Dec. 20, 1938. H. S. YOUNG 2,141,074

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Oct. 30, 1937 4 Sheets-Sheet 1

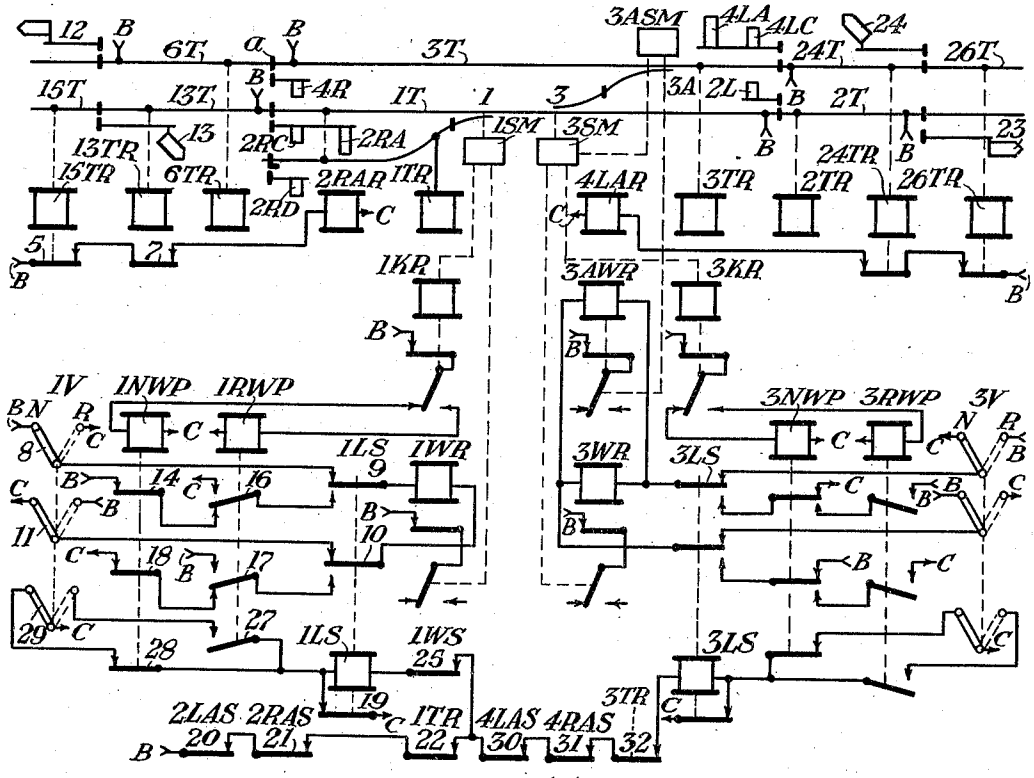


Fig. 1A.

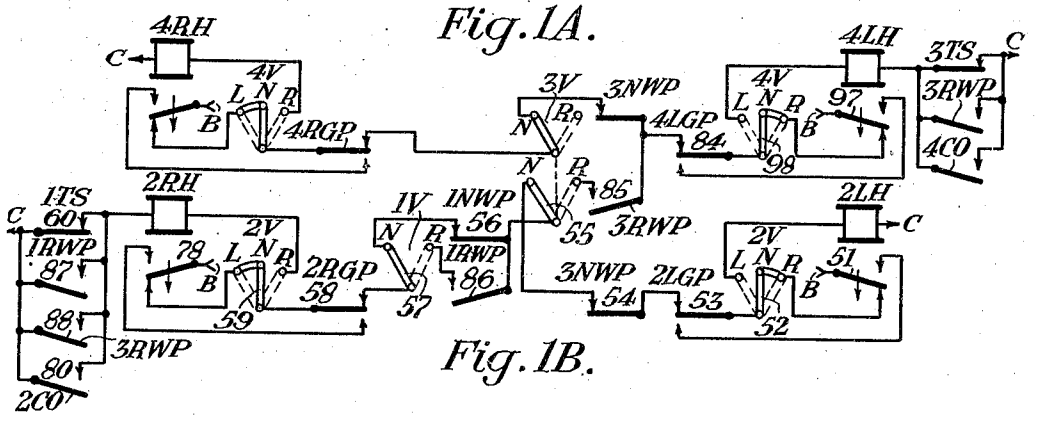


Fig. 1B.

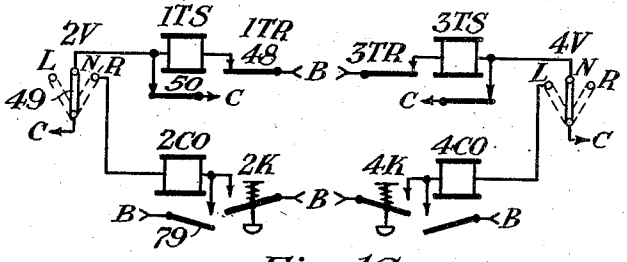


Fig. 1C.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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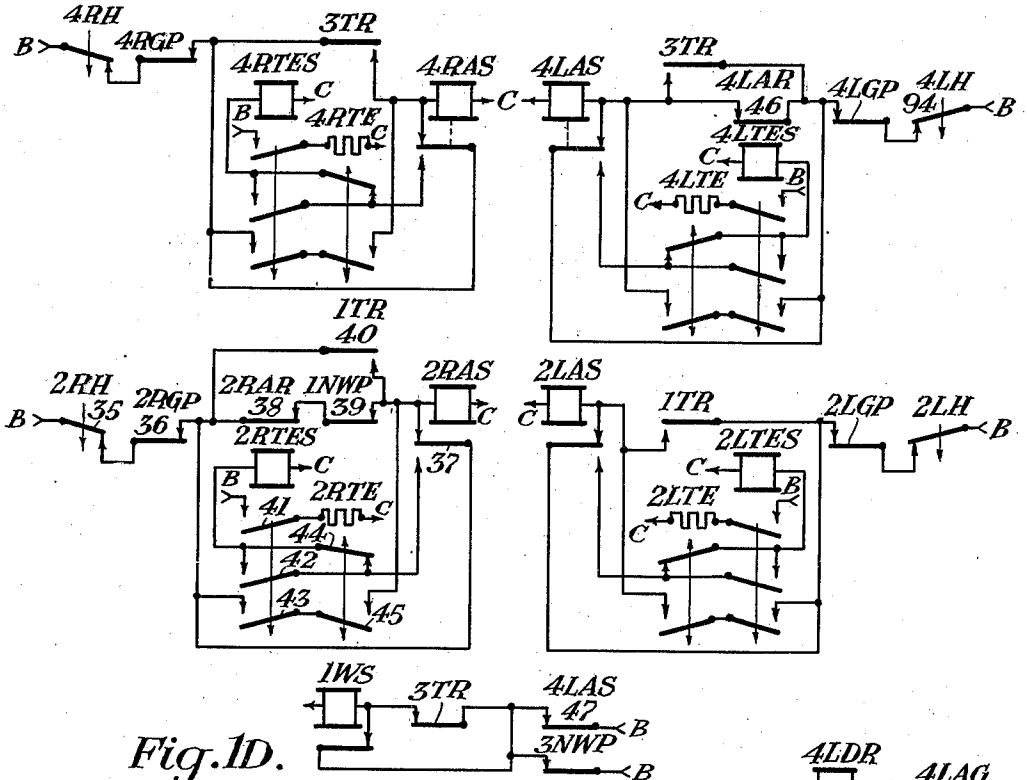


Fig. 1D.

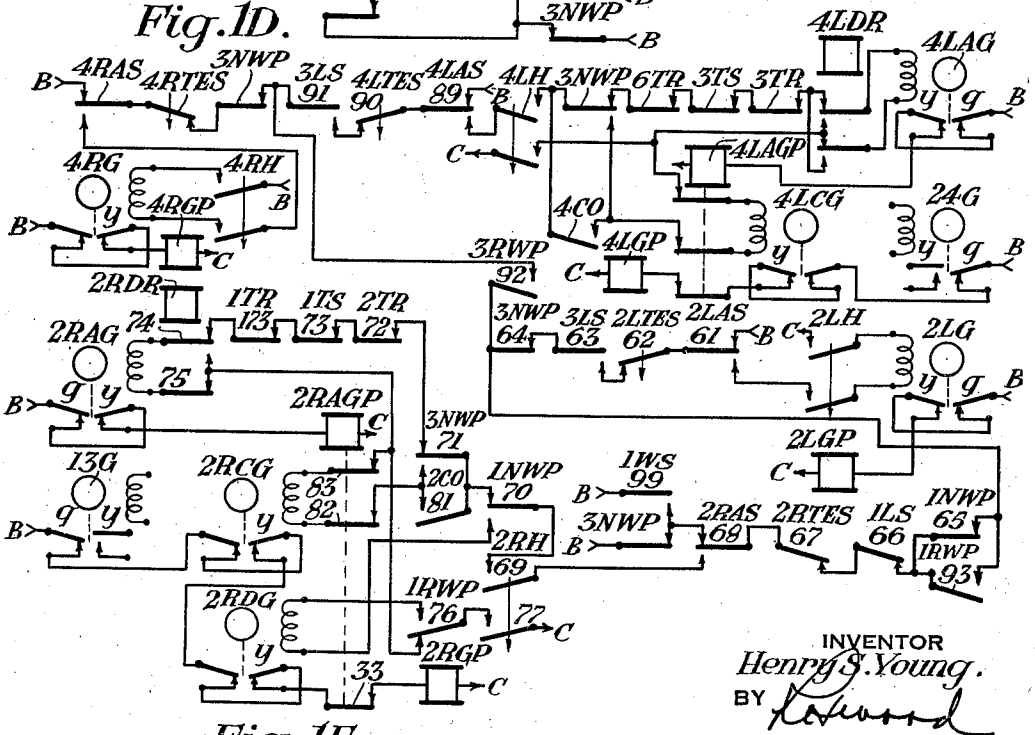


Fig. 1E.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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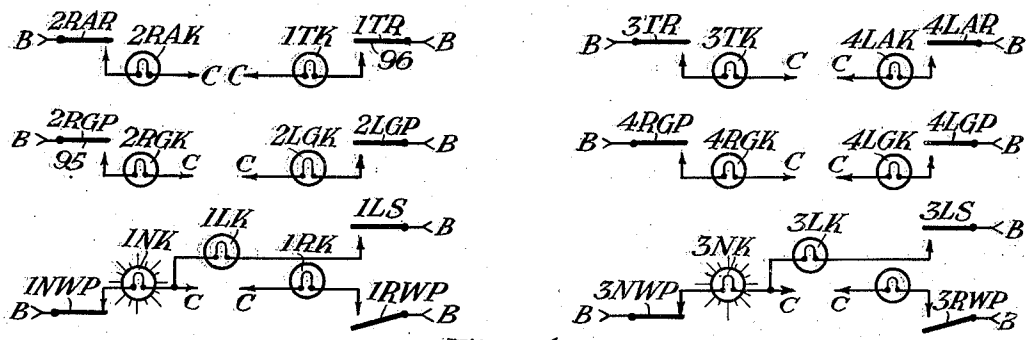


Fig. 1F.

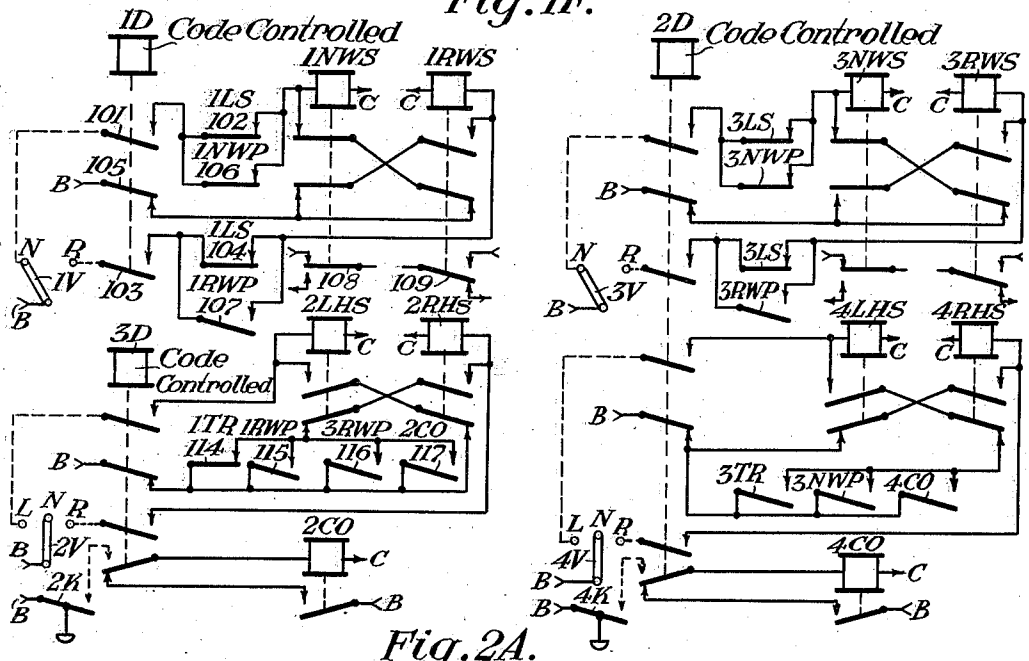


Fig. 2A.

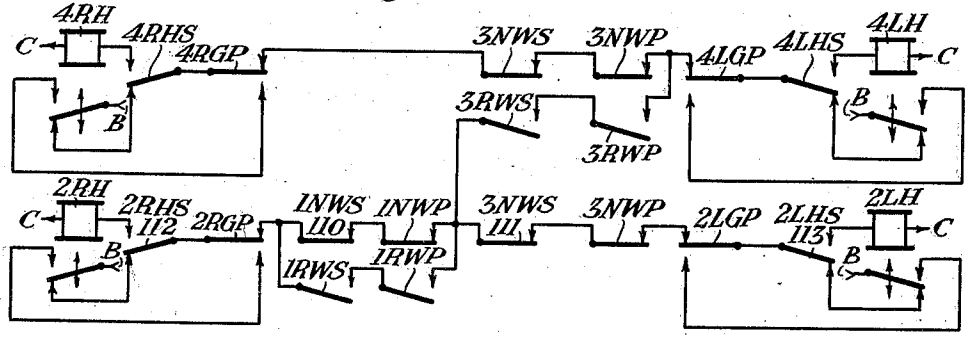


Fig. 2B.

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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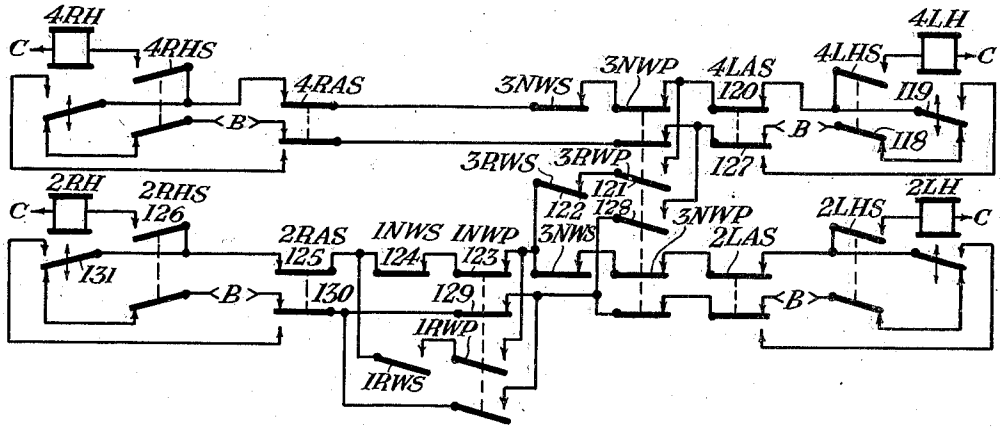


Fig. 3A.

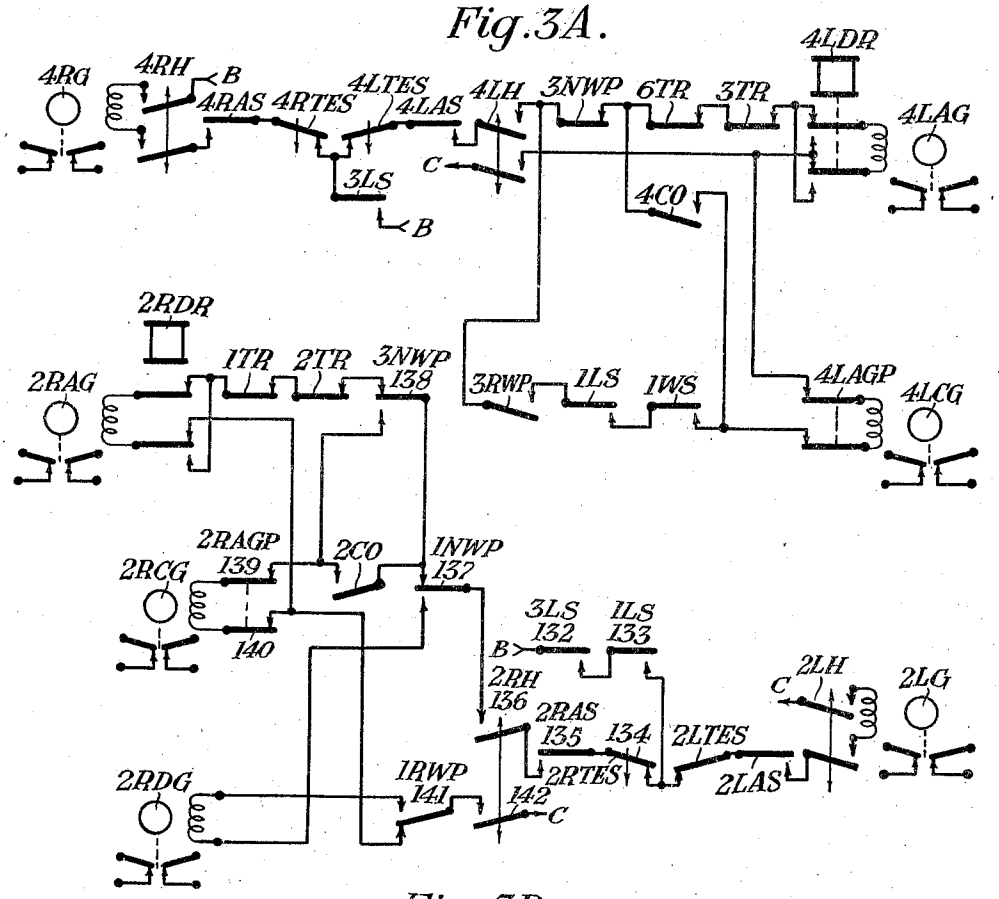


Fig. 3B.

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UNITED STATES PATENT OFFICE

2,141,074

RAILWAY TRAFFIC CONTROLLING APPARATUS

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Application October 30, 1937, Serial No. 171,923

25 Claims. (Cl. 246—134)

My invention relates to railway traffic controlling apparatus, and more particularly, to interlocking control apparatus for controlling from a centrally located control point the switches and signals of a track layout comprising a plurality of traffic routes.

The apparatus of my invention is an improvement upon that disclosed in the Allen, Brooks and Thompson application, Serial No. 505,328, filed December 29, 1930, for Railway traffic controlling apparatus, and upon that disclosed in the Allen and Thompson application Serial No. 695,294, filed October 26, 1933, for Interlocking control apparatus, and has for its object the provision of an improved system of relays and interconnected circuits for interlocking the switches and signals of a track layout, whereby the usual interlocked levers are eliminated and the apparatus is controlled by simple lever operated circuit controllers which are free to be moved at any time. A particular feature of my invention resides in the provision of means whereby a signal lever may be operated to clear a signal for a route as soon as the switch levers are operated to set up the route, and the signal will be prevented from clearing until each switch of the route governed by the signal agrees in position with its switch control means and is locked in that position, the locking for the switches of the route being rendered effective as soon as the route is fully established. Another object of my invention is the provision of improved means for insuring that any signal which is actually at clear will not be interfered with by the inadvertent operation of the switch lever for any switch of the route or by the operation of a signal lever for an opposing or conflicting signal. Another object of my invention resides in an arrangement of the apparatus such that it is readily adapted for use in a centralized traffic control system, the primary switch and signal control relays being arranged so that they may be controlled directly by the levers of a control machine or remotely through the medium of a communication system of a suitable type. Other objects, purposes and features of my invention will be pointed out as the description proceeds.

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

Referring to the accompanying drawings, Figs. 1A to 1F, inclusive, taken together, constitute a diagrammatic view of one form of the apparatus of my invention, in which the switches and signals of the track layout of Fig. 1A are arranged to be controlled directly by the levers of the control machine. Figs. 2A and 2B, taken together with Figs. 1A, 1D, 1E, and 1F, constitute a diagrammatic view of a modification of the first form of my apparatus in which the switches and signals are controlled locally by certain relays shown in Fig. 2A instead of by levers, these relays being remotely controlled by levers through the medium of a communication system. To illustrate this second form of my apparatus, Fig. 2B is substituted for Fig. 1B in the drawings of the first form, Fig. 2A is added and Fig. 1C is omitted. Figs. 3A and 3B, taken together with Figs. 1A, 1D, 1F and 2A, constitute a diagrammatic view of a third form of my apparatus also arranged for remote control but employing different circuits. To illustrate the third form, Figs. 3A and 3B are substituted for Figs. 2B and 1E, respectively, in the drawings of the second form of the apparatus.

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

In order to simplify the description, I shall first explain the functions of the several parts of the first form of my apparatus, and shall then describe its operation under selected conditions in detail, and I shall then point out the distinguishing features of the other forms of my apparatus.

Referring to Fig. 1A, while a specific track layout is disclosed, it is to be understood that the apparatus of my invention is adapted to control other track layouts that may involve entirely different combinations of switches and signals, the relatively simple layout shown, however, being adequate to illustrate the principles of my invention. The upper portion of Fig. 1A illustrates by a single line diagram a track layout comprising a portion of each of the two main tracks of a double track railway connected by a crossover comprising the track switches 3 and 3A, the lower track being also connected to a siding by a single switch 1. The movement of traffic over the switches is governed by the signals bearing the references 2 and 4 with distinguishing suffixes R and L indicating the direction of traffic governed by the signals. It is to be understood that the rails of the tracks are divided into sections by insulated joints *a*, the main track sections including the switches, and extending from one of a pair of opposing signals to the other, being indicated by the references 1T and 3T, respectively, while the track circuits for the adjoining approach sections are indicated by the references 15T, 13T, 2T, 6T, 24T, and 26T,

respectively. Each track section is provided with the usual closed track circuit including a normally energized track relay in accordance with standard practice, as indicated diagrammatically in the drawings, each track relay being identified by the reference letter R with a prefix indicating the track section with which it is associated.

It is also to be understood that the track layout is located in territory in which the main tracks are equipped with automatic block signals of the usual type, the automatic signals adjacent the layout being indicated by the references 12, 13, 23 and 24, respectively, on the track diagram. Signals 2RA and 4LA are high speed signals with the usual semi-automatic stick control. Signal 2RA indicates stop when section 1T or 2T is occupied, but may be manually controlled to indicate caution when these sections are unoccupied and its indication will then change automatically to proceed if the next signal 23 in advance indicates caution or proceed. Signal 4LA is similarly controlled by track sections 3T and 6T and by the automatic signal 12. Signals 2RC, 2RD, 2L, 4R and 4LC are each slow speed signals which are controlled manually independently of track conditions, in accordance with the usual practice. Signals 2RC and 4LC also serve as "call-on" signals which may be cleared to permit trains to enter the routes governed by signals 2RA and 4LA, respectively, when these routes are already occupied and the high speed signals are thereby prevented from clearing.

In the circuit plans, each relay is identified by a letter or combination of letters, prefixed by the designation of the switch or signal with which it is associated, and in order to enable the circuits to be more readily understood, they are arranged in the written circuit form with similar circuits grouped together in the same view. In circuits of this form, the relay contacts are not necessarily adjacent the respective relays which operate them, and a contact is identified not only by a number but more particularly by showing the designation of the relay which operates it about the contact. Furthermore, instead of showing the local source or sources of current for energizing the relays and the wires leading thereto in detail, I have shown only the terminals of the sources, which I have designated by the reference character B, referring to the positive or supply terminal, and by the reference character C, referring to the negative or common terminal. Thus, referring to Fig. 1A, the circuit for the approach relay 2RAR may be traced from one terminal B of a source of current, front contacts 5 and 7 of track relays 15TR and 13TR through the winding of relay 2RAR to the other terminal C of the same source, this circuit being opened when track section 15T or 13T is occupied by a train. The approach relay 4LAR for the upper track is similarly controlled by the track relays for the sections 24T and 26T as is obvious from the drawings.

Each of the switches 1, 3, and 3A is actuated by a power operated switch machine of the usual type identified in Fig. 1 by the references 1SM, 3SM and 3ASM, respectively. Each switch machine is provided with a motor, not shown, having an operating circuit controlled by contacts of a polarized relay WR, as indicated by a dotted line connection on the drawings. The local switch machine circuits have been omitted to simplify the drawings, but these may be arranged for example, as shown in Patent No. 2,046,049, granted June 30, 1936, to Earl M. Allen, for Railway traffic controlling apparatus. Each track switch or crossover is provided with the usual polarized indication relay KR and each relay KR controls normal and reverse switch indication repeating relays NWP and RWP, respectively, as shown on the drawings. For an understanding of the present invention it is believed sufficient to point out that relay 1NWP is energized only when the track switch 1 is closed and locked by switch machine 1SM in its normal position and that relay 1RWP is energized only when switch 1 is locked reverse; similarly, relay 3NWP is energized only when the crossover switches 3 and 3A are locked normal while relay 3RWP is energized only when the crossover switches are locked reverse. These relays constitute the means by which the various circuits of my invention are controlled in accordance with the positions and locked condition of the track switches.

Each manually operable switch or signal control lever herein disclosed is designated by the general reference V, with a prefix indicating the switch or signals which the lever controls. It is to be understood that in accordance with the usual practice these levers are mounted on a panel located at the control office and containing a miniature representation of the track layout, not shown, and associated with the levers and track diagram there are a plurality of indication lamps, as shown in Fig. 1F, for indicating track conditions to the operator and for guiding him in the operation of the control levers. The switch lever 1V, for example, as shown in Fig. 1A, controls the relative polarity of the current supplied to the operating circuit for the switch control relay 1WR, while the continuity of this circuit is controlled by the contacts of a switch locking relay 1LS. The normal circuit for relay 1WR may be traced from terminal B, normal contact 8 of lever 1V, front contact 9 of relay 1LS, relay 1WR, front contact 10 of relay 1LS, normal contact 11 of lever 1V to terminal C. The reverse circuit for relay 1WR is similar, but energizes relay 1WR in the opposite direction, as will be obvious from the drawings. Relay 1WR is also provided with holding circuits for maintaining it energized in its last-operated postion when relay 1LS is deenergized. The normal holding circuit for relay 1WR may be traced from terminal B, front contact 14 of relay 1NWP, back contacts 16 and 9 of relays 1RWP and 1LS, relay 1WR, back contacts 10 and 17 of relays 1LS and 1RWP, front contact 18 of relay 1NWP to terminal C. The reverse holding circuit for relay 1WR is similar, but includes front contacts 17 and 16 of relay 1RWP, as will be apparent from the drawings.

Relay 1LS is picked up to close the operating circuit for relay 1WR only when certain approach locking relays AS, a section locking relay 1WS, and the detector section track relay 1TR are energized. As hereinafter pointed out, the control is such that relay 1LS can be picked up only when all the signals 2R and 2L are at stop and section 1T is unoccupied, while if the crossover 3 is reversed, the signals 4L must also be at stop. Furthermore, the circuits for relay 1LS are so arranged that this relay will pick up only when lever 1V occupies a position corresponding to that of switch 1. The normal pick-up circuit for relay 1LS may be traced from terminal B, contacts 20, 21, 22 and 25 of relays 2LAS, 2RAS, 1TR, and 1WS, relay 1LS, contact 28 of relay 1NWP and normal contact 29 of lever 1V to terminal C. The reverse pick-up circuit for relay

1LS is similar but includes contact 27 of relay 1RWP and reverse contact 29 of lever 1V, as is apparent from the drawings. After relay 1LS has picked up, contacts 28 and 29, or 27 and 29, as the case may be, are bridged by front contact 19 of relay 1LS which also connects to terminal C, so that relay 1LS is not released as a result of a subsequent movement of lever 1V. It follows, therefore, that a movement of lever 1V while relay 1LS is released is without effect, and that this lever operation is not "stored" to become effective automatically upon the removal of the condition which caused relay 1LS to release, but on the contrary, the switch lever movement, to be effective, must be made at a time when the switch locking is released and relay 1LS is energized.

The switch lever 3V controls the switch control relays 3WR and 3AWR for the crossover switches by circuits which are generally similar to those for switch 1, and a detailed description of these circuits therefore appears unnecessary, except to point out that in place of contact 25 of relay 1WS, the circuit for relay 3LS includes contacts 30 and 31 of the approach locking relays 4LAS and 4RAS which are closed only when signals 4R and 4L are at stop, and also includes contact 32 of relay 3TR, which is closed only when section 3T is unoccupied.

The signals are controlled by the signal levers 2V and 4V, through the medium of two circuit networks, comprising a route circuit network shown in Fig. 1B, which includes route relays H controlled directly by the signal levers, and a signal circuit network, shown in Fig. 1E, which includes signal mechanisms G controlled by the relays H.

The signal levers 2V and 4V also control certain auxiliary relays shown in Fig. 1C, including a call-on stick relay CO for each call-on signal, controlled jointly by the signal lever and by a manually operable push button K, and a track stick relay TS for each main track controlled jointly by the signal lever and by the track relay TR. The relays TS function in a well-known manner to prevent the high speed signals 2RA and 4LA from clearing automatically when trains governed by these signals have passed beyond the control limits of the signals.

Although the signals controlled by the apparatus of my invention may be of any desired type, it is to be understood that those herein illustrated are of the searchlight type, and that the signal mechanisms G shown in Fig. 1E are of the form disclosed in the E. J. Blake Reissue Patent No. 14,940, of August 31, 1920. Each signal, or group of signals, is provided with the usual back-lock or signal indication relay GP as shown in Fig. 1E. More particularly, the mechanism 2RAG for signal 2RA controls an indication relay 2RAGP having a circuit which extends from terminal B over back contacts *g* and *y* of mechanism 2RAG through relay 2RAGP to terminal C. It is to be understood that each back contact *g* opens when the signal mechanism which controls it is energized by current of the proper polarity to cause the signal to indicate proceed, and that each back contact *y* opens when the mechanism is energized by current of the opposite polarity to cause the signal to indicate caution. It follows, therefore, that relay 2RAGP is energized only when signal 2RA indicates stop. The control of relays 2LGP, 4RGP and 4LAGP by signal mechanisms 2LG, 4RG and 4LAG, respectively, is similar, as is obvious from the drawings. Relay 2RGP has a circuit which extends from terminal B over back contact *g* of mechanism 13G, the back contacts of mechanisms 2RCG and 2RDG, front contact 33 of relay 2RAGP, relay 2RGP to terminal C, so that relay 2RGP is energized only when signals 2RA, 2RC, and 2RD indicate stop and the distant signal 13 indicates stop or caution. Relay 4LGP is similarly controlled by signals 4LA, 4LC, and 24, as will be clear from the drawings.

Referring now to Fig. 1D, an approach locking relay AS is provided for each signal or group of signals, and each relay AS is controlled jointly by the relays H and GP for the corresponding signal or signals. Relay 2RAS, for example, is normally energized over a stick circuit which may be traced from terminal B, back contact 35 of relay 2RH, front contact 36 of relay 2RGP, and the front contact 37 and winding of relay 2RAS to terminal C. Relay 2RAS is therefore energized only when relay 2RGP is picked up, that is, when signals 2RA, 2RC, and 2RD are at stop and signal 13 is at stop or caution, and releases whenever relay 2RH is picked up for the purpose of clearing one of the signals 2R. Relay 2RAS may be picked up as soon as signal 2RA or 2RC is manually put to stop, provided the approach section 13T—15T is unoccupied, over a circuit which may be traced from terminal B, contacts 35 and 36 of relays 2RH and 2RGP, front contact 38 of the approach relay 2RAR hereinbefore referred to, contact 39 of relay 1NWP, relay 2RAS to terminal C. It will be noted that this circuit is not available when signal 2RD is put to stop because contact 39 of relay 1NWP is then open. Relay 2RAS may also be picked up when a train passes one of the signals 2R and enters section 1T, provided the signal is put to stop and relay 2RH released, over the branch of the pick-up circuit just traced which includes back contact 40 of relay 1TR. Under other conditions, relay 2RAS picks up at the end of a predetermined time interval after one of the signals 2R is manually put to stop. If relay 2RAS fails to pick up in response to the closing of contacts 35 and 36, a circuit is completed from terminal B over these contacts, back contact 37 of relay 2RAS, back contact 44 of a thermal relay 2RTE, through the winding of a slow acting stick relay 2RTES to terminal C. Relay 2RTES therefore picks up, closing contact 42 to complete its stick circuit and contact 41 to energize the heating element of relay 2RTE. Relay 2RTE opens contact 44, and at the end of the predetermined time period closes contact 45 to complete a circuit over contact 43 of relay 2RTES to pick up relay 2RAS. The latter relay, upon picking up, releases relay 2RTES which in turn deenergizes relay 2RTE.

The time releasing apparatus comprising relays 2RTE and 2RTES becomes available for further use as soon as the thermal relay has cooled and is fully restored to normal as indicated by the closing of contact 44.

The circuits for relays 2LAS, 4RAS and 4LAS are generally similar to those already traced. Relays 2LAS and 4RAS are provided with detector track release and time release only, and their circuits correspond to the control of relay 2RAS by signal 2RD, while relay 4LAS has an approach release circuit in addition, including contact 46 of relay 4LAR, so that it is controlled in a manner corresponding to the control of relay 2RAS by signals 2RA and 2RC.

Relay 1WS is a section locking relay which is

released by the opening of contact 47 of relay 4LAS when signal 4LC is cleared for a train movement over switches 3 and 3A reversed, and its purpose is to lock switch 1 for the train movement mentioned. A section locking relay similar to relay 1WS is shown and fully described in the Allen patent hereinbefore referred to, and a detailed explanation of its operation in the present case therefore appears unnecessary.

The back lock relays GP, above described, in addition to controlling the approach locking relays AS, control the route circuit network of Fig. 1B. The relays AS control the switch locking relays LS as already described in connection with Fig. 1A, and the relays AS and LS jointly control the signal circuit network of Fig. 1E.

I shall now describe the operation of the first form of my apparatus under different assumed conditions. I shall first assume that the apparatus is in the condition shown in the drawings, and that the operator desires to clear signal 2RA to permit the movement of a train from left to right over the lower main track.

Since the route is already lined up, as indicated by the lighting of lamps 1NK and 3NK, Fig. 1F, the operator will merely move signal lever 2V to the right. Assuming section 1T to be unoccupied, relay 1TS, Fig. 1C, will have been energized over contact 48 of relay 1TR and normal contact 49N of relay 2V and will be held energized over its own front contact 50 after contact 49N is opened, so that a pick-up circuit for the route relay 2RH will be closed, which circuit may be traced in Fig. 1B from terminal B, back contact 51 of relay 2LH, contact 52R of lever 2V, contacts 53 and 54 of relays 2LGP and 3NWP, contact 55N of switch lever 3V, contact 56 of relay 1NWP, contact 57N of switch lever 1V, contact 58 of relay 2RGP, contact 59R of signal lever 2V, relay 2RH, contact 60 of relay 1TS to terminal C. It will be seen that the closing of the circuit just traced requires the opposing route relay 2LH to be deenergized and the opposing signal for the route to be at stop, and also requires each switch of the route to be locked in a position corresponding to that of its control lever.

Relay 2RH, upon becoming energized, opens contact 35, Fig. 1D, to release relay 2RAS, and the latter relay opens contact 21, Fig. 1A, to release the switch locking relays 1LS and 3LS, which relays then cause lamps 1LK and 3LK of Fig. 1F associated with the switch levers to become lighted, and also lock the route by opening the operating circuits for the relays WR. The release of the locking relays completes the signal circuit for mechanism 2RAG, Fig. 1E, which may be traced from terminal B, front contact 61 of relay 2LAS, back contacts 62 and 63 of relays 2LTES and 3LS, front contacts 64 and 65 of relays 3NWP and 1NWP, back contacts 66, 67 and 68 of relays 1LS, 2RTES, and 2RAS, front contacts 69 and 70 of relays 2RH and 1NWP, front contacts 71, 72, 73, 173, and 74 of relays 3NWP, 2TR, 1TS, 1TR, and 2RDR, the winding of mechanism 2RAG, front contact 75 of relay 2RDR, back contact 76 of relay 1RWP, front contact 77 of relay 2RH to terminal C.

It is to be noted that front contact 61 of relay 2LAS in the circuit just traced insures that the opposing signal is approach locked, while contact 67 of relay 2RTES checks the condition of the time release controlled by signal 2RA and back contacts 66 and 63 of relays 1LS and 3LS insure that the route is locked. Relay 2RDR is the usual distant signal relay and it is to be understood that it is controlled in the usual manner by the next signal 23 in advance. Its contacts 74 and 75 constitute a pole changer and control the relative polarity of the current supplied to mechanism 2RAG to cause signal 2RA to indicate caution when signal 23 indicates stop, and to indicate proceed when signal 23 indicates caution or proceed. Contacts 173 and 72 of relays 1TR and 2TR provide the usual track circuit control and are closed only if the sections between signals 2RA and 23 are unoccupied.

Contact 73 of relay 1TS operates to retain signal 2RA at stop until lever 2V is again operated, even though sections 1T and 3T become vacated, as will be clear from a consideration of the circuits for that relay shown in Fig. 1C.

When mechanism 2RAG is energized over the circuit just traced, the circuit for relay 2RAGP is opened at contact g or y of mechanism 2RAG, and relay 2RAGP releases, opening contact 33 to release relay 2RGP. Relay 2RGP, upon releasing, closes contact 95 to light lamp 2RGK, Fig. 1F, to indicate the clearing of the signal, and at contact 58, Fig. 1B, disconnects relay 2RH from the route circuit network and completes a local stick circuit for relay 2RH from terminal B over its front contact 78, back contact 58 of relay 2RGP, front contact 59R of lever 2V, relay 2RH, contact 60 of relay 1TS to terminal C.

It will be clear from the foregoing the signal cannot be cleared unless the route is locked, and that after the signal has cleared it cannot be interfered with by inadvertent manipulation of the switch levers nor by operation of the signal lever contact 52 which controls the opposing signal, assuming contact 52 and contact 59 to be on separate levers instead of on the same lever 2V, as shown.

I shall next assume that the approaching train passes signal 2RA at clear and enters section 1T. Relay 1TR releases, closing contact 96 to light lamp 1TK and opening contacts 48 and 173, deenergizing relay 1TS and mechanism 2RAG. Relay 1TS releases and opens contacts 73 and 60 in the circuits for mechanism 2RAG and relay 2RH. Relays 2RAGP and 2RGP pick up; relay 2RGP extinguishes the indication lamp 2RGK; and relay 2RH releases to open contacts 69 and 77 in the circuit for mechanism 2RAG, Fig. 1E. The pick-up circuit for relay 2RAS, Fig. 1D, is now closed at contacts 35, 36 and 40 and relay 2RAS picks up, opening back contact 68, Fig. 1E, in the circuit for mechanism 2RAG, and closing contact 21, Fig. 1A, in the circuits for relays 1LS and 3LS. The latter relays, however, remain released because contact 22 of relay 1TR is open.

I shall now assume that the operator desires to clear the call-on signal 2RC to admit a second train to section 1T before the first train has vacated sections 1T and 2T. He will operate key 2K momentarily to pick up relay 2CO, Fig. 1C, over the circuit including contact 49R of lever 2V, and relay 2CO will then be held energized over that contact and its own front contact 79 as long as lever 2V remains in its right-hand position. The pick-up circuit previously traced for relay 2RH is open at contact 60 of relay 1TS only, but this contact is now bridged by contact 80 of relay 2CO so that relay 2RH picks up and opens contact 35, Fig. 1B, to release relay 2RAS.

The circuit previously traced for mechanism 2RAG is now open at contact 73 of relay 1TS or at contact 72 of relay 2TR, but a circuit for mechanism 2RCG is now closed which extends from terminal B over contacts 61 to 70, inclusive,

as previously traced, thence over contact 81 of relay 2CO, contact 82 of relay 2RAGP, the winding of mechanism 2RCG, contacts 83, 76 and 77 to terminal C. Mechanism 2RCG becomes energized to cause signal 2RC to indicate caution slow speed, and opens its contact *y* to release relay 2RGP, whereupon lamp 2RGK is lighted and relay 2RH becomes disconnected from the route circuit by the operation of contact 58 as already described.

Upon the return of lever 2V to position N after the second train passes signal 2RC, relay 2RH is released by the opening of contact 59R to return the signal to its stop position and to permit relay 2RAS to be reenergized.

When the train vacates section 1T, relays 1LS and 3LS again pick up to release the switch locking, and lamps 1LK and 3LK are extinguished to indicate to the operator that the operating circuits for the switch control relays have been restored.

Since the circuits are symmetrically arranged for the two directions, it is apparent that a movement of lever 4V to the left will initiate a sequence of operations similar to those already described to clear signal 4LA if sections 3T—6T are unoccupied, or if one of these sections is occupied and key 4K is also operated, to clear the call-on signal 4LC, and it is believed that the control of these signals will be readily understood without further explanation.

I shall now assume that the apparatus is in the condition shown in the drawings, and that the operator desires to clear signal 2RD for a movement from the siding over switches 1, 3 and 3A reversed to section 24T. He will reverse levers 1V and 3V, the response of the switches being indicated by the extinguishing of lamps 1NK and 3NK, and will then move lever 2V to the right. The movement of the switch levers out of correspondence with the switch indication relays results in opening all the route circuits of Fig. 1B, so that the movement of the signal lever is temporarily ineffective. However, when the switches complete their movements to the reverse locked position in response to the operation of the switch levers, relays 1RWP and 3RWP pick up and complete circuits to light their respective indication lamps 1RK and 3RK, and also complete a pick-up circuit for relay 2RH which may be traced in Fig. 1B from terminal B, back contact 97 of relay 4LH, contact 98N of lever 4V, front contacts 84 and 85 of relays 4LGP and 3RWP, contact 55R of lever 3V, contact 86 of relay 1RWP, contact 57R of lever 1V, contact 58 of relay 2RGP, contact 59R of lever 2R, relay 2RH, contacts 87 and 88, in multiple, of relays 1RWP and 3RWP, to terminal C. Relay 2RH upon becoming energized releases relay 2RAS, which in turn releases relays 1LS and 3LS as already described, thereby completing a circuit for mechanism 2RDG which may be traced in Fig. 1E from terminal B, front contact 89 of relay 4LAS, back contacts 90 and 91 of relays 4LTES and 3LS, front contacts 92 and 93, of relays 3RWP and 1RWP, back contacts 66, 67 and 68 of relays 1LS, 2RTES and 2RAS, front contact 69 of relay 2RH, back contact 70 of relay 1NWP, the winding of mechanism 2RDG, front contacts 76 and 77 of relays 1RWP and 2RH to terminal C. Mechanism 2RDG will therefore become energized to clear the signal 2RD and to release relay 2RGP to light lamp 2RGK and to disconnect relay 2RH from the route network.

It will be clear that as in the case previously described, the signal cannot be cleared unless the corresponding route is locked and that the opposing signal 4LC for the same route is at stop, and that the cleared signal cannot be interfered with by movement of the switch levers nor by the signal lever 4V which controls the opposing signal 4LC for the same route.

My apparatus is also arranged to provide time locking of the opposing signals for each route, which functions in such a manner as to prevent the operator from putting a signal to stop in the face of an approaching train and immediately clearing the opposing signal for the same route. To illustrate this feature, I shall assume that the operator restores lever 2V to normal and moves lever 4V to the left to reverse the direction of traffic over the route last described. From an inspection of Fig. 1B, it will be evident that relay 2RH will release to put signal 2RD to stop and that relay 2RGP will pick up to complete a circuit from terminal B at back contact 78 of relay 2RH for energizing relay 4LH. Relay 2RAS, however, will remain deenergized until the end of the time period imposed by relay 2RTE. Relay 4LH by opening contact 94, Fig. 1D, will release relay 4LAS, thereby opening contact 47 to release relay 1WS, and closing back contact 89 to prepare a circuit for mechanism 4LCG. Contacts 25 and 30, Fig. 1A, in the circuits for relays 1LS and 3LS being open, these relays remain deenergized. At the expiration of the time locking period, relay 2RAS picks up and completes a circuit from terminal B over back contact 99 of relay 1WS, Fig. 1E, and front contact 68 of relay 2RAS for mechanism 4LCG, which circuit may be readily traced from the drawings, being otherwise analogous to the circuit for the opposing signal mechanism 2RDG hereinbefore traced in detail. Signal 4LC will therefore clear a measured time after signal 2RD is put to stop.

In view of the foregoing detailed description of the circuits for certain routes, it is believed that a step-by-step explanation of the remainder is unnecessary. The route circuits of Fig. 1B for relays 4RH and 2LH are obviously analogous to those described in detail for relays 2RH and 4LH, while the circuits for the corresponding signal mechanism 4RG and 2LG are similar to those for mechanisms 2RAG and 4LAG except that the track circuit control and line controlled pole changers are omitted.

As hereinbefore mentioned, my apparatus is particularly adapted to remote control. In the second form of my apparatus, the switch and signal lever contacts in the several circuits are replaced locally by the contacts of switch and signal control relays NWS, RWS, LHS and RHS, Fig. 2A, which repeat the positions of the levers of the operator's panel at the control office. These relays may be controlled in any desired manner, as for example, by direct wire connections or preferably by means of a selective communication system of a suitable type. One type of communication system suitable for controlling the apparatus of my invention is that disclosed and claimed in a copending application Serial No. 600,786, filed March 23, 1932, by Lloyd V. Lewis, for Remote control systems. For an understanding of my invention it is believed sufficient to point out that in that system the communication between the control office and the station at which the track layout is situated is effected by means of code signals, each contain-

ing elements identifying the positions of one or more control levers, the receipt of each code being characterized by the momentary energization of a code delivery relay D to actuate one or more of the control relays in accordance with the positions of the corresponding levers. This is illustrated diagrammatically in Fig. 2A by dotted line connections to the respective levers. For example, it is to be understood that if the delivery relay 1D is operated momentarily when the locking relay 1LS of Fig. 2A is energized, a circuit is completed over contacts 101 and 102 of relays 1D and 1LS to energize relay 1NWS, or over contacts 103 and 104 of these relays to energize relay 1RWS, to correspond with the normal or reverse position, respectively, of the switch control lever 1V at the control office, and that when relay 1D releases a stick circuit is completed over its back contact 105 to hold the operated switch control relay energized until relay 1D is operated by a succeeding code. The delivery relay 2D is responsive to another code, and governs the control relays for the crossover switches 3 and 3A and at the same time governs signal control relays 4LHS and 4RHS in accordance with the position of signal lever 4V, in a similar manner. Relay 2D also governs the call-on relay 4CO in accordance with the position of key 4K. Relay 3D, which is responsive to a third code, similarly governs the signal control relays 2LHS and 2RHS and the call-on relay 2CO.

The switch control relays NWS and RWS are each provided with contacts for controlling the polarity of current supplied to the operating circuit for the corresponding relay WR. Thus for example, it is to be understood that contacts 108 and 109 of relays 1NWS and 1RWS replace contacts 8 and 11 of lever 1V in the circuits for relay 1WR, shown in Fig. 1A, in this form of the apparatus. Furthermore, the route network of Fig. 2B replaces that of Fig. 1B, and differs therefrom principally in that lever contacts are replaced by control relay contacts; for example, contacts 57N and 55N of the switch levers 1V and 3V are replaced by contacts 110 and 111 of relays 1NWS and 3NWS, and contacts 59 and 52 of lever 2V by contacts 112 and 113 of relays 2RHS and 2LHS. It is to be understood that the route relays RH and LH of Fig. 2B control the signal circuit network of Fig. 1E as hereinbefore described in connection with the similar relays of Fig. 1B, and that the indication lamps of Fig. 1F are remotely controlled through the medium of the communication system and not directly, as shown. Referring now to Fig. 2B, it will be noted that relay 2RH is connected directly to terminal C and that contacts 60 of relay 1TS and contacts 80, 87 and 88 bridging that contact in Fig. 1B are omitted. These contacts, it will be remembered, were provided in order to cause relay 2RH to release so as to permit 2RAS to be picked up as soon as a train passed signal 2RA at clear, and relay 1TS was provided to insure that signal 2RA would remain at stop unless lever 2V was again operated even though sections 1T and 2T were vacated. These results are obtained in the second form of the apparatus by including contact 114 of relay 1TR in the stick circuit for relay 2RHS, Fig. 2A, and by bridging contact 114 by contacts 115, 116 and 17 of relays 1RWP, 3RWP and 2CO, a similar provision being made in the case of relay 4LHS. Relays 1TS and 3TS are therefore omitted in this form of the apparatus.

If signal 2RA is cleared by an operation of relay 2RHS, it will be readily apparent that when a train accepts the signal, relay 2RHS and mechanism 2RAG will be released by the opening of contacts 114 and 173, respectively, of relay 1TR and that the opening of contact 112 of relay 2RHS, Fig. 2B, will cause relay 2RH to release to permit relay 2RAS to pick up, as in the first form of the apparatus, and that relay 2RHS will remain deenergized until the operator sends a new code to reenergize it.

It is to be understood that the operation of the communication system is such that if a plurality of codes are stored simultaneously, the codes delivered by relays 1D, 2D, 3D will be transmitted successively, and in that order. It will be evident, therefore, that the circuits of Fig. 2A are so arranged that the signal control relays will be operated by the last of the series of one or more codes required to set up a route in each case. Thus assuming that the apparatus of Fig. 2B is in the condition shown and that signal 2RD is to be cleared, the first code will pick up relay 1RWS and release relay 1NWS to reverse switch 1, and the circuit of relay 2RH will be opened at contact 110 of relay 1NWS by the first code to prevent the premature energization of relay 2RH over the circuit for the existing route when front contact 112 of relay 2RHS closes in response to a second code, as might occur, for example, if front contact 112 were closed by the first code and contact 110 were opened by the second. In the case of the relays controlled by relay 2D, the switch control relay contacts will open and the signal control relay contacts will close at substantially the same time, but without sufficient overlap to pick up a route relay, the relays LH and RH being of the slow pick-up type in this form of the apparatus.

It may happen that the operator attempts to set up a route for which one or more of the switches are locked by the deenergization of the corresponding relays LS. In the first form of the apparatus it will be apparent that no route circuit will be completed in the network because one or more switch levers will be out of correspondence with the switch indication relays. In the second form of the apparatus a similar result is obtained. Thus an attempt to pick up relay 1RWS by code to move switch 1 from normal to reverse when relay 1LS is deenergized will be unsuccessful because the circuit for relay 1RWS is open at contact 104. However, relay 1NWS will release due to the opening of contact 105 of relay 1D so that both switch control relays are released. Consequently, all route circuits for routes over switch 1 are open. In order to enable the operator to restore the switch control relays to their original condition to correspond with the existing position of the switch, contacts 106 and 107 of relays 1NWP and 1RWP bridging contacts 102 and 104, respectively, are provided. If switch 1 is normal, the operator may pick up the normal control relay 1NWS over contact 106, while if it is reversed, he may pick up the reverse control relay 1RWS over contact 107 even though relay 1LS is deenergized, but a code for changing the position of the switch is effective only if received when relay 1LS is energized.

It will be apparent from the foregoing that although the apparatus of the second form of my apparatus differs somewhat in structure from the first form it functions in an analogous manner.

It is believed therefore that its operation will be readily understood without further explanation.

The third form of my apparatus, as illustrated, is also arranged for remote control as already described in connection with the second form, and differs therefrom in that the double network of Fig. 3A replaces the route circuits of Fig. 2B, and in that the signal circuit network of Fig. 1E is replaced by a group of individual signal circuits shown in Fig. 3B. It will be noted that the route network of Fig. 3A includes a route circuit for each route which includes corresponding contacts of the switch control and indication relays for each switch of the route and constitutes a pick-up circuit for the route relay as in Fig. 2B, but that in addition, there is a second route circuit for each route which is included in the stick circuit for the route relay and which is independent of the switch control relays and also of the signal control relay for the opposing signal in each instance.

In order to explain the operation of the third form of my invention, I shall assume that the apparatus is in the condition shown in the drawings and that the operator desires to clear signal 2RC for a movement over switch 3 reversed. Referring now to Fig. 2A, the operator will reverse lever 3V and then cause relay 2D to be operated to pick up relay 3RWS, and will then move lever 2V to the right and cause relay 3D to be operated to pick up relay 2RHS. As soon as switches 3 and 3A reverse, relay 3RWP picks up and completes a pick-up circuit for relay 2RH which may be traced in Fig. 3A from terminal B, back contacts 118 and 119 of relays 4LHS and 4LH, front contacts 120 to 126, inclusive, of relays 4LAS, 3RWP, 3RWS, 1NWP, 1NWS, 2RAS and 2RHS, the winding of relay 2RH to terminal C. Relay 2RH upon becoming energized opens contact 35, Fig. 1D, releasing relay 2RAS to complete a stick circuit for relay 2RH which may be traced in Fig. 3A from terminal B, front contact 127 of relay 4LAS, front contacts 128 and 129 of relays 3RWP and 1NWP, back contact 130 of relay 2RAS, front contacts 131 and 126 of relays 2RH and 2RHS, the winding of relay 2RH to terminal C. At the same time, relay 2RAS by opening contact 21, Fig. 1A, releases relays 1LS and 3LS and thereby locks the route and completes the signal circuit for mechanism 2RC which may be traced in Fig. 3B from terminal B, back contact 132 of relay 3LS, back contacts 133, 134, 135 of relays 1LS, 2RTES, 2RAS, front contacts 136 and 137 of relays 2RH and 1NWP, back contact 138 of relay 3NWP, front contact 139 of relay 2RAGP, the winding of mechanism 2RCG, front contact 140 of relay 2RAGP, back contact 141 of relay 1RWP, front contact 142 of relay 2RH to terminal C.

Signal 2RC will therefore indicate "caution slow speed" as long as relay 2RH is held energized and the switches remain locked. Relay 2RH is held energized by relay 2RHS over a stick circuit including contacts 129 and 128 which insure the integrity of the route and a contact 127 which indicates that the opposing signals 4LA and 4LC are at stop, and cannot be interfered with by an attempt to clear an opposing signal, inasmuch as the stick circuit for relay 2RH is independent of the manually controlled relay 4LHS.

A comparison of the circuits of Figs. 3A and 3B with those previously described in connection with Figs. 2B and 1E will show that the third form of my apparatus is generally similar to the second except for the omission of the route circuit network of Fig. 1E from the signal circuits of Fig. 3B and the addition of such a network to the route relay circuits of Fig. 3A. In view of the detailed explanation of Fig. 1E and of the circuits for one route in Figs. 3A and 3B, it is believed the remaining circuits of the third form will be readily understood from the drawings without further explanation.

It will also be evident that lever contacts may be substituted for switch and signal control relay contacts in the third form of my apparatus and that this form can likewise be arranged for direct wire control in the manner already explained in detail in connection with the first form.

While I have, in the foregoing, illustrated my system by reference to a relatively simple track layout, it will be clear that the same principles can be applied to complicated layouts involving large numbers of traffic routes and that the system of my invention provides relatively simple and reliable apparatus for safely controlling electrically interlocked railway track switches and signals in such a manner that a train can not be run over a route different from the intended route due to failure of a switch to respond to an operation of its control means and likewise that my system is so arranged as to provide a maximum degree of protection against interference with the movement of traffic when a signal has been cleared for an approaching train.

Although I have herein shown and described only a few forms 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. In combination with a railway track layout, two opposing signals one at each end of a traffic route through said layout, a signal control means and a route relay for each signal, an energizing circuit for each route relay closed when the associated signal control means is operated but only if the opposing signal control means is in its non-operated condition, a circuit for clearing each signal closed when the associated route relay is energized but only if the opposing signal is at stop, and means controlled by each signal when clear for maintaining such associated route relay energized independently of the condition of said opposing signal control means.

2. In combination with a railway track layout, two opposing signals, one at each end of a traffic route through said layout, a signal control means and a route relay for each signal, an energizing circuit for each route relay closed when the associated signal control means is operated but only if the opposing signal control means is in its non-operated condition and the opposing route relay is deenergized, a circuit for clearing each signal closed when the associated route relay is energized, provided the opposing signal is at stop, and means controlled by each signal when clear for maintaining such associated route relay energized independently of the condition of the opposing signal control means and route relay.

3. In combination with a railway track layout, two opposing signals, one at each end of a traffic route through said layout, a signal control means and a route relay for each signal, a normally energized lock relay for each route relay, means

for releasing each lock relay when the associated route relay becomes energized, an energizing circuit for each route relay closed when the associated signal control means is operated but only if both lock relays are energized and the opposing signal control means is in its non-operated condition, a circuit for clearing each signal closed when the associated route relay is energized provided the opposing signal is at stop, and means rendered effective upon the release of each lock relay to maintain the associated route relay energized independently of the condition of the opposing signal control means.

4. In combination with a railway track layout, two opposing signals, one at each end of a traffic route through said layout, a signal control means and a route relay for each signal, a lock relay for each signal energized only when such signal is at stop, a pick-up circuit for each route relay closed when the associated signal control means is operated and the opposing signal control means is in its non-operated condition and including front contacts of both said lock relays, a circuit for clearing each signal closed when the associated route relay is energized, provided the opposing signal is at stop, and a stick circuit for each route relay including its own front contact, a back contact of the associated lock relay and a contact controlled by the associated signal control means.

5. In combination, a railway track layout including a track switch, two opposing signals, one at each end of a route over said switch, switch control means for operating said track switch, a signal control means and a route relay for each signal, an energizing circuit for each route relay closed when the associated signal control means is operated but only if the track switch is in correspondence with its switch control means and the opposing signal control means is in its non-operated condition, a circuit for clearing each signal closed when the associated route relay is energized provided the opposing signal is at stop, and means controlled by each signal when clear for maintaining such associated route relay energized independently of the condition of said switch control means or of said opposing signal control means.

6. In combination, a railway track layout including a track switch, two opposing signals, one at each end of a route over said switch, switch control means for operating said track switch, a signal control means and a route relay for each signal, an energizing circuit for each route relay closed when the associated signal control means is operated but only if the track switch is in correspondence with its switch control means, the opposing signal control means is in its non-operated condition and the opposing route relay is deenergized, a circuit for clearing each signal closed when the associated route relay is energized, provided the opposing signal is at stop, and means controlled by each signal when clear for preventing the release of such route relay as long as the associated signal control means remains in its operated condition.

7. In combination, a railway track layout including a track switch, two opposing signals, one at each end of a route over said switch, switch control means for operating said track switch, a signal control means and a route relay for each signal, a normally energized lock relay for each route relay which releases when such route relay becomes energized, an energizing circuit for each route relay closed when the associated signal control means is operated but only if both lock relays are energized, the track switch is in correspondence with the switch control means and the opposing signal control means is in its non-operated condition, a circuit for clearing each signal closed when the associated route relay is energized, provided the opposing signal is at stop, and means rendered effective upon the release of the lock relay associated with the energized route relay to maintain such route relay energized as long as the associated signal control means remains in its operated condition.

8. In combination, a railway track layout including a track switch, two opposing signals, one at each end of a route over said switch, switch control means for operating said track switch, a signal control means and a route relay for each signal, a lock relay for each signal energized only when such signal is at stop, a pick-up circuit for each route relay closed when the associated signal control means is operated but only if both lock relays are energized, the track switch is in correspondence with the switch control means and the opposing signal control means is in its non-operated condition, a circuit for clearing each signal closed when the associated route relay is energized, provided the opposing signal is at stop, and a stick circuit for each route relay including only its own front contact, a back contact of the associated lock relay, and a contact controlled by the associated signal control means.

9. In combination, a railway track layout including a track switch, two opposing signals, one at each end of a route over said switch, switch control means for operating said track switch, a signal control means and a route relay for each signal, an energizing circuit for each route relay closed when the associated signal control means is operated but only if the track switch is in correspondence with its switch control means and the opposing signal control means is in its non-operated condition, switch locking means rendered effective when a route relay is energized to prevent operation of the track switch by its control means, a circuit for clearing each signal closed when the associated route relay is energized and said locking means is effective, provided the opposing signal is at stop, and means controlled by each signal when clear for maintaining such associated route relay energized independently of the condition of said switch control means and of said opposing signal control means.

10. In combination, a railway track layout including a track switch, two opposing signals, one at each end of a route over said switch, switch control means for operating said track switch, a signal control means and a route relay for each signal, an energizing circuit for each route relay closed when the associated signal control means is operated but only if the track switch is in correspondence with its switch control means, the opposing signal control means is in its non-operated condition and the opposing route relay is deenergized, a switch locking relay for each signal energized only when such signal is at stop and its route relay is deenergized, locking means effective when either switch locking relay is deenergized to prevent operation of the track switch by the switch control means, a circuit for clearing each signal closed when the associated route relay is energized provided said locking means is effective and the opposing signal is at stop, and means controlled by each signal when clear for preventing the release of such route relay

as long as the associated signal control means remains in its operated condition.

11. In combination, a railway track layout including a track switch, two opposing signals, one at each end of a route over said switch, switch control means for operating said track switch, a signal control means and a route relay for each signal, a normally energized lock relay for each route relay which releases when such route relay becomes energized, locking means rendered effective when such lock relay is released to prevent operation of the track switch by the switch control means, an energizing circuit for each route relay closed when the associated signal control means is operated but only if both lock relays are energized, the track switch is in correspondence with the switch control means and the opposing signal control means is in its non-operated condition, a circuit for clearing each signal closed by its route relay when said locking means becomes effective in response to the energization of such route relay, provided the opposing signal is at stop, and means effective as long as said locking means is effective to maintain such route relay energized independently of the condition of the switch control means or of the opposing signal control means.

12. In combination, a railway track layout including a track switch, two opposing signals, one at each end of a route over said switch, switch control means for operating said track switch, a signal control means and a route relay for each signal, a lock relay for each signal energized only when such signal is at stop, locking means rendered effective when either a lock relay or a route relay is released to prevent operation of the track switch by the switch control means, a pick-up circuit for each route relay closed when the associated signal control means is operated but only if both lock relays are energized, the track switch is in correspondence with the switch control means and the opposing signal control means is in its non-operated condition, a circuit for clearing each signal closed by its route relay when said locking means is rendered effective in response to the energization of such route relay, and a stick circuit for each route relay including only its own front contact, a back contact of the associated lock relay and a contact controlled by the associated signal control means.

13. In combination, a track layout incuding a plurality of track sections adapted to be interconnected by track switches to form different traffic routes, a signal for each direction for each route, switch control means for each track switch, a route network including contacts reflecting the positions of the track switches and their control means and adapted to form route circuits corresponding to said traffic routes, a route relay for each end of each route circuit, signal control means for each route relay normally effective to connect a current source to the adjacent route circuit but effective when manually operated to disconnect such source and to connect the associated route relay to such route circuit to effect its energization by current from the source at the opposite end thereof, a circuit controlled by each route relay when energized for clearing the signal for the corresponding direction and route, provided the opposing signal is at stop, and means controlled by each signal when clear for maintaining the associated route relay energized subject to control by its control means, irrespective of the condition of said route network.

14. In combination, a track layout including a plurality of track sections adapted to be interconnected by track switches to form different traffic routes, a signal for each direction for each route, switch control means for each track switch, a route network including contacts reflecting the positions of the track switches and their control means and adapted to form route circuits corresponding to said traffic routes, a route relay for each end of each route circuit, signal control means for each route relay normally effective to connect a current source to the adjacent route circuit but effective when manually operated to disconnect such source and to connect the associated route relay to such route circuit to effect its energization by current from the source at the opposite end thereof, switch locking means rendered effective when a route relay is energized to prevent operation of any switch of the corresponding route, a circuit controlled by each route relay when energized and closed when said switch locking becomes effective for clearing the signal for the corresponding direction and route, provided the opposing signal is at stop, and means controlled by each signal when clear for maintaining the associated route relay energized subject to control by its control means, irrespective of the condition of said route network.

15. In combination, a railway track layout including a track switch, two opposing signals, one at each end of a route over said switch, switch control means for operating said track switch, a signal control means and a route relay for each signal, a lock relay for each signal energized only when such signal is at stop, a pick-up circuit for each route relay closed when the associated signal control means is operated but only if both lock relays are energized, the track switch is in correspondence with the switch control means and the opposing signal control means is in its non-operated condition, a circuit for clearing each signal closed when the associated route relay is energized and including a contact reflecting the position of the track switch and a contact closed only when the lock relay for the opposing signal is energized, and a stick circuit for each route relay including only its own front contact, a back contact of the associated lock relay and a contact controlled by the associated signal control means.

16. In combination, a railway track layout including a track switch, two opposing signals, one at each end of a route over said switch, switch control means for operating said track switch, a signal control means and a route relay for each signal, a lock relay for each signal energized only when such signal is at stop, locking means rendered effective when either a lock relay is released or when a route relay is energized to prevent operation of the track switch by the switch control means, a pick-up circuit for each route relay closed when the associated signal control means is operated but only if both lock relays are energized, the track switch is in correspondence with the switch control means and the opposing signal control means is in its non-operated condition, a circuit for clearing each signal closed by its route relay when said locking means is rendered effective in response to the energization of such route relay, and including a contact reflecting the position of the track switch and a contact closed only when the lock relay for the opposing signal is energized, and a stick circuit for each route relay including only its own front contact, a back contact of the associated lock relay and

a contact controlled by the associated signal control means.

17. In combination, a track section including a track switch, control means for operating said switch, a route relay, a lock relay energized only when the signal is at stop, a pick-up circuit for the route relay including a manually controlled contact, a front contact of said lock relay and contacts closed only when the track switch and its control means are in correspondence, a circuit for clearing the signal including a front contact of the route relay and a contact reflecting the position of the track switch, and a stick circuit for said route relay including only its own front contact, said manually controlled contact and a back contact of said lock relay.

18. In combination, a track section including a track switch, control means for operating said switch, a route relay, a lock relay energized only when the signal is at stop, a pick-up circuit for the route relay including a manually controlled contact, a front contact of said lock relay and contacts closed only when the track switch and its control means are in correspondence, locking means rendered effective when the route relay becomes energized to prevent operation of the track switch by its control means, a circuit for clearing the signal including a front contact of the route relay, a contact reflecting the position of the track switch and a contact closed when said locking means becomes effective, and a stick circuit for said route relay including only its own front contact, said manually controlled contact and a back contact of said lock relay.

19. In combination, a railway track layout including a track switch, switch control means for operating said track switch, a signal for governing traffic movements over said track switch, a stick relay for controlling said signal, a pick-up circuit for said stick relay closed only when the track switch and its control means are in correspondence, and a stick circuit for said relay including its own front contact and a contact controlled in accordance with the position of the track switch irrespective of the condition of said switch control means.

20. In combination, a railway track layout including a track switch, two opposing signals, one at each end of a route over said switch, switch control means for operating said track switch, a signal control means and a route relay for each signal, an energizing circuit for each route relay closed when the associated signal control means is operated but only if the track switch is in correspondence with its switch control means and the opposing signal control means is in its non-operated condition, a circuit for clearing each signal closed when the associated route relay is energized and a holding circuit for each route relay including its own front contact, a contact controlled in accordance with the position of the track switch and a contact closed only when the opposing signal is at stop for maintaining such route relay energized in accordance with the condition of the route and under the control of the associated signal control means irrespective of the condition of said switch control means and opposing signal control means.

21. In combination with a railway track layout, two opposing signals one at each end of a traffic route through said layout, a route relay and a lock relay for each signal, an energizing circuit for each signal including a front contact of the route relay and a back contact of the lock relay for the corresponding signal, said circuit also including a front contact of the lock relay for the opposing signal, means deenergizing each lock relay when the route relay for the corresponding signal is energized to thereby complete the circuit for such signal, means for maintaining each lock relay deenergized as long as the corresponding signal is at clear, and means effective when either route relay is energized to prevent the energization of the opposing route relay.

22. In combination, a track layout including a plurality of track switches for establishing different traffic routes, switch control means for each track switch, a signal at each end of each route for governing traffic movements through said layout, a route circuit for each signal closed only when the route which such signal governs is established by the operation of the switch control means and track switches to corresponding positions, means for clearing each signal effective only when its route circuit is closed and the opposing signal is at stop, and means controlled by each signal when it clears for maintaining such signal at clear and for rendering the route circuit for the corresponding route ineffective to control such signal.

23. In combination with a railway track layout, two opposing signals one at each end of a traffic route through said layout, a signal control means, a route relay and a lock relay for each signal, a pick-up circuit for each route relay closed when the associated signal control means is operated but only if both lock relays are energized and the opposing signal control means is in its non-operated condition, means controlled by each route relay upon becoming energized for releasing the associated lock relay, a stick circuit for each route relay closed when the associated lock relay releases but only if the opposing lock relay is energized, means controlled by each route relay for clearing the corresponding signal, and means controlled by each signal for maintaining the corresponding lock relay deenergized as long as such signal is at clear.

24. In combination, a track layout including a plurality of track sections adapted to be interconnected by track switches to form different traffic routes, a signal for each direction for each route, switch control means for each track switch, a route network including contacts reflecting the positions of the track switches and their control means and adapted to form route circuits corresponding to said traffic routes, a route relay for each end of each route circuit, signal control means for each route relay normally effective to connect a current source to the adjacent route circuit but effective when manually operated to disconnect such source and to connect the associated route relay to such route circuit to effect its energization by current from the source at the opposite end thereof, a second network including contacts reflecting the position of the track switches and adapted to form circuits corresponding to said traffic routes but which are independent of the condition of said switch control means, a circuit controlled by each route relay when energized for clearing the signal for the corresponding direction and route, provided the opposing signal is at stop, and means including a circuit of said second network for maintaining such signal at clear irrespective of the condition of said route network.

25. In combination, a track layout including a plurality of track sections adapted to be interconnected by track switches to form different traffic routes, a signal for each direction for each

route, switch control means for each track switch, a route relay for each end of each traffic route through said layout, a route network including contacts reflecting the positions of the track switches and their control means and adapted to form route circuits corresponding to said traffic routes, a second network including contacts reflecting the positions of the track switches only and adapted to form circuits corresponding to said traffic routes, signal control means for each route relay normally effective to connect a current source to the adjacent route circuit but effective when manually operated to disconnect such source and to connect the associated route relay to such route circuit to effect is energization, a circuit controlled by each route relay when energized for clearing the associated signal, and means controlled by each signal when cleared for disconnecting such route relay from its route circuit but for maintaining it energized over the corresponding circuit of said second network.

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