or *2LHS* to normal, but without energizing relay *2ASP*, the circuit for which is open at front contact *a* of relay *ITR*. When the train enters the next section of its route, a portion of the train being in section *IT*, a circuit is closed over contacts *c* of relay *ITP*, Fig. 2B, and of relay *2RATR* or *2RBTR* to pick up relay *2LAS*, or over contact *d* of relay *ITP* and contact *e* of relay *2LATR* to pick up relay *2RAS*.

The local circuits at Station No. 2 are manually controlled by a polar neutral relay *4GR*, Fig. 2E, like relay *2GR*, and are similar to those at Station No. 1, except that the circuits for the

two directions are interchanged, but in other respects these circuits function in the same manner.

Each hand throw switch shown herein, such as the switch 5AW, Fig. 2C, is to be understood to be equipped with a suitable switch stand such as is shown in Letters Patent of the United States No. 2,184,870, issued December 26, 1939, to Herbert L. Bone et al., having an electric lock such as is shown in Letters Patent of the United States No. 1,126,834, issued February 2, 1915, to Walter P. Neubert et al. Each such switch stand has a hand throw lever 8 for operating the switch, which is normally locked to hold the switch in its normal position by a lever latch attached to a segment 25 held in its locking position by the bail of a padlock 50, as indicated diagrammatically herein and as shown in detail in the Neubert et al. patent. To unlock the switch the padlock must first be removed by the train crew. This permits the segment 25 to be moved a short distance, limited by the locking dog 27, to close contacts 46-47 and to open contact 49 to release an indication relay such as the relay 5WLP, Fig. 2D.

If traffic conditions as reflected by the circuits are such that it is proper to operate the switch, the lock magnet 5AWL will become energized in response to the release of relay 5WLP, opening contact 48 in the circuit for relay 5WLP and lifting the locking dog 27 to permit segment 25 to be moved to its full reverse position in which the switch operating lever 8 is free to be operated, and as explained in the Neubert et al. patent lever 8 holds segment 25 reversed as long as the lever is displaced from its normal position. Each hand throw switch is also provided with the usual switch circuit controller having a point detector contact N which is closed only when the switch is locked normal, which contact is included in the circuit for its indication relay.

Relay 5WLP has front contacts *a* and *c* in the signal line circuit extending to the left over line wires 35 and 36, and front contacts *b* and *d* in the one extending to the right over line wires 33 and 34, as hereinbefore pointed out, by means of which the signals 22 and 23 governing approaching trains are held at stop unless switches 5AW and 5BW are properly locked in the normal position. The similar relay 7WLP, Fig. 2E, has front contacts *b* and *d* in the signal line circuit extending to the left over line wires 31 and 32 controlling signal 24, and contact *c*, Fig. 2F, in the circuit for the route relays for signals 4LA and 4LB, which signals govern movements over switch 7W, and relay 9WLP, Fig. 2F, has similar contacts in the circuits controlling signals 4R and 2L governing movements over switch 9W.

For movements from the main track to a side track over a hand throw switch, a circuit for energizing the lock magnet is prepared automatically by the operation of time measuring apparatus comprising a thermal relay such as 5TE, Fig. 2D, together with a stick relay 5TES and a checking relay 5TEP. This apparatus functions so as to maintain the switch locked during the passage of a high speed train, while enabling the crew of a train standing on the main track at the switch to release the electric lock, provided the train approaches the switch at a greatly reduced speed and occupies the approach section for at least the measured length of time. This apparatus is set into operation by energizing the checking relay such as relay 5TEP over a circuit including a front contact *e* of the associated indication relay 5WLP and back contacts *b* of relays 5TE and 5TES and completed upon the re-

lease of a track relay. For example, relay 5TEP is energized by the closing of back contact *c* of an approach relay 5AR, which relay is released by a repeating relay 22TP of the track relay 22TR or by the track relay 23TR, when a train enters section 22T or 23T. It is to be understood that the time interval measured by the apparatus is made long enough to enforce the proper speed reduction in passing from signal 22 to switch 5BW or from signal 23 to switch 5AW, whichever is the greater distance.

The circuit for energizing the lock magnet 5AWL or 5BWL includes front contact *b* of relay 5TES and is prepared by the operation of the thermal relay through a heating and cooling cycle during which relay 5TES is picked up, and which is terminated when relay 5TE returns to its normal position. A front contact *a* of relay 5AR and a back contact *d* of relay 5TES are included in the signal line circuit to prevent a train movement over the hand throw switches unless the apparatus is in its normal condition when the train enters the approach section.

For movements from a side track to the main track over a hand throw switch, authority to remove the padlock must be obtained from the central office operator. If the block is unoccupied and the authority is granted, he will reverse the switch lock lever 5-TSW or 9SW for the block, and will then press the associated starting button, thereby transmitting control codes by which the traffic stick relays are reversed at both ends of the block. When both traffic relays are reversed, the removal of padlock 50 by the train crew releases the indication relay WLP and thereby places the corresponding lock magnet WL under the control of the signal line relay RHD or LHD when the switch is near the end of the block, as illustrated by the circuits for magnets 7WL and 9WL, or under the control of auxiliary line relays such as relays 5WAR and 5EAR when the switch is at an intermediate point, as illustrated by the circuits for magnets 5AWL and 5BWL, thereby permitting the lock to be released at once under the proper traffic conditions.

Having now described the various elements of the system of my invention, I shall now describe its operation under different conditions.

I shall first assume that the system is in the condition shown in the drawings, set up for the left-to-right traffic direction with the tracks unoccupied and all head block signals at stop.

To clear the entering head block signal 2RA for the single track block, the operator first moves lever 2SG to its right-hand reverse position, completing a circuit from terminal B at the front contact *e* of relay 4RAK, Fig. 1A, over front contact *e* of relay 2LAK, back contacts *d* of relays 4TK and 2RHK, wire 54, back contacts *b* of relays 4LHK and 3TK, wire 52, contact *c* of lever 2SG through the upper winding of relay 2-4LP to terminal C, energizing relay 2-4LP in the reverse direction, as shown. Lamp EFE is lighted over the circuit extending from terminal B at contact *c* of relay 2RHK and the reverse contact *a* of relay 2-4LP through lamp EFE to terminal C.

The operator then presses button 1STB, which with the left-to-right traffic direction already set up, as shown, energizes relay 1ST only, transmitting a control code to Station No. 1 by which relays 01S and 1D are energized, so that the code controlled relays 2RFS and 2LHS, Fig. 2A, are energized normal, their respective channels 2 and 75 5 being open, and relay 2RHS is operated to re-

verse due to energy being supplied from terminal B to channel 7 over contact *d* of relay OIS and the right-hand contact *a* of lever 2SG. Relay IWIS will be operated to normal over channel 1, and also relay IWS, provided switch IW is not locked. Relay 2LFS is energized in the reverse direction due to the supply of energy from terminal B at the reverse contact *c* of relay 4—2LP of the adjoining panel at the left, over wire 53 and contact *c* of relay OIS to channel 4. In response to the reversal of relay 2RHS by this code, relay 2GR, Fig. 2A, becomes energized in the reverse direction over the circuit extending from terminal B at the normal contact *a* of relay 2LHS over the reverse contact *b* of relay 2RHS, normal contacts *c* of relays IWIS and IWS through relay 2GR and over the reverse contact *a* of relay 2RHS and the normal contact *b* of relay 2LHS to terminal C. Relay 2GR completes its stick circuit, and also closes its right-hand polar contact *c* which completes a circuit for the route relay 2RAH, extending from terminal B at front contact *a* of relay ITR, Fig. 2A, over wire 71, contacts *c* of relays 2ATES and 2BTES, contacts *b* and *c* of relay 2GR, contact *d* of relay 2LAS, contact *a* of relay 2RHD, back contact *a* of relay IRWP and front contact *a* of relay INWP, back contact *d* of relay 2RBH through relay 2RAH to terminal C.

Relay 2RAH picks up, and by opening its contact *c* releases the approach locking relay 2RAS, which in turn by opening its contact *b*, Fig. 2A, releases the switch locking relay ILR, thereby locking relay IWS and the switch machine ISM in the normal position and completing the circuit for mechanism 2RAG extending from terminal B over contacts *a* of relays 2ATEP and 2BTEP, contact *c* of relay ILR, contact *e* of relay 2RAS, reverse contact *b* of relay 2RHD, front contact *a* of relay 2RAH, wire 72, mechanism 2RAG, wire 73, front contact *b* of relay 2RAH to terminal C over the reverse contact *d* of relay 2RHD, thereby energizing mechanism 2RAG in the reverse direction.

When mechanism 2RAG becomes energized, its circuit controller contacts shift to energize the pole changer relay 2RAPC, and to disconnect terminal B from wire 74 to release the signal indication relay 2RGP. Relay 2RAPC reverses the polarity of the current supplied to the line wires 39 and 40, thereby reversing relay 4RHD, if energized, and conditioning the next signal 4R in the rear of signal 2RA to indicate proceed, provided switch 3W is normal. Relay 2RGP, by releasing, initiates an indication code, in which channel 15 is energized over its back contact *c* to pick up relay 2RHK, Fig. 1A, and relay 2RHK, by closing its front contact *c*, lights lamp 2RE to indicate that signal 2RA has been cleared, and by opening its back contact *d* locks relay 2—4LP reversed.

When the train approaching signal 2RA from the left enters the approach section 4LAT, Fig. 2F, relay 4LATR releases to open the line circuit including wires 39 and 40, releasing relays 4RHD, 4LAER and relay 2RAER and also the repeating relays 4LAAR and 2RAAR, thereby lighting lamp 2RAE to cause signal 2RA to display its proceed indication, also lighting lamp 4LAE to cause the opposing signal 4LA to display a stop indication.

I shall next assume that the apparatus has been restored to the condition shown in the drawings and that the operator wishes to clear signal 2RB in place of signal 2RA.

To clear signal 2RB, the operator reverses lever ISW, moves lever 2SG to the right and then presses button ISTB to transmit a control code to Station No. 1. The operation of lever 2SG energizes relay 2—4LP in the reverse direction as in the preceding example, but in the code now transmitted, channel 1 is open, and channel 3 closed over the reverse contact *a* of lever ISW, reversing relays IWIS and IWS. The closing of the reverse contacts *a* and *b* of relay IWS, Fig. 2B, initiates the operation of switch IW to reverse and the reversal of contact *d* of relay IWS releases relay INWP and prepares a circuit for relay IRWP, which relay becomes energized when switch IW is fully reversed. Channels 2 and 5 are open, and channels 4 and 7 closed, as in the preceding example. Relay 2RHS reverses, and relay 2GR becomes energized in the reverse direction over the reverse contacts *c* of relays IWIS and IWS, but relay 2RAH remains released because its circuit is open at the front contact *a* of relay INWP.

Relay 2RBH becomes energized when relay IRWP picks up over a branch of the circuit for relay 2RAH already traced, extending from back contact *a* of relay INWP over front contact *a* of relay IRWP, back contact *d* of relay 2RAH and back contact *a* of relay 2RAPC through relay 2RBH to terminal C.

Relay 2RBH picks up, opening its contact *c* to release relay 2RAS, which releases relay ILR to lock relay IWS and switch machine ISM in the reverse position and to complete a circuit over wires 75 and 76 at the front contacts *a* and *b* of relay 2RBH to energize mechanism 2RBG in the normal or reverse direction corresponding to the position of relay 2RHD, disconnecting terminal B from wire 74 to release relay 2RGP to initiate an indication code as in the case of signal 2RA above described. Signal 2RB becomes lighted upon the closing of back contact *d* of relay 2RBTR when an approaching train enters section 2RBT.

I shall next assume that the operator desires to clear the leaving signal 4R at the right-hand end of the block, to permit the train to pass through the double track stretch at the right. For a movement over the main track, the operator will move lever 4SG to the right, with lever 3SW normal, and press the starting button 2STB. Lever 4SG in its right-hand position completes a circuit from terminal B at the front contact *c* of relay 2RAK, Fig. 1B, over back contacts *d* of relays 3TK and 4RHK, wire 61, back contacts *b* of relays 2LHK and 1TK, wire 62, contacts *b* of levers 3SW and 4SG through the upper winding of relay 4—2LP to terminal C, energizing relay 4—2LP reverse, as shown.

With the left-to-right traffic direction already set up, as shown, the operation of button 2STB energizes relay 2ST only, transmitting a control code to Station No. 2 in which channel 1 is energized over contacts *a* of lever 3SW and relay O2S, channel 2 is energized over contact *b* of relay O2S, wire 63 and the reverse contact *c* of relay 2—4LP, channels 3, 4 and 5 are open and channel 7 energized over contact *a* of lever 4SG and contact *d* of relay O2S, so that relays 3WIS, 3WS, 4RFS and 4LHS are operated to normal and relays 4LFS and 4RHS to reverse. Relay 4RHS energizes relay 4GR reverse, and relay 4GR completes a circuit for the route relay 4RH, Fig. 2F, extending from terminal B at contact *a* of relay 3TR, Fig. 2E, over wire 81, contacts *c* of relays 4ATES and 4BTES, contacts *b* and *c* of relay 4GR, contact *d* of relay 4LAS, front contact *e* of relay 3NWP, contact *c* of relay 9WLP, contact *a* of relay 4RHD,

back contact *e* of relay 3RWP through relay 4RH to terminal C. Relay 4RH becomes energized and opens its back contact *c* to release relay 4RAS which in turn releases relay 3LR to lock relay 3WS and the switch machine 3SM normal. Relay 4RD also becomes energized, over the reverse contact *b* of relay 4RHD, provided the next signal in advance is energized, this signal corresponding to signal 2RA as hereinbefore pointed out. When relay 3LR releases, the closing of its contact *c* completes a circuit for mechanism 4RG from terminal B over contacts *a* of relays 4ATEP and 4BTEP, contact *c* of relay 3LR, contact *e* of relay 4RAS, extending through mechanism 4RG to terminal C over contacts *a* and *b* of relays 4RD and 4RH and wires 87 and 88.

The mechanism 4RG becomes energized normal or reverse to correspond with the position of relay 4RHD, energizing relay 4RAPC over contact *d* of relay 3NWP, and disconnecting terminal B from wire 84 to release the indication relay 4RGP. Relay 4RAPC reverses the polarity of the current supplied over line wires 31 and 32 to mechanism 24G, which accordingly reverses to condition the next signal 24, in the rear of signal 4R, to indicate proceed. Relay 4RGP upon releasing initiates an indication code energizing channel 15 at its contact *c* to pick up relay 4RHK, Fig. 1B, thereby lighting lamp 4RE. The opening of back contact *d* of relay 4RHK now locks relay 4—2LP reversed.

When the train approaching from the left enters the single track block, the release of relay 1TR opens the circuit including line wires 37 and 38, releasing the series lighting relay 22ER to light lamp 22E, thereby causing signal 22 to display its proceed indication. Similarly, signal 24 becomes lighted to indicate proceed when the train enters section 22T to open the circuit including line wires 35 and 36, and signal 4R becomes lighted to indicate caution or proceed, when the train enters section 24T to open the circuit including line wires 31 and 32 and thereby release relays 4RAER and 4RAAR.

To clear signal 4R for a movement into the side track, the operator reverses lever 3SW, moves lever 4SG to the right and then presses button 2STB to transmit a code in which only channels 2, 3 and 7 are energized reversing relays 4LFS, 3WIS, 3WS and 4RHS. Relay 4GR becomes energized reverse, but relay 3NWP is released by relay 3WS to prevent the energization of relays 4RH and 4RD over the route circuit previously traced; relay 4RH being picked up by relay 3RWP when switch 3W is fully reversed over the branch circuit including back contact *e* of relay 3NWP and front contact *e* of relay 3RWP which circuit is independent of the position of relay 4RHD. Relay 4RD remains released, and the operation of relay 4RH releases relays 4RAS and 3LR to lock relay 3WS and switch machine 3SM reversed and to complete a circuit over wires 88 and 87 to energize mechanism 4RG in the normal direction to indicate caution. Relay 4RAPC remains released because contact *d* of relay 3NWP in its circuit is open, consequently the next signal 24 in the rear is also conditioned to indicate caution.

It is deemed unnecessary to trace the movement of the train step by step through the successive block sections, in view of the description of the various elements of the system already presented. It is to be noted, however, that the passage of the train through the single track block is indicated by the lighting of the track diagram

lights 1TKE, BKE and 3TKE, relay 2—4LP being held deenergized in its reverse position by the release of the indication relays which control these lamps. Similarly, the movement of the train through the main track of the double track portion is indicated by the lighting of lamps 3TKE, 2RAE and 1TKE controlled by the indication relays which hold relay 4—2LP reversed, while if the train enters the side track lamp 4LAE is lighted in place of lamp 2RAE.

I shall now describe the operation of the system under conditions involving the reversal of the traffic direction, assuming as before that the apparatus is set up for the left-to-right direction with the block unoccupied and all head block signals at stop.

To clear the entering head block signal 4LA for the single track block under this condition, the operator moves lever 4SG to the left, with lever 3SW normal, and then presses the starting button 2STB. The closing of contact *c* of lever 4SG completes a circuit from terminal B at front contact *e* of relay 4RAK, Fig. 1A, over front contact *e* of relay 2LAK and back contacts *d* of relays 1TK and 2RHK, wire 51, contacts *b* of relays 4LHK and 3TK, the left-hand reverse contact *c* of lever 4SG, wire 54 through the lower winding of relay 2—4LP to terminal C. Relay 2—4LP closes its left-hand contacts, disconnecting terminal B at its contact *d* from wire 55 to release relays 2LAK and 4RAK, and opening the stick circuit for relay 2RFR at its right-hand contact *b*, causing relay 2RFR to release after a short time to prepare new stick circuits over its back contact *d* for holding relays 2LAK and 4RAK energized when these relays are next picked up over channel 12. Relay 2—4LP is now free to be operated back and forth at the will of the operator, by closing contacts *c* of levers 2SG and 4SG alternately, due to the connection of wires 52 and 51 to terminal B over back contacts *e* of relays 2LAK, 4LFR and 2RFR. The operator is therefore now able to restore the original direction of traffic, or in the case of a fault, to make repeated attempts to reverse the traffic direction, if he so desires. Assuming that the left-hand contacts of relay 2—4LP remain closed, relay 2ST becomes energized in response to the operation of button 2STB to transmit a control code to Station No. 2 in which only channels 1 and 5 are energized to operate relays 3WIS, 3WS, 4LFS and 4RHS to normal, and to reverse relay 4LHS. At the same time, relay 1ST becomes energized in response to this operation of button 2STB over a circuit extending from terminal B at the left-hand contact *b* of relay 2—4LP, wire 56, contact *c* of button 2STB, wire 57, contact *d* of relay 5—1WP, contacts *f* of relays 2RFR and 4LFR through relay 1ST to terminal C, to transmit a second code to Station No. 1, in which channel 2 is energized over the left-hand contact *c* of relay 2—4LP, to reverse relay 2RFS.

At Station No. 2 the restoration of relay 4LFS to normal disconnects terminals B and C from the right-hand end of the reversible line circuit system and connects relay 4LHD to the line wires 31 and 32, releasing mechanism 24G and relay 24PC. Relay 24PC shifts the connections of line wires 35 and 36 from terminals B and C of the adjacent source to the winding of mechanism 23G, releasing mechanism 22G and relay 22PC. Relay 22PC shifts the connections of line wires 37 and 38 from terminals B and C of the source at its location to the winding of mechanism 21G, and the operation of relay 2RFS to normal shifts

the connections of wires 37 and 38 from relay 2RHD to terminals B and C of the source at Station No. 1, thereby energizing the line circuit system at its left-hand end to condition signal 21 to indicate caution and signal 23 to indicate proceed, and to energize relay 4LHD in the reverse direction.

The approach relays 2LAR and 4RAR remain energized, being controlled over separate line circuits, and since the coding system is arranged to transmit indication codes following the two control codes, as already mentioned, relays 2LAK and 4RAK are reenergized over channel 12 by indication codes transmitted from Stations No. 1 and No. 2, respectively, completing a circuit over their front contacts b to pick up relay 4LFK to prevent the response of relay 1ST to subsequent operations of button 2STB, and to light lamp WFE.

Relay 4GR becomes energized in the normal direction in response to the reversal of relay 4LHS, and completes local circuits for clearing signal 4LA similar to those for signal 2RA already traced, as will be apparent from the drawings. To clear signal 4LB when the left-to-right direction is set up, the block unoccupied and the head block signals at stop, the operator reverses lever 3SW, moves lever 4SG to the left and presses button 2STB, resulting in a reversal of traffic direction as described in connection with signal 4LA, and in the operation of switch 3W to reverse and the energization of mechanism 4LBG in the normal direction to condition signal 4LB to indicate caution, over circuits similar to those already described in connection with the corresponding signal 2RB, consequently a step by step description of these operations is deemed unnecessary.

Considering now the apparatus for the double track stretch under conditions involving reversal of the traffic direction, it will be assumed that signal 2L is to be cleared with switch 1W normal, for a train approaching from the right and that signal 4R has been cleared with switch 3W reversed for a train approaching from the left which is to enter the siding to permit the opposing train to pass on the main track.

To clear signal 2L, assuming sections 1T, 2RAT and 4LAT to be unoccupied with the left-to-right traffic direction set up as shown, the operator moves lever 2SG to the left with lever 1SW normal and presses button 1STB. Since switch 3W stands reversed, its reverse indication relay 3RWK is now energized, and the closing of contact b of lever 2SG completes a circuit from terminal B at front contact e of relay 2RAK, Fig. 1B, over front contact d of relay 3RWK, wire 61, back contacts b of relays 2LHK and 1TK, contacts b of levers 1SW and 2SG, wire 64 through the lower winding of relay 4—2LP to terminal C. Relay 4—2LP closes its left-hand contacts, disconnecting terminal B at its contact d from wire 65 to release relay 2RAK. The opening of the right-hand contact b of relay 4—2LP deenergizes relay 4RHK, which relay releases after a brief period. Relay 4—2LP is now free to be operated back and forth at the will of the operator like relay 2—4LP under similar conditions, but assuming that the left-hand contacts of relay 4—2LP remain closed, relay 1ST becomes energized in response to the operation of button 1STB to transmit a control code to Station No. 1 at the right-hand end of the block in which channels 1 and 5 are energized over the left-hand contacts a of levers 1SW and 2SG, respectively, and

channel 2 as well, assuming the left-hand contacts of relay 2—4LP to be closed, so that relays 1WIS, 1WS, 2LFS and 2RHS are energized normal and relays 2RFS and 2LHS are energized reverse. At the same time, relay 2ST of the adjoining panel at the left is energized over the circuit from terminal B at the left-hand contact b of relay 4—2LP, wire 66, contacts c of lever 1SW and of button 1STB, wire 67, contact d of relay 9LP, contacts f of relays 2LFK and 4RFK through relay 2ST to terminal C, to transmit a second code to Station No. 2 at the left-hand end of the block in which channel 4 is energized over the left-hand contact c of relay 4—2LP to reverse relay 4RFS.

At Station No. 1, the restoration of relay 2LFS to normal disconnects terminals B and C from the right-hand end of the line circuit including the line wires 39 and 40 and connects relay 2LHD thereto, releasing relays 4RHD and the lighting relays in series therewith. The operation of relay 4RFS to reverse shifts the connections of wires 39 and 40 from relay 4RHD to terminal C at back contact b of relay 4LAPC, and to terminal B at contact d of relay 3RWP so that relay 2LHD becomes energized in the normal direction and the lighting relays in its circuit become energized, relay 2RAER energizing relay 2RAAR to initiate an indication code at Station No. 1 in which channel 14 is energized to pick up relay 2RAK. Relay 2LFK, Fig. 1B, becomes energized over contact b of relay 2RAK to prevent the response of relay 2ST to subsequent operation of button 1STB.

Relay 2GR becomes energized in the normal direction in response to the reversal of relay 2LHS and completes local circuits for conditioning signal 2L to indicate caution, similar to those already described in connection with the corresponding signal 4R.

Assuming next that the train moving from right to left is to take the siding and that the one moving from left to right is to pass on the main track, and that the line relay 4RHD controlling signal 4R is energized over the circuit extending to terminal B over contacts c of relays 1TP and 2LAS, in Fig. 2A. If the operator now reverses lever 1SW and moves lever 2SG to the left, the circuit traced above including wires 61 and 64 and contact b of lever 2SG for operating relay 4—2LP to its left-hand position is open at contact b of lever 1SW, and if signal 4R has been cleared, also at contact d of relay 4RHK. Relay 4—2LP remains reversed and relay 4RFK remains energized and the circuit including wires 66 and 67 by which button 1STB controls relay 2ST is held open at contact b of relay 4—2LP, at contact c of lever 1SW, and at contact f of relay 4RFK. Under the conditions described, therefore, the operation of button 1STB results in the transmission of a code to Station No. 1 only, this being sufficient to effect the clearing of signal 2L for a movement into the side track by the operation of circuits similar to those already traced in detail for the opposing signal 4R.

Returning now to a consideration of the single track block, and assuming the apparatus to be set up for the right-to-left direction with the track unoccupied and all head block signals at stop when the operator moves lever 2SG to the right and presses the starting button 1STB to transmit a code to Station No. 1, for clearing signal 2RA or 2RB, as hereinbefore described. Under these conditions the closing of the right-hand contact c of lever 2SG completes a circuit

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over wires 51 and 52 to operate relay 2-4LP to reverse, releasing relay 4LRFK so that when button 1STB is operated, a circuit will be closed from terminal B at the right-hand contact b of relay 2-4LP over contact d of button 1STB, contacts 5 g of relay 2RPFK and 4LRFK, contact e of relay 5-7LP, wire 68 through relay 2ST to terminal C, resulting in the energization of relay 2ST to transmit a control code to Station No. 2 at the right-hand end of the block in which channel 2 is energized from terminal B at the right-hand contact c of relay 2-4LP over wire 63 and contact b of relay 02S to reverse relay 4LFS. Relay 1ST is also operated to transmit a control code to Station No. 1 at the left-hand end of the block as in the first example given, restoring relay 2RFS to normal, these relays cooperating to set up the reversible line circuit system for the left-to-right direction as already described, for the opposite direction, to complete the local circuits for clearing signal 2RA or 2RB.

The line circuit for the main track block of the double track stretch may be similarly restored to the left-to-right direction by operating lever 4SG to the right with lever 3SW in its normal position to complete a circuit over wires 61 and 62 and contacts b of these levers to operate relay 4-2LP to the right, releasing relay 2LRFK, and rendering button 2STB effective to energize relay 1ST of the adjoining panel at the right over the circuit including wire 58.

It will be understood that the resulting indication codes cause relay 2RPFK or 4RPFK to become energized, interrupting the connection over wire 68 or 58, and that the starting button for the entrance end of the block is only temporarily effective to initiate the transmission of codes to both ends.

I shall now describe the operation of the system under conditions involving the operation of the hand throw switches, assuming that the apparatus is set up for the left-to-right direction of traffic movement as shown.

Assuming first that a train is approaching signal 22 at clear and is to enter the side track over switch 5AW or 5BW. When the approaching train enters section 22, the release of the track relay 22TR completes a circuit momentarily from terminal B at its back contact e over front contact a of relay 22PC through relay 22SR to terminal C so that relay 22SR picks up, establishing a stick circuit at its own front contact a. The opening of front contacts a and c of relay 22TR causes the repeating relay 22TP, Fig. 2D, to release and to open its contacts a and b to release relay 5AR at the location of switch 5BW, thereby completing a circuit from terminal B at front contact e of relay 5WLP over back contact c of relay 5AR and back contacts b of relays 5TE and 5TES through relay 5TEP to terminal C. Relay 5TEP becomes energized to complete a stick circuit at its own front contact b and to close its contact c to energize the thermal relay 5TE. At the end of a predetermined heating period, relay 5TE closes its front contact a to energize relay 5TES, which picks up and completes a stick circuit at its own front contact a comprising a branch of the circuit for relay 5TEP. Relay 5TE is deenergized by the opening of back contact c of relay 5TES and returns to its normal position, closing its contact b at the end of a predetermined cooling period.

The switch indication relay 5WLP is normally energized over a circuit including the line wires 41 and 42 from terminals B and C of the source

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at the location of switch 5AW, and is released when the train crew removes padlock 50 of either switch 5AW or 5BW by the opening of the corresponding contact 49, and the release of relay 5WLP completes new stick circuits for relays 5TEP and 5TES over front contact a of relay 5TEP extending to terminal B at back contact e of relay 5WLP.

The time measuring operation therefore continues if not already completed, the closing of contact b of relay 5TE at the end of its cooling period completing a circuit for the selected lock magnet 5AWL or 5BWL over front contact b of relay 5TES and contacts 46-47, the circuit also including in the case of magnet 5AWL, the line wires 43 and 44.

Segment 25 may now be operated to full reverse to unlock the operating lever 8 to permit the switch to be operated to reverse to enable the train to leave the main line. As long as relay 5WLP remains released, signal 22 is held at stop with its directional stick relay 22SR energized over back contact a of relay 22PC to supply current of the proper polarity to line wires 37 and 38 to energize relay 2RHD in the normal direction, consequently signal 2RA or 2RB may be conditioned to indicate caution to admit a following train to the block section at the left of signal 22. When the first train clears the main line, switch 5AW or 5BW is restored to normal and locked by replacing padlock 50. This releases the lock magnet to close contact 48, and thereby reenergizes the indication relay 5WLP to clear signal 22 for the following train.

The time measuring apparatus associated with switches 1W and 9W functions similarly, that for switch 1W being set into operation when a train enters section 4RAT or 3T and that for switch 9W when a train enters section 4LAT.

For a movement from a side track to the main track over a hand throw switch, the train crew must request the operator by telephone or otherwise to authorize the movement. If traffic conditions are favorable and the operator consents to a movement from a side track over a hand throw switch into the single track block, he will reverse lever 5-7SW and press button 1STB, Fig. 1A, thereby energizing relay 5-7LP and completing a circuit from terminal B at contact b of button 1STB over front contact e of relay 5-7LP and wire 68 to pick up relay 2ST along with relay 1ST, resulting in the transmission of a control code to Station No. 1 at the left-hand end of the block in which channel 2 is energized over the circuit extending from terminal B over contacts b of lever 5-7SW, and relay 5-7LP, contact e of lever 2SG and contact b of relay 01S, to reverse the traffic relay 2RFS, and in the transmission of a second code to Station No. 2 at the right-hand end of the block in which channel 2 is energized over contact c of relay 5-7LP, wire 59, contact e of lever 4SG and contact b of relay 02S, to reverse relay 4LFS. Contact c of the directional relay 2-4LP provides a second connection to channel 2 at one panel or the other over which the traffic relay at the exit end of the block, as indicated by the position of relay 2-4LP, has already been reversed. The circuits established by the switch lock lever therefore are effective to reverse the traffic relay at that end of the block at which it is not already reversed, for either direction of traffic. Under this condition signals 21 and 24 are conditioned to indicate caution, and signals 22 and 23 are at stop.

Assuming first that the train is on the side track at switch 5BW, the release of the indication relay 5WLP by the train crew connects relay 5WAR to line wires 35 and 36 extending to the left and relay 5EAR to line wires 33 and 34 extending to the right, and if the entire block is unoccupied, and the entering head block signals are at stop with their approach locking relays 2RAS and 4LAS energized, relays 5WAR and 5EAR pick up to complete a pick-up circuit for relay 5TES over their front contacts *a*, extending to terminal B at back contact *e* of relay 5WLP.

Relay 5STEP picks up over contact *a* of relay 5TES, completing stick circuits at its own contact *a* for holding relays 5STEP and 5TES energized. Since relay 5TES picks up first, relay 5TE is not energized and the circuit for the lock magnet 5BWL, which in this instance extends from terminal B at back contact *e* of relay 5WLP over front contacts *a* and *b* of relay 5STEP, back contact *b* of relay 5TE, front contact *b* of relay 5TES and contacts 46—47, is completed when relay 5STEP picks up so that the lock may be released at once.

The lock for switch 5BW or 5AW may also be released following the passage of a through train through section 23T into section 24T, in which case relay 24SR picks up when the through train passes signal 24 to supply current to line wires 33 and 34, thereby energizing relay 5EAR as soon as the train vacates section 23T, relay 5WAR being energized as in the preceding example.

When the train movement from the side track to the main line via switch 5BW is completed and the operator has been advised by the train crew that the switch is again locked normal so as to reenergize relay 5WLP, he restores lever 5—7SW to normal and presses button 1STB. Relay 5—7LP is held energized over a stick circuit including its contact *a* and extending to terminal B at back contact *F* of relay 1ST and also over wire 60 to terminal B at back contact *e* of relay 2ST, maintaining the circuit for relay 2ST including wire 68 and front contact *e* of relay 5—7LP, available only until relays 1ST and 2ST are both energized in response to the operation of button 1STB, whereupon relay 5—7LP is released. This operation is effective therefore to transmit codes to both stations but since relay 5—7LP releases before they are transmitted, channel 2 is energized in the code transmitted to the exit end of the block only, according to the position of relay 2—4LP, and thereby restores the line circuits to their normal condition.

When the train which entered the block via switch 5BW reversed passes signal 24 at clear or caution, relay 24SR picks up to supply current to the line circuit in the rear to condition signal 22 to indicate caution and to permit the entering head block signal to be manually cleared, as will be readily apparent.

It will also be clear that when the right-to-left direction is set up, train movements similar to those just described may be made in that direction.

Assuming now that the train is on the side track at switch 7W, Fig. 2E, and that the operator reverses both traffic relays 2RFS and 4LFS as above described. When relay 7WLP is released by the train crew, the dropping of its contacts *b* and *d* disconnects terminals B and C from line wires 31 and 32 and connects relay 4LHD thereto, restoring signals 24 and 22 to stop, and since the operator has reversed relay 2RFS, sig-

nal 21 will indicate caution and signal 23 will indicate proceed, and relay 4LHD will then become energized, provided the entire block is unoccupied, but signals 4LA and 4LB are held at stop, because the circuit for their route relays 4LAH and 4LBH is open at contact *c* of relay 7WLP. Relay 7TES becomes energized over the circuit from terminal B at back contact *e* of relay 7WLP, the reverse contact *a* of relay 4LFS, front contact *f* of relay 4LAS and front contact *e* of relay 4LHD to complete the circuit for lock magnet 7WL including front contact *b* of relay 7TES. Contact *f* of relay 4LAS provides approach locking protection for switch 7WL corresponding to that provided by contact *b* of relay 4LAS, for switch 3W.

When the right-to-left direction is set up, switch 7W may be unlocked in the rear of a train which has passed signal 23 to energize relay 23SR or 23PC, as will be readily seen.

For a movement into the main track of the double track block over a hand throw switch such as 9W, the operator reverses lever 9SW to energize relay 9LP, and presses the starting button 2STB, completing a circuit over contact *b* of button 2STB, contact *e* of relay 9LP and wire 58 to pick up relay 1ST of the adjoining panel at the right, along with relay 2ST, to transmit codes to both ends of the main track block to energize relays 4RFS and 2LFS reverse, and when lever 9SW is subsequently restored to normal, relay 9LP is held energized over a stick circuit including wire 70 until a second code is transmitted to set up the traffic direction corresponding to the position of relay 4—2LP, these operations being similar to those already described.

When relay 9WLP is released by the train crew, the dropping of its contacts *b* and *d* causes relay 4RHD to become energized, provided the portion of the main track block to the right of section 3T is unoccupied, signal 4R being held at stop, if switch 3W is normal, by the opening of contact *c* of relay 9WLP in the circuit for its route relay 4RH. If section 3T at the left-hand end of the block is also unoccupied, or switch 3W reversed, the energization of relay 4RHD completes a circuit for relay 9TES extending from terminal B at back contact *e* of relay 9WLP over the reverse contact *a* of relay 4RFS and over contacts *f* of relays 4RAS and relay 3TR or over contact *g* of relay 3RWP, and contact *d* of relay 4RHD, and relay 9TES then picks up to prepare the circuit for magnet 9WL. Contact *f* of relay 4RAS provides approach locking protection following the return of signal 4R manually to stop after having been cleared, with switch 3W normal.

It will be seen that in each different arrangement shown, the lock magnet circuit is completed only when the traffic relays are reversed at both ends of the block.

Although I have herein shown and described only one form of railway traffic controlling 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. Railway traffic controlling apparatus comprising, a signal at each end of a stretch of railway track for governing traffic movements into the stretch, a signal control relay and a traffic relay at each signal location, a system of reversible signal circuits controlled jointly by said traffic relays in selected positions and by traffic

conditions in the stretch for rendering one signal or the other responsive to the operation of its control relay, a code system for communicating between said signal locations and a control office having a starting relay and a signal lever for each signal location, a starting button for each starting relay, a directional relay controllable by said levers when the stretch is unoccupied to designate one end of the stretch or the other as the entrance end, a circuit for energizing each starting relay including a contact of the associated starting button, means controlled by each starting relay when energized for effecting the code control of the signal control relay at the corresponding location in accordance with the position of its lever and of the traffic relay at that location in accordance with the position of said directional relay, a second circuit for energizing each starting relay including a contact of the starting button associated with the other starting relay and a normal or reverse contact of said directional relay for effecting the code control of the traffic relay for the exit end in response to the operation of the starting button for the entrance end of the stretch, and means rendering said second circuit effective temporarily in response to a change in the position of said directional relay.

2. Railway traffic controlling apparatus for a stretch of railway track which includes alternate single track and main track portions connected by track switches, each track switch being located in a short detector track section; overlapping traffic blocks for said portions, so arranged that each detector track section constitutes the end section of each of the two blocks which extend in opposite directions from its location, a signal at each end of each block for governing traffic movements into the corresponding block, a signal control relay and a traffic relay for each signal, a system of reversible signal circuits for each block controlled jointly by the traffic relays for the signals at its opposite ends and by traffic conditions in such block for rendering one signal or the other governing traffic movements into such block responsive to the operation of its control relay, a code system for communicating between the signal locations and a control office, having a starting relay for each such location and a three position signal lever for controlling the opposing signals governing traffic movements into the blocks which extend in opposite directions from that location, a starting button for each starting relay, a directional relay for each block operable to normal or reverse when the block is unoccupied in response to the operation of one of the levers for the signals located at its opposite ends to designate one signal location or the other as the entrance end of such block, a circuit for energizing each starting relay including a contact of the associated starting button, means controlled by each starting relay when energized for effecting the code control of the signal control relays at the corresponding location in accordance with the position of the associated lever and for effecting the code control of the traffic relays at that location in accordance with the positions of the directional relays for the corresponding blocks, a second circuit for energizing each starting relay including a normal contact of the directional relay for one of the two blocks at such location and a contact of the starting button for the opposite end of such block, a third circuit for energizing each starting relay including a reverse contact of the directional relay for the other block at such location and a contact of

the starting button for the opposite end of said other block, and means for rendering said second or third circuit effective temporarily in response to a change in the position of the corresponding directional relay.

3. Railway traffic controlling apparatus comprising, a signal at each end of a stretch of railway track for governing traffic movements into the stretch, track circuits for indicating the presence of a train in said stretch, a signal control relay and a traffic relay at each end of the stretch, block indication means at a control office, a code system for controlling said relays at the ends of the stretch from said office and for also controlling said block indication means in accordance with the condition of said track circuits, a system of reversible signal circuits controlled jointly by the traffic relays and by said track circuits, said traffic relays being adapted to energize said circuit system in one direction or the other for rendering one signal or the other responsive to the operation of its control relay, a signal lever for each signal, a directional relay, circuits rendered effective only when said block indication means indicates that the stretch is unoccupied for operating said directional relay to a position designating one traffic direction in response to the reversal of one signal lever and to a position designating the opposite traffic direction in response to the reversal of the other signal lever, provided said levers are reversed only one at a time, a starting button for each lever, means responsive to the operation of the starting button associated with that one of the two levers which is reversed for initiating the transmission of a control code by said system for operating the signal control relay controlled by said lever to its signal clearing position and for also operating the associated traffic relay to a position corresponding to the direction designated by the directional relay, a circuit including a contact of said directional relay and a contact closed in response to the operation of such relay from one position to another for rendering said starting button operation effective to initiate the transmission of a second code by said system for operating the other traffic relay to a position corresponding to the direction designated by said directional relay, and means responsive to the transmission of both said codes for opening said circuit.

4. Railway traffic controlling apparatus comprising, a signal at each end of a stretch of railway track for governing traffic movements into the stretch, track circuits for indicating the presence of a train in said stretch, a code system for communicating between the locations of said signals and a control office, a manually controllable directional relay at said office for designating the direction of traffic movements in the stretch, a traffic relay at each signal location, a system of reversible signal circuits controlled by said track circuits for controlling the signals, means controlled jointly by said traffic relays in selected positions or reversibly energizing said signal circuit system at either end of the stretch to render the signal at the opposite end responsive to traffic conditions as manifested by said track circuits, a plurality of starting buttons at the office including one for each signal location each effective when operated to initiate the transmission by said code system of a code for operating the traffic relay at the corresponding signal location to a position corresponding to the traffic direction designated by said directional relay, and means for at times temporarily rendering

one starting button or the other depending upon the position of said directional relay effective when operated to initiate the transmission by said code system of a second code for operating the traffic relay at the other signal location to a position corresponding to the same traffic direction.

5. Railway traffic controlling apparatus for a stretch of railway track which includes alternate single track and main track portions connected by track switches, each track switch being located in a short detector section; overlapping traffic blocks for said portions, so arranged that each detector track section constitutes the end section of each of the two blocks which extend in opposite directions from its location, a signal located at each end of each block for governing traffic movements into the corresponding block, a code system having a station at each track switch location and a transmitter at a control office for transmitting codes to said stations, code controlled signal control relays at the stations for controlling the signals, for the two blocks at that location, two code controlled traffic relays at each intermediate station in said stretch which jointly with the traffic relays at the adjacent stations located in opposite directions from such station are adapted to control the direction of traffic movements through the blocks extending from said intermediate station to each adjacent station, a plurality of starting buttons at the office for controlling said transmitter including one for each station, means controlled by each starting button when operated for initiating the transmission of a code by which the signal control and traffic relays are operated at the corresponding station, and directionally controlled means for at times rendering the operation of the starting button for said intermediate station effective to initiate the transmission of a second code to one of said adjacent stations or to the other to operate the traffic relays at such adjacent station.

6. Railway traffic controlling apparatus comprising, a signal at each end of a stretch of single track railway for governing traffic movements into the stretch, a hand throw switch equipped with an electric lock and located in said stretch, an indication relay having an energizing circuit closed only when the switch is locked in its normal position, track circuits for indicating the presence of a train in said stretch, a code system for communicating between the locations of said signals and a control office, a manually controllable directional relay at said office for designating the direction of traffic movements in the stretch, a traffic relay at each signal location, a system of reversible signal circuits controlled by said track circuits and including a front contact of said indication relay for controlling said signals, means including said traffic relays in selected positions for reversibly energizing said circuit system at either end and for controlling the signal at the opposite end over said circuit system, a plurality of starting buttons at the office including one for each signal location, each effective when operated to initiate the transmission by said code system of a code for operating the traffic relay at the corresponding signal location to a position corresponding to the direction designated by said directional relay, a switch lever at said office for said switch, a repeating relay having an energizing circuit closed when said lever is reversed, means responsive to the operation of one of said starting buttons when

said switch lever is reversed and its repeating relay energized for initiating the transmission of codes to both ends of the stretch to operate the traffic relays to positions to energize said line circuit system at both ends, means at said switch location adapted to be energized over said line circuit system upon the release of said indication relay if the stretch is unoccupied for releasing the electric lock, a stick circuit controlled by said code system arranged to hold said repeating relay energized following the return of said switch lever to normal, and means responsive to a second operation of said one starting button following the return of said switch lever to normal for initiating the transmission of codes to both ends of the stretch whereby said traffic relays are operated to positions corresponding to the traffic direction designated by said directional relay and said repeating relay is then released.

7. In combination with a stretch of railway track having signals at each end for governing traffic movements into the stretch, track circuits for indicating the presence of a train in said stretch, a hand throw switch in said stretch, an electric lock effective when deenergized to prevent the hand operation of the switch, a reversible line circuit system adapted to be energized at one end of the stretch or the other and effective only when said switch is locked normal to control one of said signals or the other in accordance with the condition of said track circuits, a directional relay at a control office for controlling the direction of energization of said line circuit system to govern the direction of traffic movements through the stretch, a switch lever at said office for said switch, a repeating relay controlled by said lever, means controlled by said lever when reversed with said repeating relay energized for energizing said line circuit system at both ends, relay means adjacent the switch adapted to be energized over said line circuit system when energized at both ends provided the stretch is vacant, and effective when energized to energize said electric lock, and means controlled by said repeating relay and rendered effective upon restoration of the switch lever to normal to condition said line circuit system for train movements in a direction corresponding to the position of said directional relay.

8. In combination with a stretch of railway track having signals at each end for governing traffic movements into the stretch, track circuits for indicating the presence of a train in the stretch, a hand throw switch located in the stretch, an electric lock effective when deenergized to prevent the hand operation of the switch, two traffic relays one at each end of the stretch, a switch lever, a repeating relay and a directional relay located at a control office, means for operating the traffic relays to positions selected by the directional relay in which one traffic relay designates its location as the entrance end and the other designates its location as the exit end of the block, means controlled by the traffic relays in said selected positions and by said track circuits for clearing the signal at the entrance end of the block, means for energizing said repeating relay when the switch lever is reversed, means controlled by the lever when reversed with its repeating relay energized for operating said traffic relays to positions to designate both ends of the block as exit ends, means controlled by the traffic relays when both occupy their exit end positions and by said track circuits for energizing the electric lock provided the stretch is unoccu-