Aug. 17, 1943. H. S. YOUNG 2,326,991

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Sept. 27, 1941 4 Sheets-Sheet 1

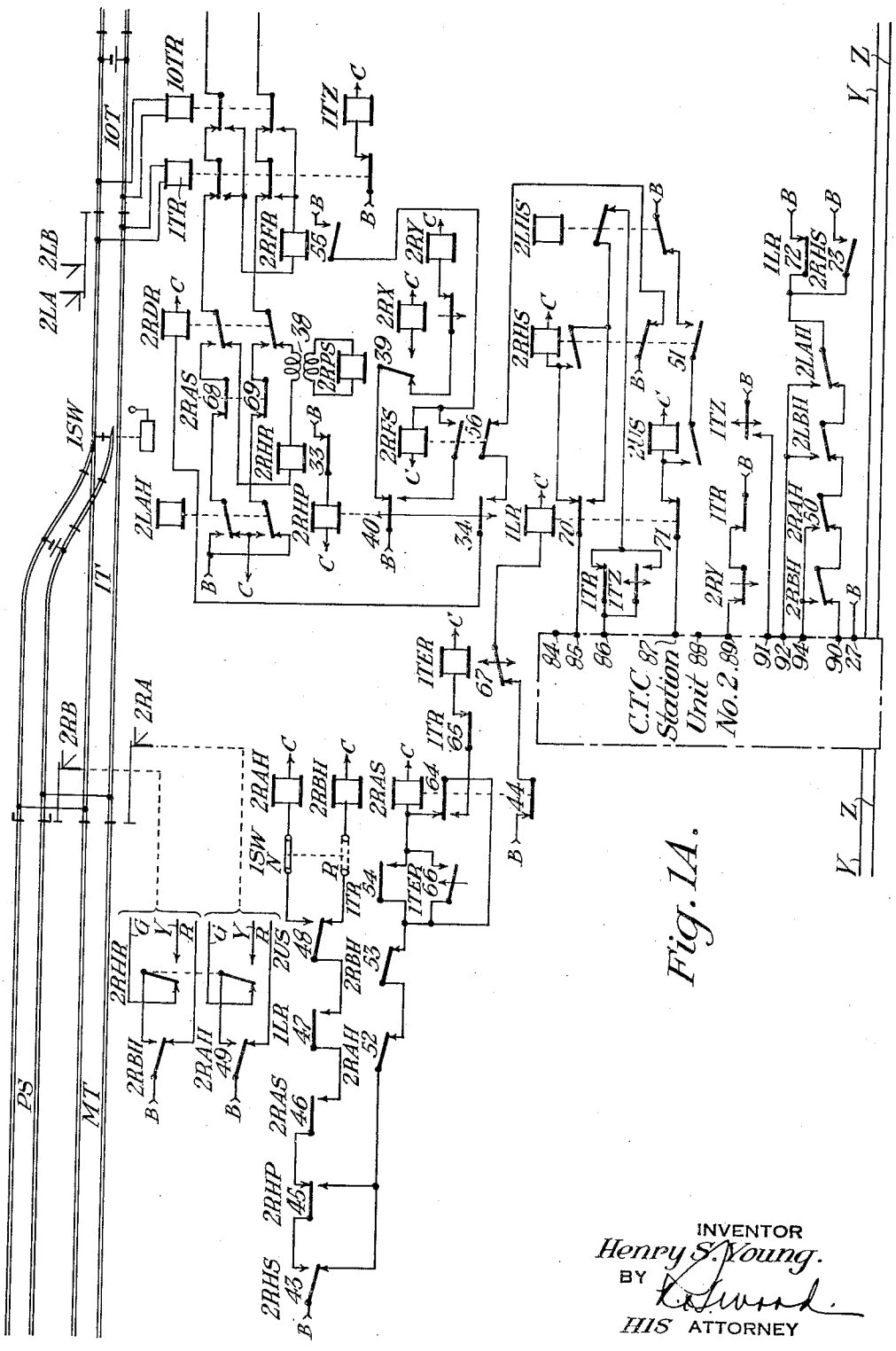


Fig. 1A.

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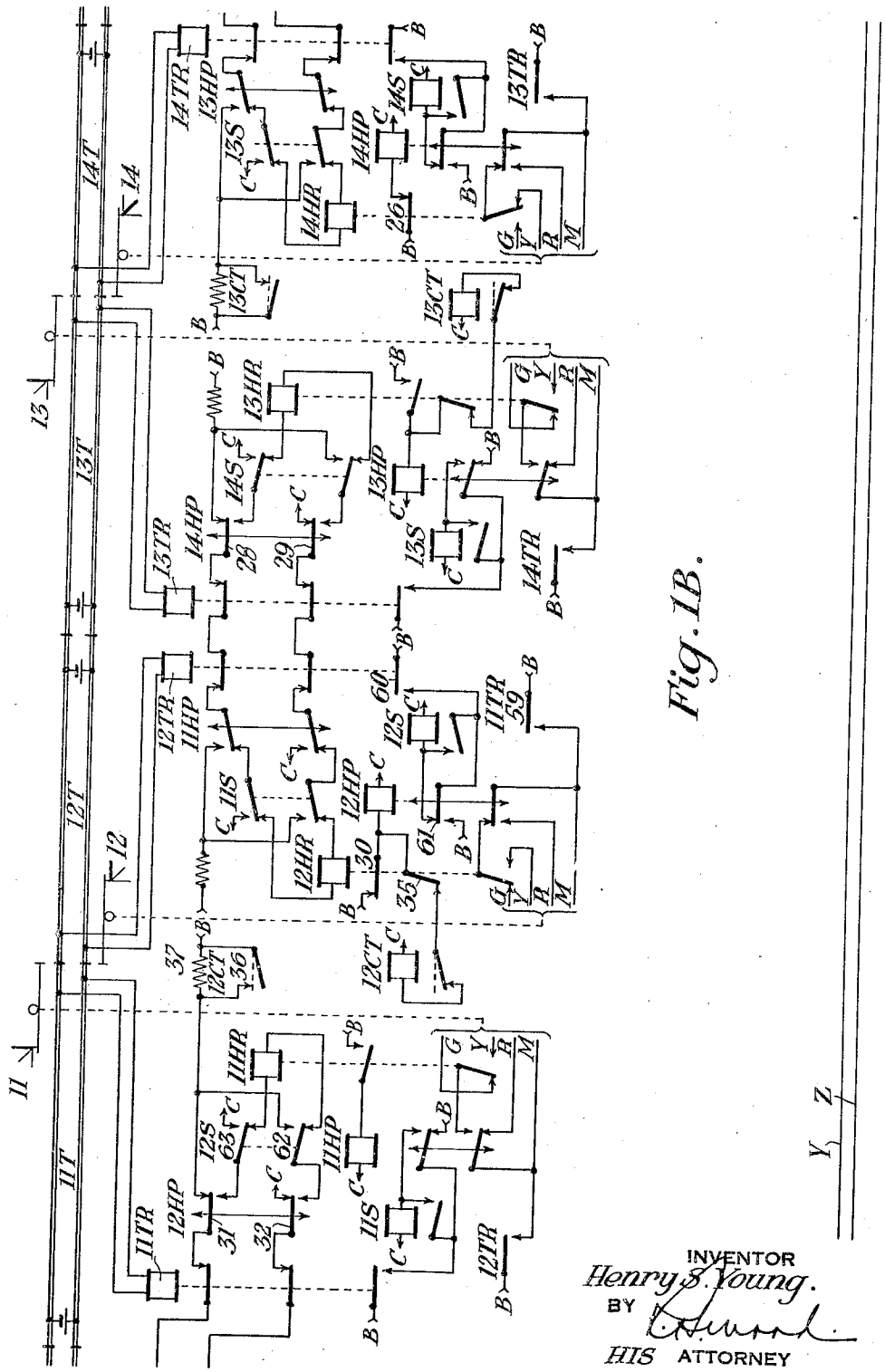


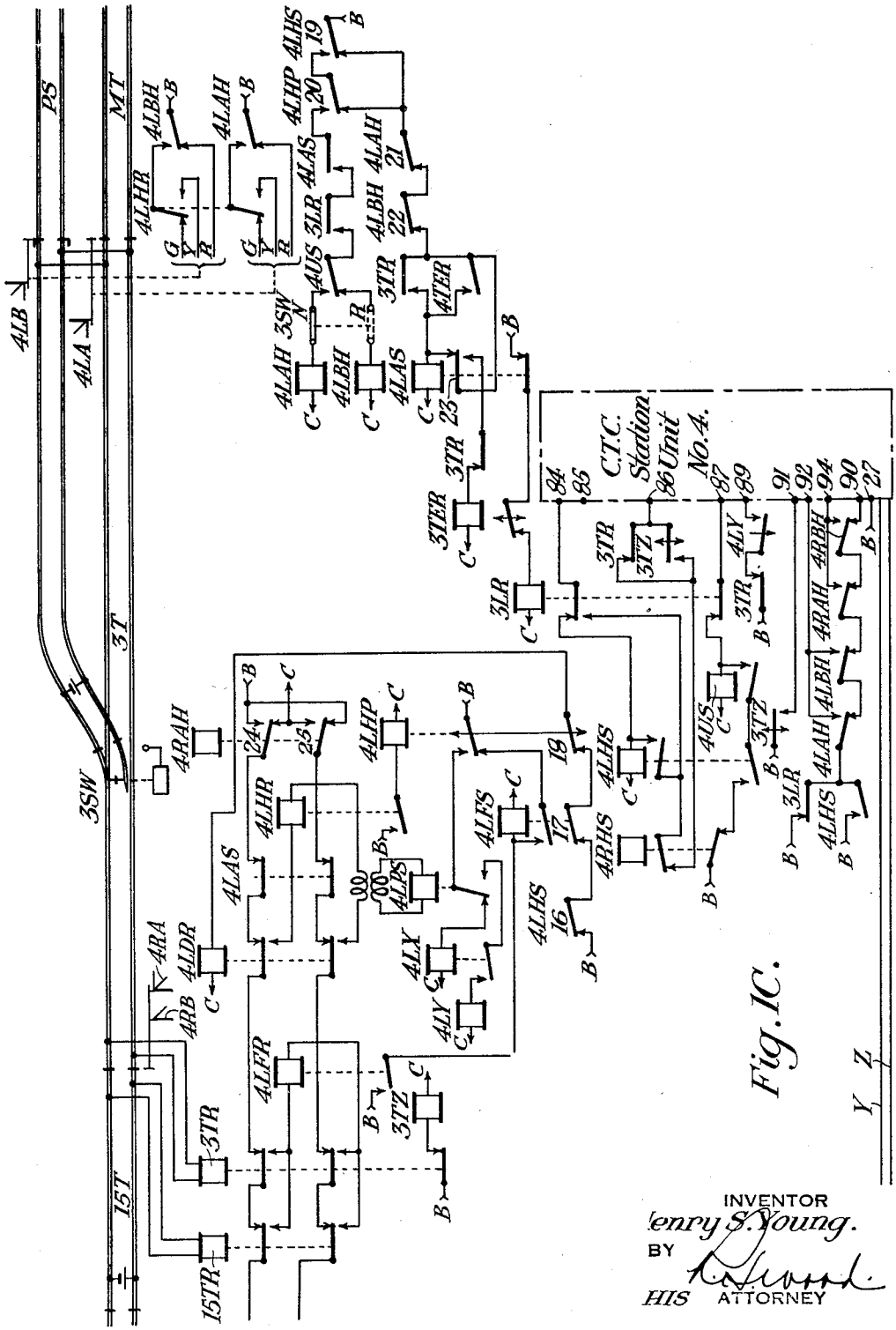
Fig. 1B.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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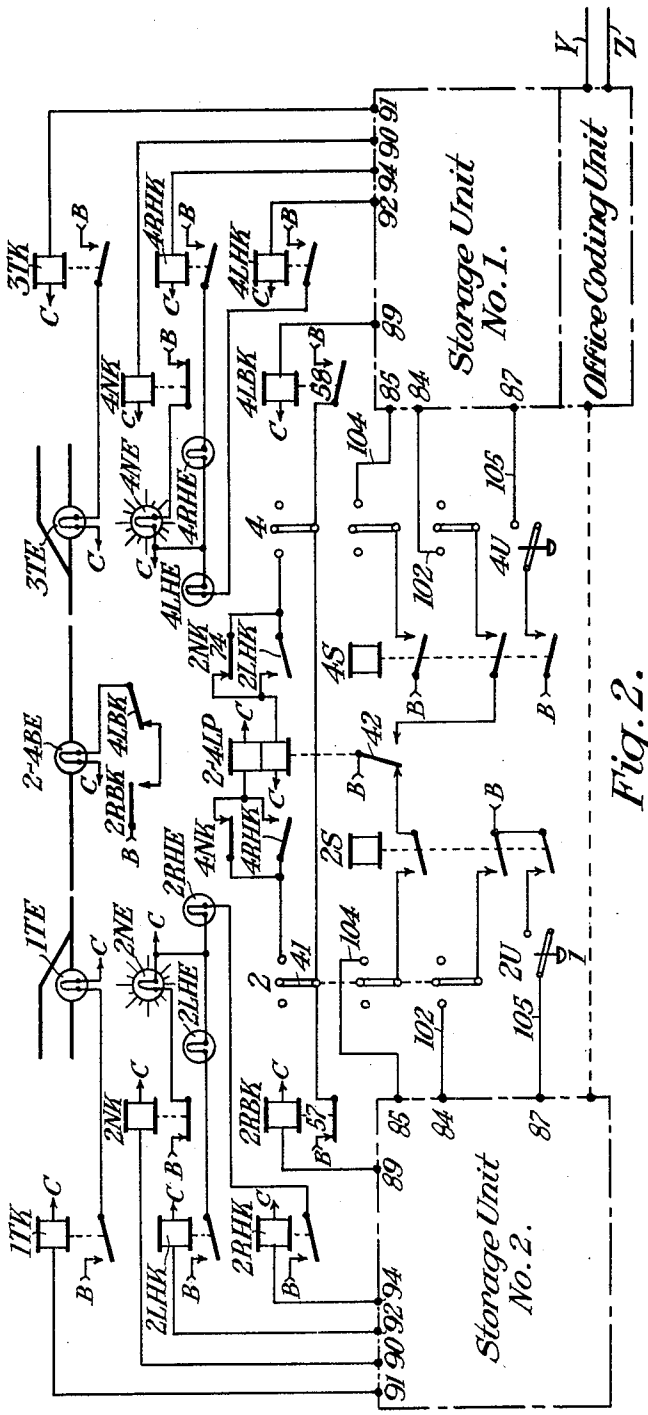


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RAILWAY TRAFFIC CONTROLLING APPARATUS

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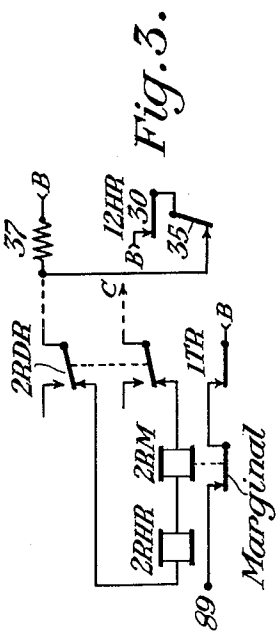


Fig. 3.

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UNITED STATES PATENT OFFICE

2,326,991

RAILWAY TRAFFIC CONTROLLING APPARATUS

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Application September 27, 1941, Serial No. 412,627

22 Claims. (Cl. 246—3)

My invention relates to railway traffic controlling apparatus for governing the movement of traffic over stretches of single track over which traffic moves in both directions, and in its specific embodiment, to the provision of an improved absolute permissive block signaling system in which the signals for both directions are controlled over circuits employing but two line wires which may be energized at one end or the other by current of normal or reverse polarity to provide three position control of the signals, and in which the direction of traffic is manually governed from a central point by means of a centralized traffic control system.

One feature of my invention is the provision of an improved system of directional control for systems of this character, which functions automatically when a train enters an unoccupied single track stretch from either end, to establish the corresponding traffic direction or to maintain it if already established, to thereby effect the clearing of the intermediate signals for the corresponding direction located within the stretch and ahead of the train, the purpose being to avoid delays to traffic in the event of failure of the centralized traffic control system by means of which the direction of traffic is established in normal operation.

Another feature of my invention is the provision of a single track signaling system of relatively low cost in which hand throw switches may be used in lieu of the usual power operated track switches and in the provision of an improved system of time locking for the signals for a system of this character, for the purpose of preventing a change in the established route under unsafe traffic conditions.

My invention also includes the provision of novel arrangements for the control of a block indicator for visually indicating at the control office when a train moving in either direction occupies any portion of the single track stretch, and for interlocking the circuits controlled by the control levers for the opposing head block signals governing traffic movements into the single track stretch so as to prevent interference with train movements in the event of improper manipulation of these levers.

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

Referring to the accompanying drawings, Figs. 1A, 1B and 1C, when placed end to end in that order with Fig. 1A at the left, constitute a diagrammatic view showing trackway apparatus embodying one form of my invention applied to the portion of a single track railroad located between and including the ends of two adjacent passing sidings. Fig. 2 shows the control office apparatus including the signal control levers together with an illuminated track diagram of the stretch of track and associated apparatus for effecting the control and supervision of train movements over the single track block of Figs. 1A, 1B and 1C. Fig. 3 illustrates a modification of the circuits of Fig. 1A for controlling the block indicator.

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

In order to simplify the drawings and to enable the circuits to be more readily traced, I have herein identified each switch and signal by a number and each relay by a letter or combination of letters with a numerical prefix identifying the switch or signal with which the relay is associated. Insteal of showing the sources of current for energizing the various circuits, I have shown only the terminals of the sources, these being identified by the references B and C, referring to the power supply or positive and the common return or negative terminals respectively.

The track diagram extending across the top of each of the views Figs. 1A, 1B and 1C represents a stretch of railway track constituting a typical single track block to which my invention is applied in the manner illustrated by the circuits below the diagram. This stretch of track is provided with continuous track circuits, being divided into track sections T by the usual insulated joints, and each section T is provided with a track circuit having a current source connected across the track rails at one end and a track relay TR connected across the track rails at its opposite end.

The hand-throw switches 1SW and 3SW, when reversed, connect the ends of the single track stretch with a non-track-circuited passing siding PS, and when normal, as shown, with a stretch of main track MT.

The track switches 1SW and 3SW are located in the usual detector track section having the track relays 1TR and 3TR over which traffic movements are governed by the signals bearing the references 2 and 4 respectively, each signal being identified by a distinguishing suffix. The single track block to which my invention is applied extends from the head block signal 2RA or 2RB through track sections 1T, 10T to 15T,

inclusive, and 3T to the opposing head block signal 4LA or 4LB. The spacing of trains moving in the same direction through the block is governed by the intermediate signals 12 and 14, or by signals 13 and 15 of Fig. 1B, as will be readily understood.

The territory illustrated may be extended through the passing siding to the entrance to an adjacent single track block, merely by placing Fig. 1A at the right of Fig. 1C. When so arranged, Figs. 1C and 1A illustrate a block extending from signal 4RA or 4RB through track sections 3T, MT and 1T to an opposing signal such as signal 2LA or 2LB but located in the next single track block to the right of that described above, but since the circuits for controlling these signals 4R and 2L form no part of the present invention they have not been shown herein, suitable circuits being well known. For example, these signals may be controlled by circuits similar to those for signals R2 and L4 shown in my Patent No. 2,282,841, granted May 12, 1942, for Railway traffic controlling apparatus.

It will be understood that each of the head block signals is controlled automatically by the track relays in accordance with traffic conditions in advance, and is also subject to manual control from the central office illustrated in Fig. 2, through the medium of a centralized traffic control system.

The communication system connecting the office with the various field locations may be of any suitable type, and as shown herein it is to be understood to be of the impulse code type such as that shown in Letters Patent of the United States No. 2,229,249, granted January 21, 1941, to Lloyd V. Lewis, for Remote control systems. In this system, communication is established intermittently between the control office and various field stations over a single pair of line wires Y and Z which, it is to be understood, extend from the office (assumed to be at the left of the controlled territory) through each station corresponding to the location of a head block signal such as those shown in Figs. 1A and 1C in the manner illustrated in Fig. 10 of the Lewis patent.

Referring to Fig. 1A, for example, the dot-and-dash line rectangle bearing the legend "CTC station unit No. 2" represents the station coding unit illustrated in Figs. 6 and 7 of this patent by means of which the central office operator governs the signal control relays 2LHS, 2RHS and 2US corresponding to the similarly designated relays in Fig. 8 of the patent, while the dot-and-dash line rectangle in Fig. 3 represents a similar unit at another location, and those in Fig. 2 represent the corresponding office coding and storage units such as are shown in Figs. 1 to 5 of the patent. The station unit terminals bear numerical designations 27, 84 to 92 and 96 in Fig. 1A and likewise in Fig. 1C, which are the same as those of the corresponding terminals of the station unit as shown in Figs. 7 and 8 of the patent. Certain of these represent channels for communication, by code, with the corresponding storage unit at the office, and in order that the office terminals of the circuits controlled over these channels may be readily identified without the necessity of tracing the code operation in detail, they have been given similar numercial designations in Fig. 2 herein. For example, the transmission of a control code including the code call for station No. 2 with signal control lever 2 of Fig. 2 in its right-hand position causes the selector relay 2S to be picked up thereby energizing wire 85 to pick up the stick relay 2RHS, Fig. 1A, which relay then remains picked up until a control code is transmitted to station No. 2 with lever 2 in its center or left-hand position, whereupon relay 2RHS is released, as explained in the patent. The transmission of indications is carried out in an analogous manner; when a train enters section 1T for example, the track relay 1TR releases, deenergizing its repeater relay 1TZ which releases to energize wire 91, causing the transmission of an indication code to effect the energization of the track indication stick relay 1TK (corresponding to relay 11K of Fig. 5 of the patent), and when relay 1TZ again picks up, a second code is transmitted to cause relay 1TK to release, relay 1TK controlling the "OS" lamp 1TE, which is lighted to indicate the occupancy of the corresponding switch section of the miniature track diagram at the office. Each station unit also controls, over the channel corresponding to wire 89, a block indicator lamp 2—4BE in the track diagram, which lamp is lighted when any portion of the single track block is occupied, and the indication relays 2RBK and 4LBK which control the block indicator lamp also control the energization of a polar stick relay 2—4LP by means of which the circuits controlled by the signal levers 2 and 4 are interlocked as hereinafter described, so as to prevent interference with the established traffic direction by operation of these levers except under proper conditions. The indication stick relays LHK, NK and RHK which govern the signal indication lamps associated with levers 2 and 4 are controlled over circuits 90, 92 and 94 and correspond with relays 10K, 12K and 14K of the patent, but the control of these circuits has been modified as shown herein so as to include an indication of the condition of the approach locking stick relays 2RAS and 4LAS associated with the head block signals, as explained hereinafter.

The signaling system shown herein employs a two-wire reversible line circuit extending between the head block signal locations at opposite ends of the single track stretch, which is sectionalized at each intermediate signal location, each section being controlled over front contacts of the track relays for the corresponding block section. The reversible line circuit corresponds generally to that shown in Letters Patent of the United States No. 2,112,945, granted April 5, 1938, to L. B. Yarbrough, for Railway traffic controlling apparatus, but differs in that the electroresponsive devices governed over the line circuit to control the signals are here shown as polarized line relays HR, in place of the equivalent signal mechanisms of the patent. Furthermore, the contacts of the code-controlled stick relays in the line circuit of this patent which control the direction in which it is to be energized have been replaced herein by contacts of directional relays R2DR and L4DR. These relays are controlled by the corresponding code controlled relays 2RHS and 4LHS in a novel manner, in accordance with a feature of my invention, so that as soon as the establishment of either traffic direction is completed by the energization of the line relay at one end or the other, the code-controlled relay at the entrance end is free to be operated as required to control the adjacent signal without interrupting the con-

tinuity of the line circuit, and the established traffic direction is maintained by keeping the code control relay at the exit end deenergized.

The code-controlled stick relays 2RHS and 4LHS which govern the relays DR to select the direction of energization of the two wire line circuit also control local circuits for controlling the head block signals; that is, these relays jointly with the polarized line relays 2RHR and 4LHR controlled over the line circuit and their slow acting repeater relays 2RHP and 4LHP govern the energization of the signal relays H, such for example, as the relay 2RAH for signal 2RA. The code controlled stick relay 2US or 4US is energized along with the associated relay 2RHS or 4LHS if the operator closes the key 2U or 4U, Fig. 2, and when energized selects the "A" signal for a movement from the main track MT, and when deenergized selects the "B" signal for a movement from the siding PS, the selection in each case being effective only when the associated track switch occupies the corresponding normal or reverse position.

Each intermediate signal is provided with a line relay HR, a slow acting repeater relay HP, and also with the usual directional stick relay S for at times supplying current of reverse polarity to the line relay for the next signal in the rear in accordance with the usual practice.

The signals as shown are to be understood to be of the three position color light type having green, yellow and red lamps for indicating proceed, caution and stop, respectively. To simplify the drawings the signal lamps have been omitted and only the wires leading thereto have been shown herein, these bearing the characters G, Y and R to identify the green, yellow and red lamps, respectively, which are energized over these wires. Each intermediate signal is also provided with a marker lamp, the circuit for which bears the reference character M. The intermediate signals are lighted only upon the approach of a train, the lamp circuits including a back contact of the track relay for the section in approach to the signal in each case.

The line circuit sections are controlled in tandem, energy being applied at the exit end of the block by picking up the corresponding directional relay 2RDR or 4LDR. Each directional relay is energized over a circuit including back contacts of the line repeater relay HP and of the code controlled relay HS at the same end of the block, the circuit also including a back contact of a directional stick relay FS which is picked up by an auxiliary line relay FR when a train enters the block for a purpose hereinafter to be explained. As shown, the line circuits are in the condition which they assume when the block is vacated after a train movement from left to right through the block.

Tracing the circuits in detail, it will be seen that relay 4LDR, Fig. 1C, is energized over a circuit from terminal B, back contacts 16, 17 and 18 of relays 4LHS, 4LFS and 4LHP, relay 4LDR to terminal C. Signals 4LA and 4LB are at stop, and the approach locking stick relay 4LAS associated therewith is held energized over a stick circuit extending from terminal B over back contact 19 or 20 of relay 4LHP or 4LHS, back contacts 21 and 22 of relays 4LAH and 4LBH, front contact 23 and winding of relay 4LAS to terminal C.

Assuming the leaving signal 4RA to be at stop, its control relay 4RAH is released and the polarized line relay 14HR is energized in the reverse direction over the circuit extending from terminals B and C at the pole changer contacts 24 and 25 of relay 4RAH over front contacts of relays 4LAS, 4LDR, 3TR, 15TR and 14TR, back contacts of relays 13HP and 13S and the winding of relay 14HR. Relay 14HP is energized over contact 26 of relay 14HR. The line relay 12HR for the next section is energized in the normal direction over the circuit extending from terminals B and C at front contacts 28 and 29 of relay 14HP over front contacts of relays 13TR and 12TR, back contacts of relays 11HP and 11S and the winding of relay 12HR. Relay 12HP is energized over contact 30 of relay 12HR. The line relay 2RHR is energized in the normal direction over the circuit extending from terminals B and C at front contacts 31 and 32 of relay 12HP, front contacts of relays 11TR, 10TR and 1TR and back contacts of relay 2RDR and the winding of relay 2RHR. Relay 2RHP is energized over contact 33 of relay 2RHR. The circuit for relay 2RDR, which is similar to that for relay 4LDR already traced, is held open at back contact 34 of relay 2RHP.

It will be seen that since the signal relay 2RAH is deenergized, signal 2RA normally indicates stop, and that the remaining head block signals 2RB, 4LA and 4LB also indicate stop for similar reasons. The intermediate signals are dark, but with the directional relay 4LDR picked up, signal 12 is conditioned to indicate clear upon the approach of a train, while signal 14 is similarly conditioned to indicate caution or clear dependent upon the position of relay 4RAH, and the opposing signals 11 and 13 are conditioned to indicate stop.

Although the signals require only three position control, the line circuits shown herein are arranged in a novel manner to provide four distinctive conditions at the head block locations, the fourth condition indicating that the entire single track block is unoccupied. This is effected by "coding" or periodically varying the line current in the line circuits which extend from the entrance end to the second signal from the exit end of the block for the direction established, that is, for the circuit extending from the location of signal 2RA to that of signal 12, as shown. Relay 12HR for the second signal from the end of the block when energized in the normal direction as shown indicates that the portion of the block extending from the location of that signal to the exit end of the block at the location of signal 4LA is unoccupied, but this is not true of the line relay for any section in the rear of that signal, relay 2RHR, for example, being energized in the normal direction when relay 13S has been picked up by a train occupying section 13T or 14T, consequently the block indication requires a different condition of the line circuits for the remainder of the block. A circuit is closed over the neutral contact 39 and normal polar contact 35 of relay 12HR to energize a code transmitter relay 12CT, which relay when energized operates its contacts repeatedly at a fixed rate such as 75 times per minute. Relay 12CT may be, for example, of the type shown in Letters Patent of the United States No. 1,858,876, granted May 17, 1932, to P. N. Bossart, for Coding apparatus. When relay 12CT is in operation its contact 36 periodically shunts the resistor 37 and thereby periodically varies the current in the line circuits for the remainder of the block, that is, for the portion of the block which extends from its entrance end to the location of the second signal from the exit end, which por-

tion, as shown, comprises the circuit for relay 2RHR, but without interfering with the steady energization of that relay. These variations, however, are impressed upon the primary of a transformer 38 in series with relay 2RHR to cause impulses of alternately opposite polarity to be delivered to a polar stick relay 2RPS connected to the secondary of transformer 38, thereby causing relay 2RPS to operate its contact 39 at the same rate as that of contact 36 of relay 12CT. Each time contact 39 moves to the right a circuit is completed to terminal B over front contact 40 of relay 2RHP to energize a slow release relay 2RX, and each time contact 39 moves to the left, with relay 2RX picked up, a circuit is completed to pick up a second slow release relay 2RY. Relay 2RY is arranged to remain picked up steadily in response to the code operation of relay 2RPS, and therefore constitutes a block relay which is energized only when the entire block from signal 2RA to signal 4LA is unoccupied. A front contact of relay 2RY controls the energization of wire 89 of the station unit governing the stick indication relay 2RBK at the office. When relay 2RY becomes energized a C. T. C. code is transmitted whereby relay 2RBK is picked up, extinguishing the block indication lamp 2—4BE, and when relay 2RY releases a second C. T. C. code is transmitted to effect the lighting of lamp 2—4BE provided a relay 4LBK which is similarly controlled by the corresponding block relay 4LY for the opposite direction is also released.

When line conditions permit, the block indication may be superimposed upon the line circuits in a somewhat more simple manner, as indicated in Fig. 3. In this view a marginal relay 2 RM is inserted in the line circuit in place of transformer 38, relay 2RM being arranged to pick up on a current value higher by a predetermined amount than that supplied through resistor 37, while relay 2RHR picks up on a lower value than that supplied through resistor 37. Relay 2RM picks up only when the neutral and left-hand polar contacts of relay 12HR are closed, and it therefore may replace relay 2RY in Fig. 1A for controlling the energization of wire 89 governing the block indicator.

It is also to be understood that the number of intermediate signals may be more or less than the two shown, dependent upon the spacing of the passing sidings. In the former case there will be two or more line circuit sections in the rear of signal 12 and the superimposed indication may be relayed from section to section in an obvious manner, and in the latter the energization of wire 89 may be controlled directly by the polar neutral contacts of the head block signal line relay.

It will be readily apparent from a cursory examination of the drawings that the circuits shown herein are fully symmetrical with respect to the two directions of traffic movement through the single track block, and it follows that a description of any of the circuits for one direction is equally applicable, by making suitable changes in the designations of the relays and signals involved, to the corresponding circuits for the opposite direction. Thus for example, if the last train movement through the block had been from right to left, relay 2RDR would have been picked up and relay 4LDR would have been released, the line relays 11HR, 13HR and 4LHR and their repeater relays HP would be energized and relays 14HR, 12HR and 2RHR together with the relays HP associated therewith would be released. The code transmitter relay 13CT would operate in place of relay 12CT, causing the energization of relays 4LPS, 4LX and 4LY at station No. 4 in place of the corresponding relays at station No. 2, and relay 4LBK would be picked up to maintain lamp 2—4BE dark in place of relay 2RBK.

I shall now assume that the apparatus is in the condition shown in the drawings and that with the object of arranging for a train movement from left to right, the operator moves levers 2 and 4 to the right and closes keys 2U and 4U, and then initiates the transmission of control codes to stations Nos. 2 and 4. It is to be understood that the code received at station No. 4 will cause the energization of relays 4RHS and 4US as described in the Lewis patent, and that as a result thereof relay 4RAH will become energized to clear signal 4RA, and that contacts 24 and 25 of relay 4RAH will then supply current of normal polarity to relay 14HR to condition signal 14 to indicate clear.

At the office, indication stick relay 2RBK is picked up, indicating that the block is unoccupied, and if the indication stick relay 4RHK or 4NK is picked up, indicating that signals 4LA and 4LB are at stop, the closing of the right-hand contact 41 of lever 2 completes a circuit through the upper winding of the polar stick relay 2—4LP, causing that relay to operate its contact 42 to the left to prepare a circuit completed over another right-hand contact of lever 2 and a contact of the selector relay 2S during the transmission of the code to energize wire 104, wire 105 being also energized over the closed contact of key 2U. The energization of these wires as described in the Lewis patent causes wires 85 and 87 to be energized by the code received at station No. 2, to pick up relays 2RHS and 2US.

Relay 2RHS, by opening its back contact 43, opens the stick circuit for the approach locking stick relay 2RAS (similar to that for relay 4LAS already described) so that relay 2RAS releases and by opening its contact 44 releases the locking relay 1LR, thereby completing the circuit for the signal relay 2RAH extending from terminal B over front contacts 43 and 45 of relays 2RHS and 2RHP, back contacts 46 and 47 of relays 2RAS and 1LR, front contact 48 of relay 2US, contact N closed by the track switch 1SW in its normal position, relay 2RAH to terminal C. Relay 2RAH picks up; and the closing of its front contact 49 in the lighting circuit for the signal 2RA causes the signal indication to change from stop to proceed. The closing of front contact 50 of relay 2RAH energizes wire 94 thereby causing the C. T. C. station unit to transmit an indication code to pick up relay 2RHK and to release relay 2NK at the office, thereby lighting the lamp 2RHE associated with lever 2 (corresponding to lamp 12E of the Lewis patent) and opening contact 74 in the circuit for the lower winding of relay 2—4LP, thereby preventing the energization of that winding and consequently contact 42 is held in its left-hand position. Wire 102 leading to storage unit No. 4 therefore cannot be energized in response to a code transmitted to station No. 4 with lever 4 in its left-hand position and consequently relay 4LHS cannot be picked up by code as long as contact 42 remains in its left-hand position.

It will be seen that the clearing of the signal is dependent upon the release of the locking relays 2RAS and 1LS, but before describing the

function of these relays I shall first briefly trace the movement of a train through the block from left to right.

When the train enters section 1T, relay 1TR and its slow acting repeater relay 1TZ release successively, interrupting the stick circuit for relay 2RHS over wire 86, so that relay 2RHS releases. The opening of contact 51 of relay 2RHS causes relay 2US to release. The opening of front contact 43 of relay 2RHS releases relay 2RAH, restoring signal 2RA to stop, and the closing of back contact 43 completes a pick-up circuit for relay 2RAS extending from terminal B over back contacts 43, 52, 53 and 54 of relays 2RHS, 2RAH, 2RBH and 1TR through relay 2RAS to terminal C. Relay 2RAS picks up and completes its stick circuit and by closing contact 44 causes relay 1LR to pick up.

The dropping of the contacts of relay 1TR in the line circuit causes relays 2RHR and 2RHP to release, and stops the periodic operation of relay 2RPS so that relays 2RX and 2RY release. The auxiliary line relay 2RFR picks up over the back contacts of relay 1TR, its contact 55 completing the pick-up circuit for the directional stick relay 2RFS, which picks up. Relay 2RFS completes its stick circuit extending to terminal B at back contact 40 of relay 2RHP, and opens its contact 56 in the circuit of relay 2RDR to hold that circuit open until relay 2RHR is again energized.

When relay 1TZ releases, wire 91 is energized to initiate an "OS" code to release relay 1TK to light lamp 1TE at the office. Since relays 2RY and 1TR are released, wire 89 is deenergized so that this code releases relay 2RBK to complete the circuit for energizing the block indicator lamp 2—4BE. Relay 2—4LP is held deenergized in its last operated or left-hand position until the block is again vacated because contacts 57 and 58 of relays 2RBK and 4LBK are both open. Wire 94 is deenergized and wire 90 energized by the dropping of contact 50 of relay 2RAH, so that the code causes the release of relay 2RHK and the energization of relay 2NK, consequently lamp 2NE becomes lighted and lamp 2RHE extinguished. When the train vacates section 1T, a code will be transmitted to extinguish lamp 1TE, and when the train enters section 11T, relay 11TR releases to open the line circuit, releasing relay 2RFR and back contact 59 of relay 11TR completes the circuits G and M for signal 12 which accordingly becomes lighted to display a proceed indication as indicated conventionally by the representation of the signal on the track plan.

When the train enters section 12T, relay 12TR releases, and its back contact 60 completes the pick-up circuit for the directional stick relay 12S, which picks up, completing its stick circuit extending to terminal B at back contact 61 of relay 12HP. When the train vacates section 11T, current of reverse polarity is supplied to the line circuit over back contacts 31 and 32 of relay 12HP and front contacts 62 and 63 of relay 12S, so that relays 2RHR and 2RHP pick up, conditioning signal 2RA to display a caution indication and releasing relay 2RFS. Signal 2RA however continues to indicate stop unless relay 2RHS is again operated to pick up relay 2RAH.

Similarly, when the train enters section 13T, signal 14 becomes lighted to indicate clear, and when the train enters section 14T, relay 14S picks up.

When the train vacates section 13T relays 12HR and 12HP pick up to condition signal 12 to indicate caution, relay 12HP energizing relay 2RAH in the normal direction to condition signal 2RA to indicate clear and also releasing relay 12S.

It is to be understood that relay 4RAH will release when the train enters section 3T and that at the same time an "OS" code will be transmitted from station No. 4 to light lamp 3TE. When the train vacates section 3T, signal 14 will be conditioned to indicate caution and signal 12 to indicate clear, and a code will be transmitted from station No. 4 to extinguish lamp 3TE, and at this time the transmitter 12CT is set into operation to effect the reenergization of relay 2RY so that a code will be transmitted from station No. 2 to pick up relay 2RBK, extinguishing lamp 2—4BE. This completes the restoration of the apparatus to its normal condition following the movement of a train through the block from left to right, as shown.

I shall next assume that the apparatus has been restored to the condition shown in the drawings and the operator, as before, moves levers 2 and 4 to the right and initiates the transmission of control codes, but in this case without closing key 2U, in order to permit a train occupying the siding PS to pass signal 2RB, and it will be also assumed that the track switch 1SW has been reversed by the train crew. In this case the closing of front contact 43 of relay 2RHS will complete a circuit from terminal B over back contact 48 of relay 2US and contact R controlled by switch 1SW through relay 2RBH to terminal C, relay 2RBH becoming energized to clear signal 2RB in place of signal 2RA, the operations in other respects being similar to those already described.

In either case, it will be noted, the clearing of the signal depends upon the closing of back contacts 46 and 47 of relays 2RAS and 1LR, and if the signal is then put to stop manually the time locking is made effective to prevent a change of route until after the lapse of a predetermined time interval, as I shall now describe. Assuming that the train does not enter section 1T but that the signal is put to stop due to the release of relay 2RHS by the operator, a circuit will be completed from terminal B over back contacts 43, 52, 53 and 64 of relays 2RHS, 2RAH, 2RBH and 2RAS, front contact 65 of relay 1TR through relay 1TER to terminal C. Relay 1TER is to be understood to be a time element relay requiring energization for a predetermined time interval of the order of from one to four minutes to close its front contact 66, after which relay 2RAS picks up, releasing relay 1TER to close its back contact 67, whereupon relay 1LR picks up. It will be seen that the line circuit for governing traffic movements from right to left which extends to terminals B and C at front contacts 68 and 69 of relay 2RAS is held open, thereby preventing the reversal of the direction of energization of the line circuit with the object of clearing signal 4LA or 4LB until relay 2RAS is picked up at the end of the predetermined time interval above mentioned. Contacts 68 and 69 of relay 2RAS and the similar contacts of relay 4LAS in the line circuits for the opposite direction thus provide "time locking" of the opposing head block signals.

It will also be seen that the pick-up circuits for relays 2RHS and 2US include front contacts 70 and 71 of relay 1LR and that the stick circuit for relay 2US is controlled over contact 51 of relay 2RHS. Consequently after relays 2RHS

and 2US have been picked up to clear signal 2RA, and relay 1LR releases, the code-controlled relays are rendered non-responsive to a code for picking up relay 2RHS only, to clear signal 2RB, and vice versa; that is, if either of the two signals for the same direction has been cleared and it is desired to clear the other, a stop code must be sent first to initiate the time release of the locking, and it will be seen that relay 2RHS can be picked up by a code involving a change in the position of relay 2US only after the completion of the predetermined time interval.

A distinctive indication by the operation of the time locking apparatus is obtained by extinguishing the signal indication lamp for the duration of the time interval, and this is accomplished in the following manner: Contacts 72 and 73 of relays 1LR and 2RHS, in multiple, are interposed in the signal indication circuits by which wires 90, 92 and 94 are energized, and cause the deenergization of all of these wires from the time relay 2RHS is released to begin the locking period until it is completed by the energization of relay 1LR. A connection from terminal B to wire 27 of the station coding unit provides a starting circuit which functions to initiate an indication code following each control code, as explained in the Lewis patent. It will be seen that following the control code which releases relay 2RHS, an indication code will be initiated which will release relay 2RHK without energizing relay 2NK, so that all of the signal indication lamps associated with lever 2 become dark. At the end of the predetermined time interval, wire 90 becomes energized by the closing of contact 72 of relay 1LR, causing the initiation of a second indication code which will pick up relay 2NK, thereby closing contact 74 and also lighting lamp 2NE which informs the operator that the directional relay 2—4LP is again responsive to a movement of lever 4 to the left so that he may transmit a control code to pick up relay 4LHS.

It is to be noted that the time locking as above described is initiated by dropping contact 43 of relay 2RHS. The circuits are arranged, however, so as to avoid releasing the locking relays as a result of the energization of a code controlled relay when the associated line relay is not energized, as in that case the signal controlled thereby remains at stop and there is no occasion for imposing the time delay. It will be seen that if the line relay 2RHP is in its released position when relay 2RHS is picked up so that the signal 2RA or 2RB is prevented from clearing (front contact 45 of relay 2RHP being open), relay 2RAS is prevented from releasing, being maintained energized until relay 2RHS is again released, over front contact 43 of relay 2RHS and back contact 45 of relay 2RHP, for the purpose stated.

I shall now assume that with signal 2RA at clear, the operator finds it necessary to reverse the direction of traffic and to clear signal 4LA. He will first send a code to station No. 2 to release relay 2RHS thereby putting signal 2RA to stop. Relay 1TER is operated, and relays 2RAS and 1LR become energized at the end of the predetermined time interval, causing the transmission of an indication code to pick up relay 2NK, which is indicated by the lighting of lamp 2NE, and rendering the directional relay 2—4LP responsive to the operation of lever 4. The operator will then send a code to station No. 4 with lever 4 in its left-hand position, operating contact 42 of relay 2—4LP to the right and energizing relay 4LHS. The opening of contact 16 of relay 4LHS releases relay 4LDR, and consequently all the HR and HP relays governing traffic movements from left to right release, and when relay 2RHP releases, its contact 34 completes the circuit for relay 2RDR. Relays 2RDR, 11HR, 11HP, 13HR, 13HP, 4LHR and 4LHP then pick up in order. Relay 4LHP releases relays 4LAS and 3LR, and if switch 88W is normal relay 4LAH picks up to clear signal 4L, these changes being registered on the control panel at the office by the transmission of indication codes in the usual manner.

It will be clear that the energization of relay 4LHS as above described cannot be effected if any portion of the block is occupied, for in that case both block indication relays 2RBK and 4LBK are released. To set up the block for a traffic movement in either direction, a block clear indication must be received from one end or the other and the lever locking relay 2—4LP operated in the required direction prior to the transmission of the code for clearing the signals. It follows that the signals which have been cleared cannot be interfered with by an inadvertent attempt to clear an opposing signal.

It will now be assumed that the apparatus is in the condition shown but that the operator is for some reason unable to clear signal 2RA or 2RB, even though the stretch is unoccupied. He may then give permission to a train moving from left to right to pass the signal at stop and enter the block under the usual flagging protection. As soon as the train enters section 1T the apparatus assumes the same condition as if the signal had been passed at clear, signal 12 displaying its clear indication as soon as the train enters section 11T. It follows that as soon as the train passes signal 12 it may continue through the block under signal protection as hereinbefore described.

It will next be assumed that the traffic direction is set up for a movement from left to right as shown, and the operator gives permission to a train moving from right to left to pass through the block but with signal 4LA or 4LB at stop. When the train enters section 3T, the dropping of the track relay 3TR will initiate the release of the energized relays HR and HP for governing train movements from left to right. The last of these relays to release is relay 2RHP, and the closing of its back contact 34 energizes the directional relay 2RDR which picks up to cause the energization of relays HR and HP ahead of the train for governing traffic moving from right to left, relays 4LFR and 4LFS being also energized. Since the operation of all these relays consumes some time, it may be that if the train comprises a single vehicle it may pass entirely out of section 3T before current is available to pick up relay 4LFR. To insure the energization of relay 4LFS under this condition, relay 4LFR is arranged to be energized over back contacts of relay 15TR as well as of relay 3TR. It will be noted that signals 13 and 11 will be conditioned to indicate caution or clear according to the conditions of the next signals in advance, and after passing signal 13 the train may continue under signal protection the same as in normal operation.

It will be seen therefore that relay 4LFS or 2RFS maintains the established direction regardless of whether the associated head block signal has been cleared or not, and although the system of my invention employs only two line wires, it provides a degree of flexibility in operation under abnormal conditions as well as under normal conditions heretofore attained only in

systems employing independent normaliy energized line circuits for the two directions.

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

Having thus described my invention, what I claim is:

1. In a signaling system for railroads, a stretch of single track provided with head block signals located at each end and intermediate signals at spaced locations within said stretch, for governing traffic movements in opposite directions through said stretch, a reversible line system extending between the head block signal locations comprising a pair of line wires sectionalized at each intermediate signal location, a line relay for each signal, a slow acting repeating relay for controlling each signal controlled by a front contact of the associated line relay, a directional relay at each end of the stretch, an energizing circuit for each directional relay including a back contact of the repeating relay for the signal at the same end of the stretch and also including a manually controlled contact, means for alternatively connecting the winding of each head block signal line relay or a source of current to the line wires at the corresponding end of the stretch comprising back and front contacts, respectively, of the associated directional relay, and means for alternatively connecting the winding of each intermediate signal line relay or a source of current to the line wires extending in advance of the corresponding signal, comprising back and front contacts, respectively, of the repeating relay for the opposing signal at the same location.

2. In a signaling system for railroads, a stretch of single track divided into track sections, each provided with a track circuit including a track relay, head block signals located at each end and intermediate signals located at the ends of track sections within said stretch, for governing traffic movements in opposite directions through said stretch, a reversible line circuit system extending between the head block signal locations but divided into sections each line circuit section extending from one signal to the next and including front contacts of the track relays for the intervening track sections, a line relay for each signal, a slow acting repeating relay for controlling each signal controlled by a front contact of the associated line relay, a directional relay at each end of the stretch, an energizing circuit for each directional relay including a back contact of the repeating relay for the signal at the same end of the stretch and also including a manually controlled contact, means for alternatively connecting the winding of each head block signal line relay or a source of current to the line circuit section terminating at the corresponding end of the stretch comprising back and front contacts, respectively, of the associated directional relay, and means for alternatively connecting the winding of each intermediate signal line relay or a source of current to the line circuit section extending in advance of the corresponding signal, comprising back and front contacts, respectively, of the repeating relay for the opposing signal at the same location.

3. In a signaling system for railroads, a stretch of single track divided into track sections, each provided with a track circuit including a track relay, head block signals located at each end and intermediate signals located at the ends of track sections within said stretch, for governing traffic movements in opposite directions through said stretch, a reversible line circuit system extending between the head block signal locations but divided into sections each extending from one signal to the next and including front contacts of the track relays for the intervening track sections, a line relay for each signal, a slow acting repeating relay for controlling each signal controlled by a front contact of the associated line relay, a stick relay and a directional relay at each end of the stretch, a pick-up circuit for each stick relay closed when a train enters the stretch at the corresponding end provided the line circuit section directly in advance of the train is energized at its distant end, a stick circuit for each stick relay controlled by a back contact of the repeating relay for the associated head block signal, an energizing circuit for each directional relay including back contacts of the associated repeating relay and stick relay and also including a manually controlled contact, means for alternatively connecting the winding of each head block signal line relay or a source of current to the line circuit section terminating at the corresponding end of the stretch comprising back and front contacts, respectively, of the associated directional relay, and means for alternately connecting the winding of each intermediate signal line relay or a source of current to the line circuit section extending in advance of the corresponding signal, comprising back and front contacts, respectively, of the repeating relay for the opposing signal at the same location.

4. In a signaling system for railroads, a stretch of single track divided into track sections each provided with a track circuit including a track relay, head block signals located at each end of the stretch for governing traffic movements in opposite directions into said stretch, a reversible line circuit system extending between the head block signal locations including front contacts controlled by said track relays, a line relay for controlling each signal, a directional relay and a manually controlled contact at each end of the stretch, means for alternatively connecting the winding of each line relay or a source of current to the line circuit system at the corresponding end of the stretch, comprising back and front contacts, respectively, of the associated directional relay, and an energizing circuit for each directional relay including said manually controlled contact and a contact which closes in response to the release of the associated line relay, and also including a contact which opens when a train enters the stretch and the line circuit system is energized at its distant end, even though the line relay at the end at which said train enters has not been picked up.

5. In a signaling system for railroads, a stretch of single track divided into track sections each provided with a track circuit including a track relay, head block signals located at each end of the stretch for governing traffic movements in opposite directions into said stretch, a reversible line circuit system extending between the head block signal locations including front contacts controlled by said track relays, a line relay for controlling each head block signal, a manually controllable directional relay at each end of the

stretch, means for alternatively connecting the winding of each line relay to the line circuit system or for energizing said line circuit system at the corresponding end, comprising back and front contacts, respectively, of the associated directional relay, and means controlled by each line relay when energized for preventing the energization of the associated directional relay.

6. In a signaling system for railroads, a stretch of single track divided into track sections each provided with a track circuit including a track relay, head block signals located at each end of the stretch for governing traffic movements in opposite directions into said stretch, a reversible line circuit system extending between the head block signal locations including front contacts controlled by said track relays, a line relay for controlling each signal, a manually controllable directional relay at each end of the stretch, means for alternatively connecting the winding of each line relay to the line circuit system or for energizing said line system at the corresponding end, comprising back and front contacts, respectively of the associated directional relay, means controlled by each line relay when energized for preventing the energization of the associated directional relay, and other means effective when a train enters the stretch and releases the line relay at the end at which the train enters to prevent the energization of the associated directional relay until that line relay is again energized.

7. In an absolute permissive block signal system, a stretch of railway track divided into block sections provided with continuous track circuits including track relays, a line circuit system comprising a pair of line wires extending from the entrance to the exit end of said stretch and divided into sections corresponding to said block sections each section of said line circuit system including front contacts controlled by the intervening track relays, a three position signal at the entrance to each block section for governing the movement of traffic in a given direction, an electroresponsive device for controlling each signal adapted to be energized over the line circuit section directly in advance thereof, means for supplying current of normal or reverse polarity to the line circuit section terminating at the exit end of the stretch, means at each intermediate signal location for supplying current of normal relative polarity to the line circuit section extending to the rear thereof only when the electroresponsive device at that location is energized, and for supplying current of reverse relative polarity to that section only when such electroresponsive device is deenergized by a train in the corresponding block section moving in said given direction, a block relay at the entrance end of the stretch, manually operable means at a control office for at times disconnecting the supply of current of normal or reverse relative polarity to the line circuit system at the exit end of the stretch, means controlled over said line circuit system section by section and effective only when all of said track relay controlled contacts are closed for energizing said block relay, a block indication relay at said office remotely controlled by said block relay, and means effective when any portion of said stretch is occupied as manifested by the condition of said block indication relay for preventing the disconnection of said source of current from the line circuit system in response to the operation of said manually operable means.

8. In a signaling system for a stretch of railway track provided with continuous track circuits controlling a sectionalized line circuit and with signals at the entrances to block sections defined by said track circuits for governing traffic movements in a given direction through said stretch, in which each signal indicates caution or clear dependent upon the normal or reverse energization, respectively, of a polar line relay included in a line circuit section which is closed only when the block section directly in advance of such signal is unoccupied, each signal indicating stop when its line relay is deenergized, and in which the energized or deenergized condition of each line relay for an intermediate signal in said stretch controls the normal or reverse energization respectively of the line circuit section for the next block section in the rear thereof, the combination of a block relay at the entrance to said stretch, with means for superimposing a distinctive indication upon one or more sections of said line circuit to energize said block relay only when all the block sections are unoccupied, irrespective of the number of said sections, and a visual indicator controlled by said block relay.

9. In a signaling system for a stretch of railway track provided with continuous track circuits controlling a sectionalized line circuit and with signals at the entrances to block sections defined by said track circuits for governing traffic movements in a given direction through said stretch, in which each signal indicates caution or clear dependent upon the normal or reverse energization, respectively, of a polar line relay included in a line circuit section which is closed only when the block section directly in advance of such signal is unoccupied, each signal indicating stop when its line relay is deenergized, and in which the energized or deenergized condition of each line relay for an intermediate signal in said stretch controls the normal or reverse energization respectively of the line circuit section for the next block section in the rear thereof, the combination of a block relay at the entrance to said stretch, with means dependent upon the normal energization of the line relay for the second signal from the exit end of said stretch for increasing the current supplied to the line circuit portion in the rear of that signal by a predetermined amount, irrespective of the number of sections in said portion, means at the entrance to the stretch controlled over said last named line circuit portion and selectively responsive to said increased current for energizing said block relay, and a visual indicator controlled by said block relay for indicating when a train is occupying any portion of said stretch.

10. In a signaling system for a stretch of railway track provided with continuous track circuits controlling a sectionalized line circuit and with signals at the entrances to block sections defined by said track circuits for governing traffic movements in a given direction through said stretch, in which each signal indicates caution or clear dependent upon the normal or reverse energization, respectively, of a polar line relay included in a line circuit section which is closed only when the block section directly in advance of such signal is unoccupied, each signal indicating stop when its line relay is deenergized, and in which the energized or deenergized condition of each line relay for an immediate signal in said stretch controls the normal or reverse energization respectively of the line circuit section for the next block section in the rear there-

of, the combination of a block relay at the entrance to said stretch, with means dependent upon the normal energization of the line relay for the second signal from the exit end of said stretch for periodically varying the current supplied to the line circuit portion in the rear of that signal irrespective of the number of sections in such portion and without operatively affecting the line relay in any section, means at the entrance to the stretch selectively responsive to the periodic variations in current in said last named line circuit portion for energizing said block relay, and a visual indicator controlled by said block relay for indicating when a train is occupying any portion of said stretch.

11. In an absolute permissive block system for a stretch of railway track provided with continuous track circuits controlling a sectionalized line circuit and with signals at the entrances to block sections defined by said track circuits for governing traffic movements in opposite directions through said stretch, in which each signal indicates caution or clear dependent upon the normal or reverse energization, respectively, of a polar line relay included in a line circuit section which is closed only when the block section directly in advance of such signal is unoccupied, each signal indicating stop when its line relay is deenergized, and in which the energized or deenergized condition of each line relay for an intermediate signal in said stretch controls the normal or reverse energization respectively of the line circuit section for the next block section in the rear thereof; manually controllable means at a control office for energizing said line circuit at one end of the stretch or the other for establishing the direction of traffic movements through said stretch; a block relay at each end of said stretch, means for superimposing a distinctive indication upon one or more sections of said line circuit when energized at either end for energizing the block relay at the other end whereby one block relay or the other is energized when all the block sections are unoccupied, irrespective of the number of said sections, and direction locking means at said office controlled by said block relays for preventing the deenergization of said line circuit in response to the operation of said manually controllable means when a train is occupying any portion of said stretch.

12. In an absolute permissive block system for a stretch of railway track provided with continuous track circuits controlling a sectionalized line circuit and with signals at the entrances to block sections defined by said track circuits for governing traffic movements in opposite directions through said stretch, in which each signal indicates caution or clear dependent upon the normal or reverse energization, respectively, of a polar line relay included in a line circuit section which is closed only when the block section directly in advance of such signal is unoccupied, each signal indicating stop when its line relay is deenergized, and in which the energized or deenergized condition of each line relay for an intermediate signal in said stretch controls the normal or reverse energization respectively of the line circuit section for the next block section in the rear thereof; manually controllable means at a control office for energizing said line circuit at one end of the stretch or the other for establishing the direction of traffic movements through said stretch; a block relay at each end of said stretch, means for superimposing a distinctive indication upon one or more sections of said line circuit when energized at either end for energizing the block relay at the other end whereby one block relay or the other is energized when all the block sections are unoccupied, irrespective of the number of said sections, and means controlled by said block relays for preventing the deenergization of said line circuit in response to the operation of said manually controlled means for reversing the established direction of traffic unless one block relay or the other is energized.

13. In a signaling system, a stretch of railway track having a signal at each end for governing the movement of traffic into the stretch, a signal control relay for each signal, means controlled by each signal control relay when energized for clearing the associated signal in accordance with traffic conditions in said stretch but only if the signal at the other end of the stretch is at stop and its control relay is deenergized, control means at a central office comprising a signal lever for each signal, a two position directional relay of the polar stick type, signal indication means controlled by the signals, and block indication means controlled by traffic conditions in said stretch, a circuit for operating said directional relay to one position or the other when one signal lever or the other is reversed, each such circuit being closed only when the signal indication means indicates that the opposing signal is at stop and the block indication means indicates that the entire stretch is unoccupied, and a circuit controlled by each signal lever when reversed closed in response to the operation of the directional relay to said corresponding position for energizing the associated signal control relay.

14. In combination with a stretch of railway track having a signal at each end for governing the movement of traffic into the stretch, a manually controllable signal control relay for each signal, a directional relay of the two position type arranged to remain in its last operated position when deenergized, a signal lever for each signal, control circuits for said signal control relays including contacts controlled by said directional relay and by said levers, one control circuit being closed only when one signal lever is reversed and said directional relay is in one position and the other only when the other signal lever is reversed and said directional relay is in its other position, and a second circuit controlled by each lever for operating the directional relay to a corresponding position to establish the control circuit controlled by that lever, each said second circuit including contacts which when closed indicate that the stretch of track between said signals is unoccupied and the opposing signal is at stop.

15. In a centralized traffic control system for railroads, a stretch of railway track having a head block signal at each end and intermediate signals at spaced points within the stretch for governing the movement of traffic through the stretch in opposite directions, a control relay for each head block signal, an energizing circuit for each head block signal controlled in accordance with traffic conditions in said stretch and closed only when the associated control relay is energized, an energizing circuit for each intermediate signal closed when the portion of the stretch in advance thereof is unoccupied but only if the control relay for the opposing head block signal is deenergized; direction selecting means, block indication means, and a signal lever for each control relay, all located at a control office, cir-

cuits controllable by said signal levers when said block indication means is conditioned to indicate that the entire stretch is unoccupied for actuating said direction selecting means to one position or another to establish the desired direction for traffic movements through the stretch but without energizing either control relay, and a circuit controlled by each signal lever for selectively energizing the corresponding control relay closed in response to the actuation of said direction selecting means to the corresponding position.

16. In a centralized traffic control system for railroads, a stretch of railway track having a signal at each end for governing the movement of traffic into the stretch, a control relay for each signal, an energizing circuit for each signal closed when the associated control relay is energized and the control relay for the signal at the other end of the stretch is deenergized; direction selecting means, block indication means, and a signal lever for each control relay, all located at a control office, circuits controllable by said signal levers when said block indication means is conditioned to indicate that the entire stretch is unoccupied for actuating said direction selecting means to one position or another to establish the desired direction for traffic movements through the stretch but without energizing either control relay, and a circuit controlled by each signal lever for selectively energizing the corresponding control relay closed in response to the actuation of said direction selecting means to the corresponding position.

17. In combination with a hand throw track switch, two signals for governing traffic movements in a trailing direction over the two routes established by the track switch in its normal and reverse positions, respectively, a locking relay energized only when both said signals indicate stop, two manually controllable relays which may be picked up only when said locking relay is energized, a line relay controlled by traffic conditions in advance of said signals, means effective when one of said manually controllable relays and said line relay are both energized to release said locking relay, circuits for selectively clearing one signal or the other closed over contacts of said manually controllable relays according as one or both are picked up, each including a front contact of said line relay, a back contact of said locking relay and a contact controlled by the track switch which is closed only when the switch occupies a position to establish the route governed by the selected signal, and means effective if said one manually controllable relay is released to thereby restore the cleared signal manually to stop for delaying the energization of said locking relay until said signal has been at stop for a predetermined time interval.

18. In combination with a stretch of railway track having a signal at each end for governing traffic movements into the stretch, a locking relay for each signal energized only when such signal indicates stop, a line relay for each signal having an energizing circuit controlled by traffic conditions in said stretch and by a front contact of the locking relay for the opposing signal, a manually controllable relay for each signal which may be picked up only when the associated locking relay is energized, means effective when either manually controllable relay and the associated line relay are both energized for releasing the associated locking relay, a circuit for clearing each signal including front contacts of the associated manually controllable relay and line relay and a back contact of the associated locking relay, and means effective if such manually controllable relay is released to thereby restore the associated signal manually to stop for delaying the energization of the associated locking relay until such signal has been at stop for a predetermined time interval.

19. In a signaling system for railroads, a stretch of single track provided with head block signals located at each end for governing traffic movements in opposite directions into said stretch, a reversible line circuit system extending between the head block signal locations comprising a pair of line wires sectionalized at a plurality of intermediate locations, an electroresponsive device for controlling each signal, a directional relay at each end of the stretch, an energizing circuit for each directional relay including a contact controlled by the electroresponsive device for the signal at the same end of the stretch in series with a manually controlled contact, means for alternatively connecting the winding of each such electroresponsive device or a source of current to the line wires at the corresponding end of the stretch comprising back and front contacts, respectively, of the associated directional relay, means at said intermediate locations rendered effective when one directional relay or the other is picked up and the line circuit system is thereby energized at the corresponding end of the stretch in response to the closing of the associated manually controlled contact for extending such energization section by section to energize the electroresponsive device at the other end of the stretch, and means controlled by each electroresponsive device when energized for opening its contact in the circuit for the directional relay at the same end of the stretch.

20. In a signaling system for railroads, a stretch of single track divided into track sections each provided with a track circuit including a track relay, head block signals located at each end of the stretch for governing traffic movements in opposite directions into said stretch, a reversible line circuit system extending between the head block signal locations including front contacts controlled by said track relays, an electroresponsive device for controlling each signal, a directional relay, a directional stick relay and a manually controlled relay at each end of the stretch, means for alternatively connecting the winding of each line relay or a source of current to the line circuit system at the corresponding end of the stretch, comprising back and front contacts, respectively, of the associated directional relay, an energizing circuit for each directional relay including in series a back contact of the associated manually controlled relay, a contact which is held open as long as the associated electroresponsive device is energized, and a back contact of the associated directional stick relay, a pick-up circuit for each directional stick relay closed when a train enters the adjacent end of the stretch to deenergize the associated electroresponsive device, and a stick circuit effective to hold such directional relay picked up until the associated electroresponsive device is again energized.

21. In a signaling system for railroads, a stretch of single track provided with continuous track circuits provided with track relays and having head block signals located at each end for governing traffic movements in opposite direc-

tions into said stretch, an electroresponsive device for controlling each signal, a reversible line circuit system controlled by said track relays for controlling the operation of said electroresponsive devices, a directional relay at each end of the stretch, an energizing circuit for each directional relay including two contacts controlled by the electroresponsive device for the signal at the same end of the stretch in series with a manually controlled contact, means comprising front and back contacts, respectively, of each directional relay for alternatively connecting a source of current to the line circuit system to energize it at the adjacent end or for rendering the associated electroresponsive device responsive to the energization of the line circuit system effected by closing the manually closed contact at its distant end, means controlled by each electroresponsive device when energized for opening one contact in the circuit for the associated directional relay, means for opening the other contact controlled by such electroresponsive device in said circuit upon the release of the adjacent track relay when a train enters the same end of the stretch, and means for maintaining said other contact open upon the release of said electroresponsive device until it again becomes energized.

22. In a signaling system for railways, a stretch of track divided into block sections, a track circuit for each block section, each having a track relay, head block signals for governing traffic movements into the stretch in opposite directions, a manually controlled relay adjacent each signal, line circuits divided into sections corresponding to the block sections for controlling said signals, each line circuit section including contacts controlled by the track relays which are closed only when the corresponding block section is unoccupied, means comprising back contacts of each manually controlled relay for controlling the line circuit for that signal which governs traffic movements into the stretch at its opposite end, means comprising front contacts of each manually controlled relay for controlling that signal which governs traffic movements into the stretch at the adjacent end in accordance with the condition of one or more sections of its line circuit, a block relay at each end of the stretch, means for energizing each block relay over the line circuit for the adjacent signal but only if the track relay controlled contacts in each section of such line circuit are closed, and means preventing the operation of either manually controlled relay after the other manually controlled relay has been operated unless one block relay or the other is energized.

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