Feb. 28, 1939. E. M. ALLEN 2,149,202

INTERLOCKING CONTROL APPARATUS

Filed Dec. 21, 1937 4 Sheets-Sheet 1

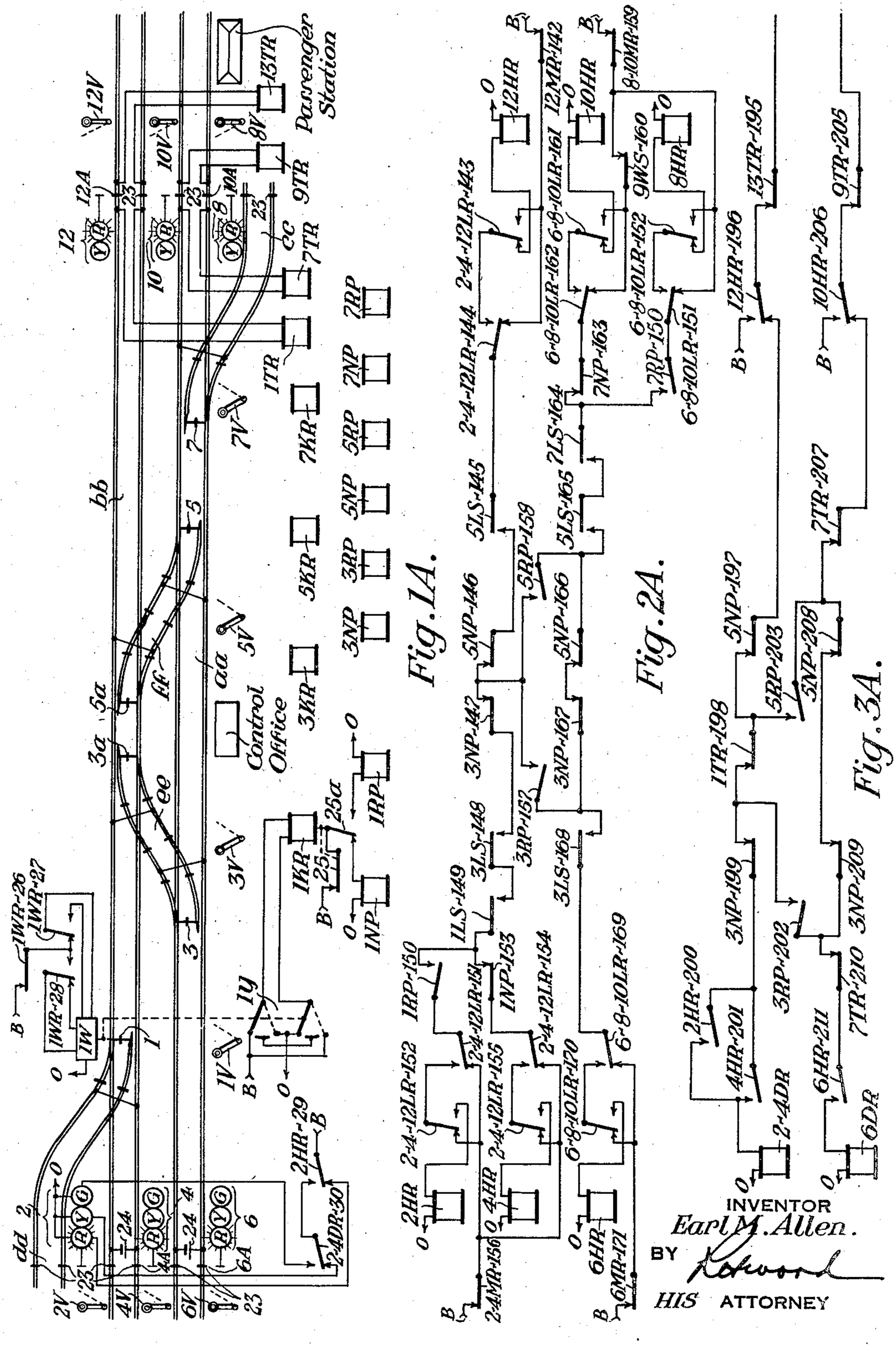

Fig. 1A.

Fig. 2A.

Fig. 3A.

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INTERLOCKING CONTROL APPARATUS

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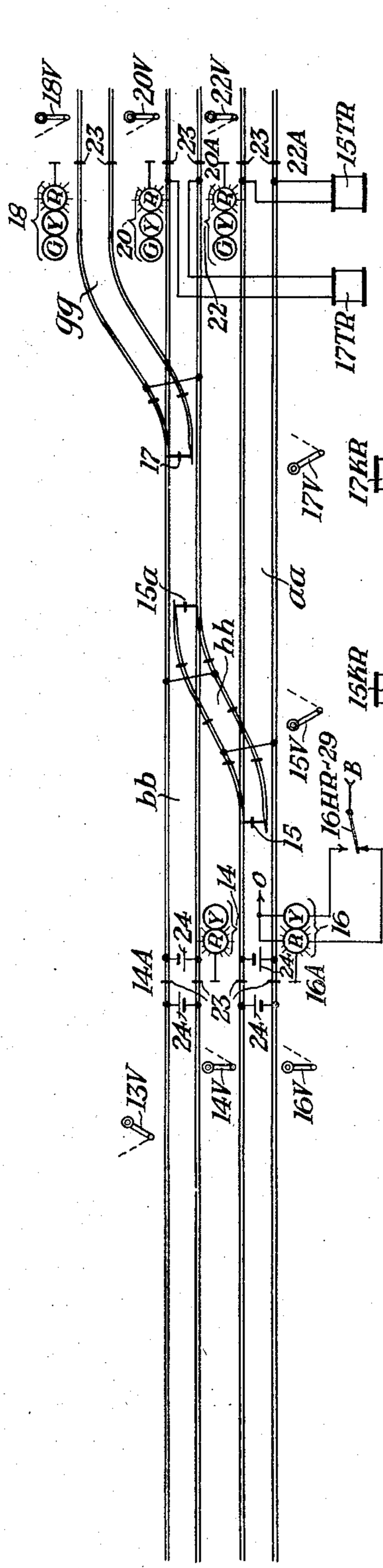

Fig. 1B.

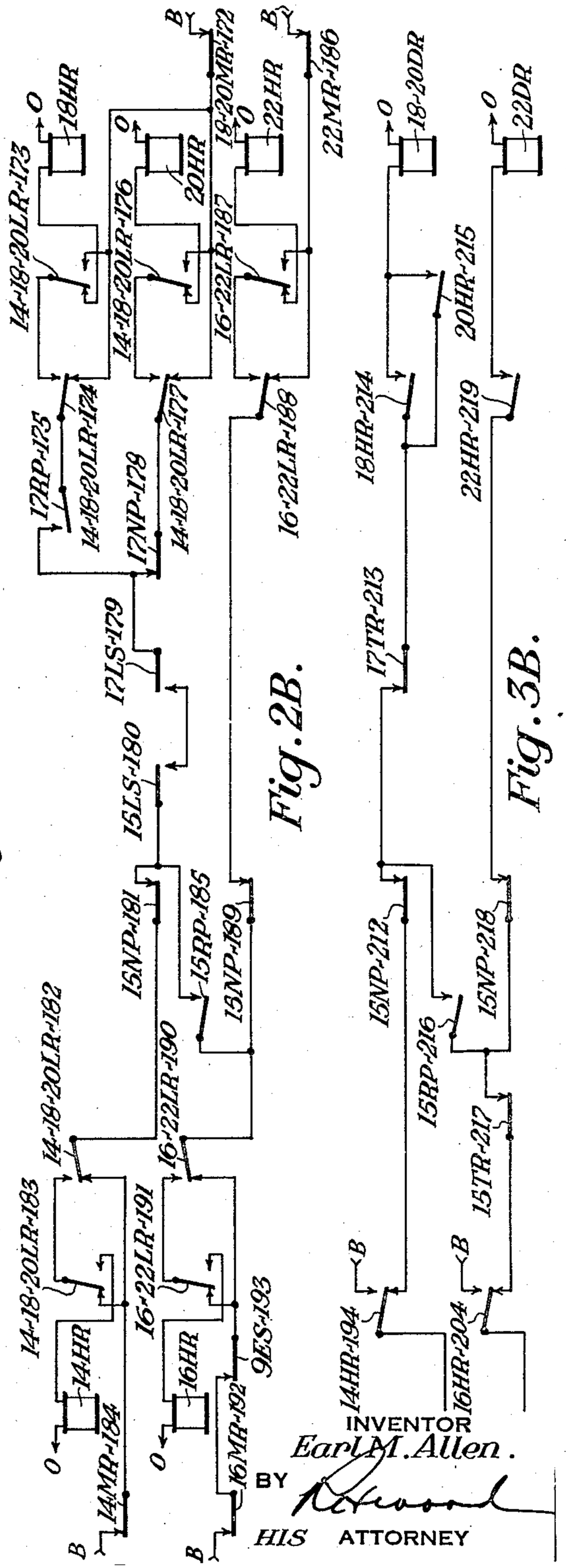

Fig. 2B.

Fig. 3B.

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INTERLOCKING CONTROL APPARATUS

Filed Dec. 21, 1937 4 Sheets-Sheet 3

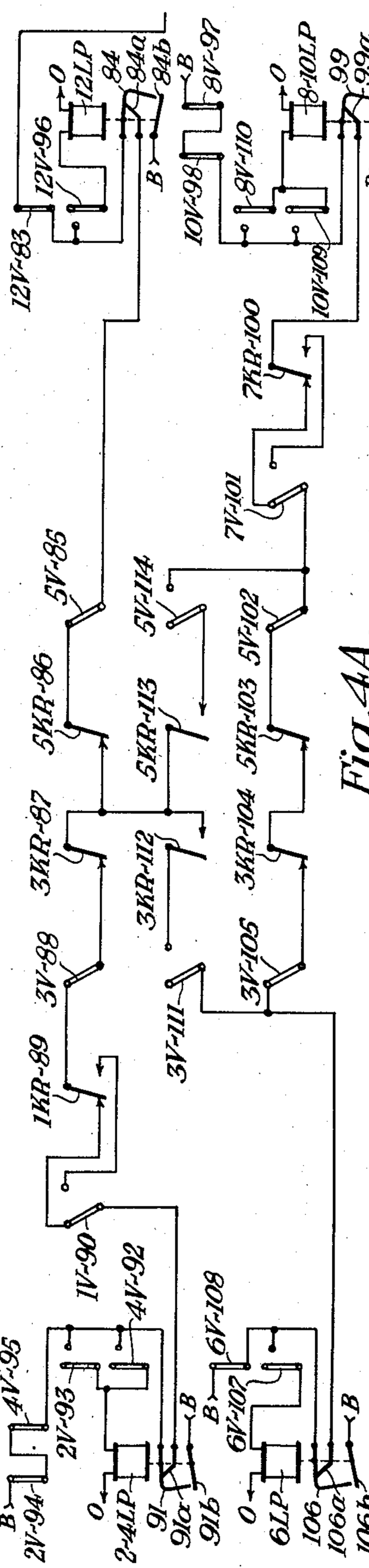

Fig. 4A.

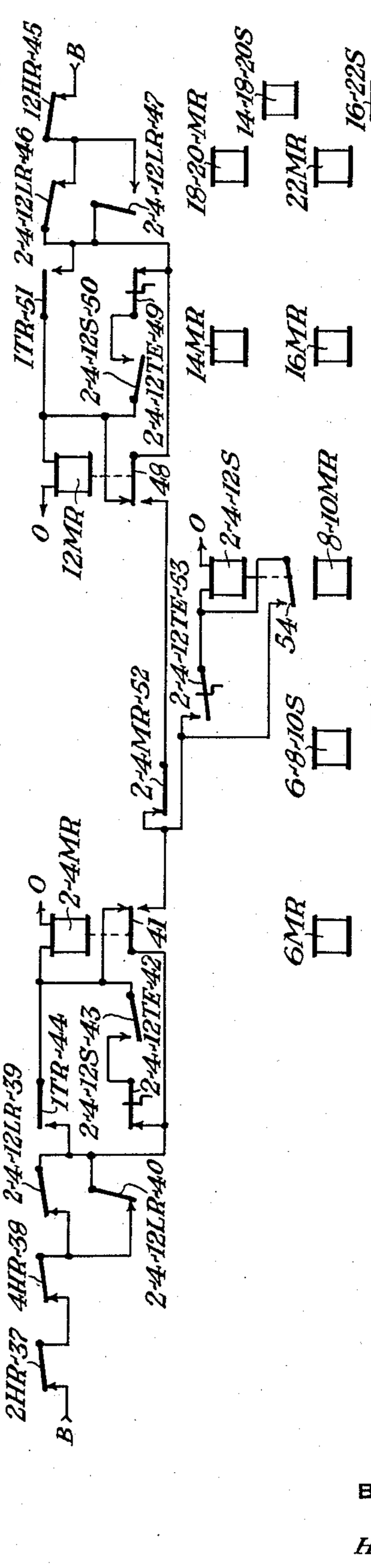

Fig. 4B.

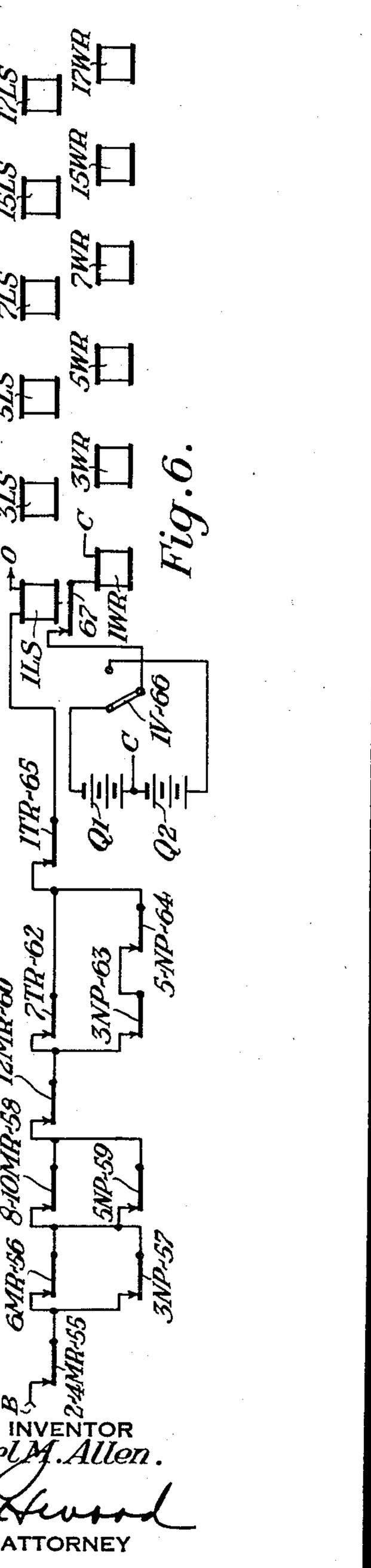

Fig. 5.

Fig. 6.

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INTERLOCKING CONTROL APPARATUS

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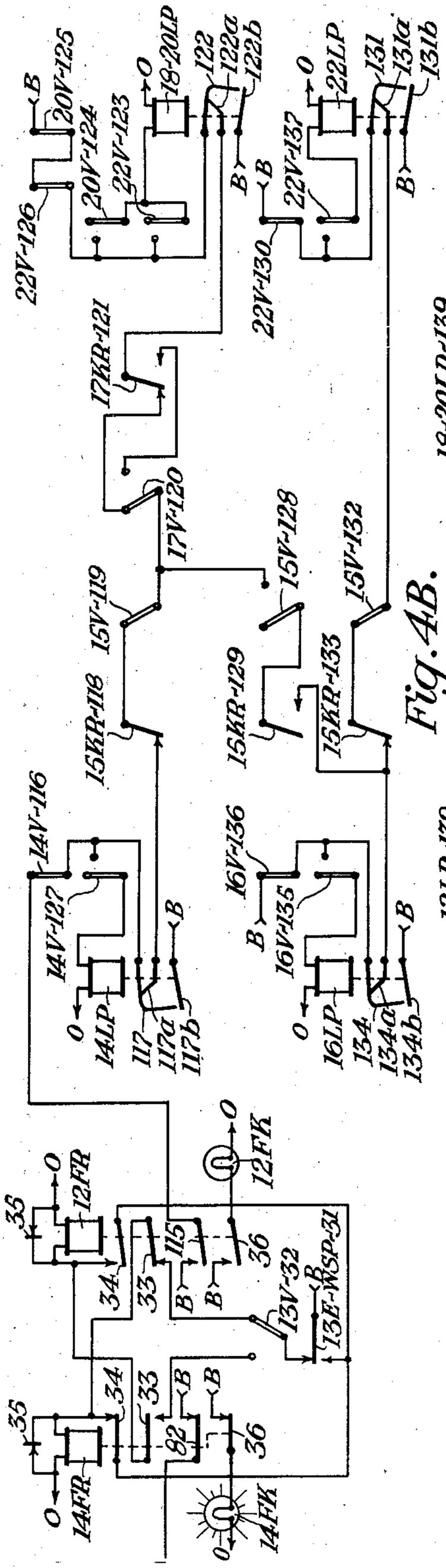

Fig. 4B.

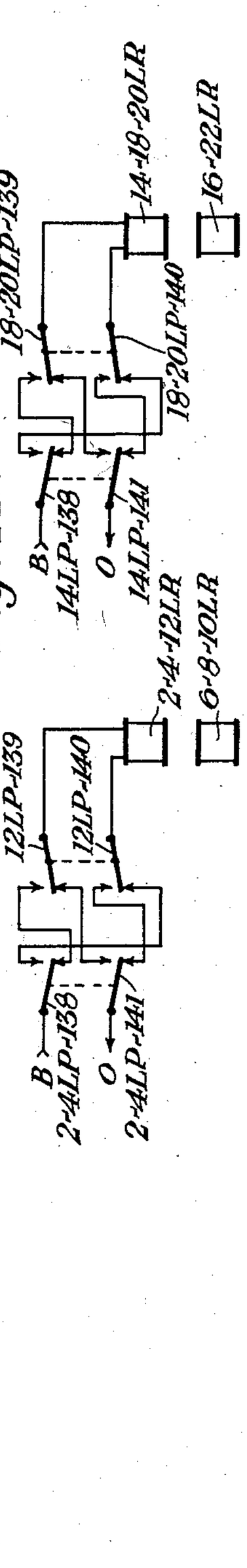

Fig. 7.

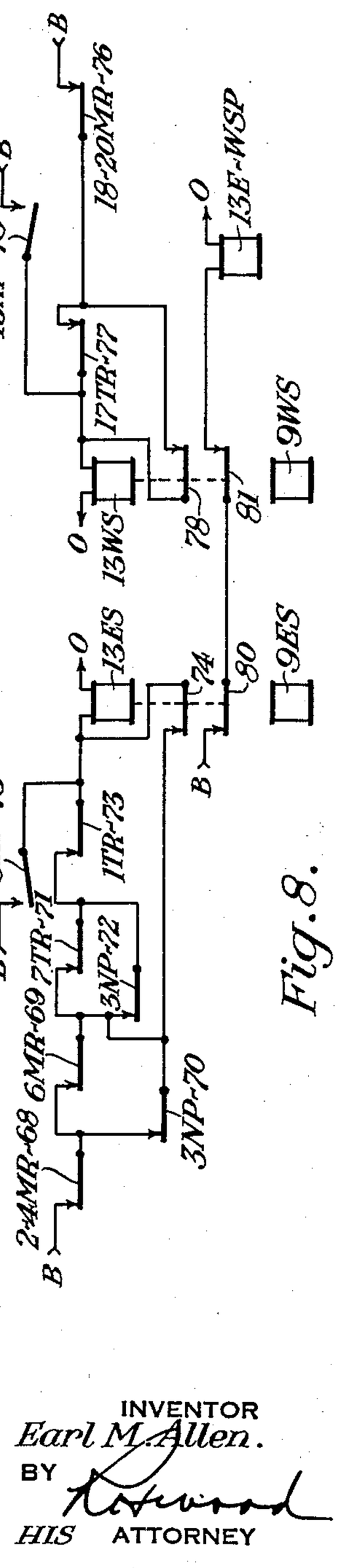

Fig. 8.

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Patented Feb. 28, 1939

2,149,202

UNITED STATES PATENT OFFICE

2,149,202

INTERLOCKING CONTROL APPARATUS

Earl M. Allen, Swissvale, Pa., assignor to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

Application December 21, 1937, Serial No. 181,007

10 Claims. (Cl. 246—134)

My invention relates to interlocking control apparatus for railway track switches and signals in railway switching or interlocking layouts.

One feature of my invention is the provision of novel and improved means, effective after a signal has been cleared, for retaining the signal in the clear condition independently of erroneous attempts to clear an opposing signal or to operate a switch of the interlocking layout. Another feature of my invention is the provision of novel and improved traffic direction control and locking apparatus.

The apparatus of my invention is an improvement over that disclosed in the copending applications Serial No. 323,286, filed December 3, 1928, by Lester E. Spray for Multiple control apparatus; Serial No. 416,061, filed December 23, 1929, by Howard A. Thompson for Multiple control apparatus; Serial No. 561,422, filed September 5, 1931, by Lester E. Spray for Multiple control apparatus; Serial No. 695,294, filed October 26, 1933, by Earl M. Allen and Howard A. Thompson for Interlocking control apparatus; Serial No. 726,957, filed May 22, 1934, by Lester E. Spray for Interlocking control apparatus; and Serial No. 19,462, filed May 2, 1935, by Paul P. Stoker for Traffic controlling apparatus.

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

In the accompanying drawings, Figs. 1A and 1B, when placed end to end, with Fig. 1A on the left, constitute a diagrammatic view showing one interlocking layout of switches and signals in Fig. 1A, and a second interlocking layout of switches and signals in Fig. 1B, with a passenger station shown in Fig. 1A adjacent an intermediate stretch of track between these two interlocking layouts; Figs. 2A and 2B show the home or caution control signal relays, designated by the reference character HR with distinguishing numerical prefixes, and the circuit network for controlling these relays for the signals shown in Figs. 1A and 1B, respectively; Figs. 3A and 3B show the distant or proceed control signal relays, designated by the reference character DR with distinguishing numerical prefixes, and the circuit network for controlling these relays for the signals shown in Figs. 1A and 1B, respectively; Figs. 4A and 4B show lever repeater or primary control relays, designated by the reference character LP with distinguishing numerical prefixes, and the circuit network for controlling these relays for the layouts shown in Figs. 1A and 1B, respectively; traffic control relays 12FR and 14FR, together with their control circuits, are also shown in Fig. 4B; Fig. 5 shows approach locking control relays, with typical control circuits shown for relays 2—4MR and 12MR; Fig. 6 shows switch locking and control relays, designated by the reference characters LS and WR, respectively, with distinguishing numerical prefixes, and shows typical circuits for relays 1LS and 1WR; Fig. 7 shows polarized lever repeater relays, designated by the reference character LR with distinguishing numerical prefixes; and Fig. 8 shows route locking relays, designated by the reference characters ES and WS with distinguishing numerical prefixes, and a traffic locking relay 13E—WSP.

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

Referring first to Figs. 1A and 1B, these drawings show tracks *aa* and *bb* of a stretch of double track railway. In the layout shown in Fig. 1A, tracks *aa* and *bb* are interconnected through a crossover *ee* with which they are respectively joined by switches 3 and 3*a*, and are likewise interconnected by a second crossover *ff* with which they are respectively joined by switches 5 and 5*a*. Tracks *aa* and *bb* are also respectively joined to passing sidings *cc* and *dd* by switches 7 and 1. In the layout shown in Fig. 1B, tracks *aa* and *bb* are interconnected through a crossover *hh* with which they are respectively joined by switches 15 and 15*a*. Track *bb* is also joined to passing siding *gg* by switch 17.

The rails of tracks *aa* and *bb* are divided by insulated joints 23 to form a plurality of track sections 6A—10A, 10A—16A, 16A—22A, 4A—12A, 12A—14A, and 14A—20A. Each of these track sections is supplied with current by a battery 24 connected across the rails adjacent one end of the section. A track relay, designated by the reference character TR with a distinguishing numerical prefix, is connected across the rails adjacent the opposite end of each track section.

Signals designated by the reference numerals 2, 4, 6, 8, 10, 12, 14, 16, 18, 20 and 22 are placed adjacent the ends of these sections. The signals as here shown are of the color light type, signals 2, 4, 6, 18, 20 and 22 each having three lamps, a green or proceed lamp G, a yellow or caution lamp Y, and a red or stop lamp R, and signals 8, 10, 12, 14 and 16 each having only two lamps Y and R. Signals 2, 4, 6, 14 and 16 govern traffic movements toward the right, as shown in the drawings, which I shall assume to be the eastbound direction, and signals 8, 10, 12, 18, 20 and 22 govern traffic movements in the opposite or westbound direction.

Control levers, each designated by the reference character V with a numerical prefix corresponding to the number of the signal or switch controlled by the lever, are shown in Figs. 1A and 1B adjacent the representations of the signals or switches which the corresponding levers control.

In each of the views, the contacts operated by the various relays or other devices are identified by numbers, each such number having a distinguishing prefix, from which it is separated by a dash, when the contacts are shown apart from the relay or other control devices by which they are operated. The prefix for each of these contact numbers comprises the reference character for the respective relay or other device. For example, contact 2HR—29 shown in Fig. 1A in the control circuits for signal 2 is identified by the number 29 separated by a dash from the prefix 2HR which is the reference character for relay 2HR by which this contact is operated. Similarly, contact 2V—93 shown in the control circuit for relay 2—4LP adjacent this relay in Fig. 4A is identified by the number 93 separated by a dash from the prefix 2V which is the reference character for lever 2V by which this contact is operated.

Each track switch is operated by a mechanism such, for example, as 1W shown for switch 1. Each switch mechanism is controlled by a polarized switch control relay. Mechanism 1W for switch 1, for example, is controlled by relay 1WR, the control circuits for which are shown in Fig. 6.

Operated in conjunction with each switch mechanism is a pole changer, similar to pole changer 1*y* shown for switch 1 in Fig. 1A, for controlling a polarized indication relay 1KR. With switch 1 in the normal position shown in the drawings, current is supplied from a source not shown but having terminals B and O, over the contacts of pole changer 1*y* for energizing relay 1KR in the normal direction, whereas, when switch 1 is operated to the reverse position, pole changer 1*y* reverses the polarity of the current which energizes relay 1KR. Relays 7KR and 17KR for switches 7 and 17, respectively, are controlled similarly to relay 1KR. Only one indication relay 3KR is shown for crossover *ee*, the circuits for this relay being so arranged in a well-known manner that, when both switches 3 and 3*a* are in the normal position, relay 3KR will be energized by current of normal polarity, and when both switches 3 and 3*a* are in the reverse position, relay 3KR will be energized by current of reverse polarity. Relays 5KR and 15KR for crossovers *ff* and *hh*, respectively, are controlled similarly to relay 3KR.

Each of the indication relays, designated by the reference character KR with a distinguishing numerical prefix corresponding to the number of the switch or switches by which it is controlled, controls a normal and a reverse indication relay designated by the reference characters NP and RP, respectively, with a distinguishing numerical prefix, similarly to the manner in which relays 1RP and 1NP are shown controlled by neutral contact 25 and polar contact 25*a* of relay 1KR in Fig. 1A.

Each of the signals having three lamps is controlled, as shown for signal 2, by its home signal relay HR and by its distant signal relay DR, each of which has a numerical prefix associated with the reference characters HR and DR corresponding to the signal which it controls. Each of the signals which have two lamps is controlled, as shown for signal 16 in Fig. 1B, by only its HR relay.

In Figs. 4A and 4B, circuit networks are shown for controlling lever repeater or primary control relays which are designated by the reference character LP with distinguishing numerical prefixes. In the interlocking layout shown in Fig. 1A, parallel traffic movements can be made over two groups of interconnecting routes, that is, a traffic movement can be made in either direction over either of the intersecting routes which include switches 3 and 5 in the normal position and switch 7 in the normal or reverse position, at the same time that a traffic movement can be made in either direction over either of the intersecting routes which includes switches 3*a* and 5*a* in the normal position and switch 1 in the normal or the reverse position. For each end of each group of intersecting routes which are thus in parallel with one or more other routes, an LP relay is provided, as shown in Figs. 4A and 4B. The number of LP relays is therefore twice the number of possible contemporaneous parallel movements. Since there are two groups of parallel routes shown in Fig. 1A, four LP relays are provided for the interlocking layout shown in Fig. 1A. Four LP relays are also provided for the layout shown in Fig. 1B.

A manual control device, here shown as a lever designated by the reference character V with a distinguishing numerical prefix, is provided for each route end. In order to energize any relay LP, the lever for one of the route ends at the corresponding end of a group of intersecting routes must be reversed, while the lever for the opposite end of the route must be in its normal position. In order to energize relay 8—10LP, for example, for the route extending from signal 8 to signal 6, lever 8V must be reversed for the corresponding route end, and lever 6V for the opposite end of the route must be in its normal position. If switches 5 and 5*a* were reversed and switch 3*a* were in its normal position, levers 2V and 4V for the opposite ends of the two possible routes would have to be in the normal position for relay 8—10LP to be energized.

As shown in the drawings, each relay LP is equipped with a make-before-break contact, such, for example, as contact 99 of relay 8—10LP in Fig. 4A, which closes at its front point 99*b* before opening at its back point 99*a*. The pick-up circuits for each relay LP include the back point of the make-before-break contact of the corresponding relay LP and also of the relay LP for an opposite route end. The stick circuit or circuits for each relay LP include the front point of its own make-before-break contact and a reverse contact for a lever for a corresponding route end, but are independent of the position of the lever or the relay LP for the opposite end of the same route.

In Fig. 4B, a traffic direction control arrangement is shown for use with the network circuits of Figs. 4A and 4B for the LP relays. A traffic lever 13V controls traffic relay 12FR or 14FR for track *bb* according as lever 13V is in one position or the other. An asymmetric unit 35 is connected across the winding of each of the traffic control relays 12FR and 14FR in order to make these relays slightly slow in releasing. The unit 35 may be of the copper oxide rectifier type, with the low resistance direction indicated by the arrow head portion of the symbol for device 35 shown in the drawings. Traffic indication lamps, designated by the reference characters 12FK and

14FK, are controlled by traffic relays 12FR and 14FR, respectively. A traffic control arrangement similar to that which is shown for track *bb* could also be provided for track *aa*, if desired.

In Fig. 5, circuits are shown for approach locking relays 2—4MR and 12MR, with a release stick relay 2—4—12S controlled by a time element device 2—4—12TE which may be of the well-known clockwork type.

In Fig. 6, a typical switch lock relay circuit is shown for relay 1LS controlled by approach locking relays and by track relays. Normal and reverse control circuits are also shown in Fig. 6 for a switch control relay 1WR energized by current from batteries Q1 and Q2 having a common terminal C.

Fig. 7 shows polarized lever repeater relays LR controlled by the neutral lever repeater or primary control relays LP which are shown in Figs. 4A and 4B. Each polarized relay LR is energized by current of one polarity when the LP relay for one end of a group of intersecting routes is energized while the LP relay for the opposite end of the same group of intersecting routes is deenergized. Each polarized relay LR is energized by current of the opposite polarity when the LP relay for the first end of the group of intersecting routes is deenergized while the LP relay for the opposite end of the same group of intersecting routes is energized.

In Fig. 8, circuits are shown for controlling route locking relays 13ES and 13WS, which in turn control a traffic locking relay 13E—WSP. Route locking relays 9ES and 9WS may be controlled similarly to relays 13ES and 13WS, and may in turn control a traffic locking relay similarly to the manner in which relays 13ES and 13WS control relay 13E—WSP. As shown in Fig. 4B, traffic direction control is provided for track *bb* but is not shown for track *aa*. Contact 9ES—193 of route locking relay 9ES is therefore inserted in the HR relay network in Fig. 2B near relay 16HR, and contact 9WS—160 of route locking relay 9WS is inserted in the HR relay network in Fig. 2A near relay 10HR.

Having described, in general, the arrangement and control of the various parts of one form of apparatus embodying my invention, I shall now describe in detail the operation of the apparatus.

As shown in the drawings, all parts of the apparatus are in normal condition, that is, the various track sections are unoccupied, and hence the track relays are energized; the track switches are in the normal position; the signals are indicating stop; the manual control lever for each route end is in the normal position; traffic lever 13V is in the right-hand position; switch levers 1V, 3V, 5V, 7V, 15V and 17V are in their normal position; the KR relays and the WR relays are energized by current of normal polarity; neutral relays NP, 14FR, MR, LS, ES, WS and 13E—WSP, and traffic direction indicating lamp 14FK, are energized; and relays RP, HR, DR, LP, 12FR, 2—4—12S and LR, and traffic direction indicating lamp 12FK, are deenergized.

Of the circuits by which the various parts are energized, the circuits for the red lamps of the signals are similar to that which is shown for signal 2, Fig. 1A, passing from terminal B of a suitable source of current not shown in the drawings, through back point of contact 2HR—29, and lamp R of signal 2 to terminal O of the same source of current.

The polarized switch indication or KR relays in Fig. 1A are energized by current of normal polarity supplied by circuits which are similar to the circuit shown for relay 1KR, which includes pole changer 1*y* operated in conjunction with switch 1 which is in the normal position. The normal switch indication or NP relays are energized by circuits similar to that shown for relay 1NP, passing from terminal B, through contact 25 of relay 1KR, contact 25*a* of relay 1KR in the left-hand position, and the winding of relay 1NP to terminal O.

Relay 14FR in Fig. 4B is shown energized by its pick-up circuit passing from terminal B, through the front point of contact 13E—WSP—31, contact 13V—32 in the right-hand position, contact 33 of relay 12FR, and the winding of relay 14FR to terminal O. Traffic direction indicating lamp 14FK is energized by a circuit including contact 36 of relay 14FR.

Approach locking relay 2—4MR in Fig. 5 is energized by stick circuits passing from terminal B, through contacts 2HR—37, 4HR—38, 2—4—12LR—39 in multiple with contact 2—4—12LR—40, front point of contact 41 of relay 2—4MR, and the winding of relay 2—4MR to terminal O. Approach locking relay 12MR is energized by a stick circuit which is somewhat similar to that just traced for relay 2—4MR through contact 2—4—12LR—39. A second stick circuit for relay 12MR is similar to the stick circuit for relay 2—4MR through contact 2—4—12LR—40, but is normally open at contact 2—4—12LR—47. The closed stick circuit for relay 12MR passes from terminal B, through contacts 12HR—45, 2—4—12LR—46, front point of contact 48 of relay 12MR, and the winding of relay 12MR to terminal O. The other approach locking or MR relays are energized by stick circuits which are similar to the circuits shown for relays 2—4MR and 12MR, but which are not shown in the drawings.

Switch locking relay 1LS in Fig. 6 is energized by circuits including terminal B, contact 2—4MR—55, contact 6MR—56 in multiple with contact 3NP—57, contact 8—10MR—58 in multiple with contact 5NP—59, contact 12MR—60, contact 7TR—62 in multiple with a path through contact 3NP—63 in series with contact 5NP—64, contact 1TR—65, and the winding of relay 1LS to terminal O. Switch locking relays for the other switches, designated by the reference character LS with distinguishing numerical prefixes, are also energized by circuits which are similar to the circuits just traced for relay 1LS.

Switch control relay 1WR in Fig. 6 is energized by current of normal polarity passing from the battery Q1, through contact 1V—66 in the left-hand or normal position, contact 67 of relay 1LS, and the winding of relay 1WR back to the common terminal C of batteries Q1 and Q2. The other switch control or WR relays are energized by circuits similar to that just traced for relay 1WR.

Route locking relay 13ES in Fig. 8 is energized by pick-up circuits passing from terminal B, through contact 2—4MR—68, contact 6MR—69 in multiple with contact 3NP—70, contact 7TR—71 in multiple with contact 3NP—72, contact 1TR—73, and the winding of relay 13ES to terminal O. Stick circuits are also closed for relay 13ES, passing from terminal B, through contact 2—4MR—68, contact 6MR—69 in multiple with contact 3NP—70, contact 74 of relay 13ES, and the winding of relay 13ES to terminal O. Route locking relay 13WS is energized by a pick-up circuit passing from terminal B, through contacts 18—20MR—76 and 17TR—77, and the winding of

relay 13WS to terminal O. A stick circuit is also closed for relay 13WS, which is the same as the pick-up circuit just traced except that it includes contact 78 of relay 13WS instead of contact 17TR—77. Route locking relays 9ES and 9WS are energized by circuits which are similar to the circuits just traced for relays 13ES and 13WS, but which are not shown in the drawings.

Traffic locking relay 13E—WSP in Fig. 8 is energized by a circuit passing from terminal B, through contact 80 of relay 13ES, contact 81 of relay 13WS, and the winding of relay 13E—WSP to terminal O.

I shall assume that, with all parts of the apparatus thus in the normal condition the leverman or operator desires to arrange the apparatus for an eastbound train to proceed from track *dd* over track *bb*. He will therefore move switch lever 1V to the reverse position, completing a circuit for energizing relay 1WR in Fig. 6 by current of reverse polarity, this circuit passing from terminal C of batteries Q1 and Q2, shown in Fig. 6, through the winding of relay 1WR, contact 67 of relay 1LS, and contact 1V—66, closed in the reverse or right-hand position, back to battery Q2. With relay 1WR energized by current of reverse polarity, a reverse operating circuit will be completed for switch mechanism 1W, shown in Fig. 1A, this circuit passing from terminal B, through contact 1WR—26, contact 1WR—28 in the right-hand position, mechanism 1W, contact 1WR—27 in the right-hand position, and mechanism 1W to terminal O.

The operator will then move lever 2V to the reverse position, thereby completing a pick-up circuit for relay 2—4LP, passing from terminal B, through contact 82 of relay 14FR, contact 12V—83, contact 84—84*a* of relay 12LP, contacts 5V—85, 5KR—86, 3KR—87, 3V—88, 1KR—89 closed in the right-hand position, contact 1V—90 closed in the right-hand position, contact 91—91*a* of relay 2—4LP, contact 2V—93, and the winding of relay 2—4LP to terminal O. Relay 2—4LP, upon becoming energized by its pick-up circuit, closes its front contact 91—91*b*, and then opens its back contact 91—91*a*, thereby completing a stick circuit passing from terminal B, through contact 91—91*b*, contact 2V—93, and the winding of relay 2—4LP to terminal O.

With relay 2—4LP energized, relay 2—4—12LR in Fig. 7 will become energized by current of reverse polarity passing from terminal B, through contact 2—4LP—138 closed at the front point, contact 12LP—140 closed at its back point, winding of relay 2—4—12LR, contact 12LP—139 closed at the back point, and contact 2—4LP—141 closed at the front point, back to terminal O. Relay 2—4—12LR, upon becoming energized by current of reverse polarity, opens its contacts 2—4—12LR—39 and 2—4—12LR—40 in the stick circuits previously traced for relay 2—4MR in Fig. 5, thereby causing relay 2—4MR to become deenergized.

With relay 2—4MR deenergized, contact 2—4MR—55 operated by this relay will be opened in the circuits previously traced for relay 1LS in Fig. 6, causing relay 1LS to become deenergized and in turn open its contact 67, and thereby deenergize relay 1WR. Switch locking relays 3LS and 5LS and switch control relays 3WR and 5WR will be similarly deenergized.

With switch 1 occupying the reverse position, pole changer 1*y* will be in the reverse position, causing switch indication relay 1KR to be energized by current of reverse polarity. With relay 1KR energized by current of reverse polarity, reverse indication relay 1RP will be energized by current passing from terminal B, through contact 25 of relay 1KR, contact 25*a* of relay 1KR in the right-hand position, and the winding of relay 1RP to terminal O.

With relay 2—4MR deenergized, contact 2—4MR—68 in the circuits previously traced for relay 13ES will be opened, causing relay 13ES to be deenergized. With relay 13ES deenergized, contact 80 of this relay will open the circuit previously traced for relay 13E—WSP, causing relay 13E—WSP to also be deenergized. With relay 13E—WSP deenergized, the pick-up circuit previously traced for relay 14FR will be opened at the front point of contact 13E—WSP—31, but relay 14FR will now be retained in the energized condition by its stick circuit passing from terminal B, through the back point of contact 13E—WSP—31, contact 34 of relay 14FR, and the winding of relay 14FR to terminal O.

With the various relays energized or deenergized as described, a circuit will now be complete for energizing relay 2HR, this circuit passing from terminal B, through contact 12MR—142, contact 2—4—12LR—143 closed in the right-hand position, front point of contact 2—4—12LR—144, contacts 5LS—145, 5NP—146, 3NP—147, 3LS—148, 1LS—149, 1RP—150, front point of contact 2—4—12LR—151, contact 2—4—12LR—152 closed in the reverse position, and the winding of relay 2HR to terminal O.

If signal 14 is indicating stop, the yellow lamp of signal 2 will be lighted by its circuit passing from terminal B, through the front point of contact 2HR—29, back point of contact 2—4DR—30, and lamp Y of signal 2 to terminal O.

If, however, signal 14 has been cleared, by energization of its control relay 14HR similarly to the energization of relay 2HR, and if track section 12A—14A is unoccupied, distant control relay 2—4DR will be energized by its circuit passing from terminal B, through the front point of contact 14HR—194, contact 13TR—195, back point of contact 12HR—196, contacts 5NP—197, 1TR—198, 3NP—199 and 2HR—200, and the winding of relay 2—4DR to terminal O. With relay 2—4DR energized as well as relay 2HR, green lamp G of signal 2 will be lighted by its circuit passing from terminal B, through the front point of contact 2HR—29, front point of contact 2—4DR—30, and lamp G of signal 2 to terminal O.

I shall assume that, with signal 2 displaying either the caution or the proceed indication, the operator erroneously attempts to clear the opposing signal 12 by moving lever 12V to its reverse position. From Fig. 4A, it will be understood that, since contact 91—91*a* of relay 2—4LP is now open, the opening of contact 12V—83 in the pick-up circuit previously traced for relay 2—4LP can have no effect on relay 2—4LP which will continue energized by its stick circuit previously traced through contact 91—91*b*.

I shall now assume that, with signal 2 indicating proceed and signal 14 indicating caution, an eastbound train passes signal 2, causing relay 1TR to become deenergized. With relay 1TR deenergized, its contact 1TR—198 will open the circuit for relay 2—4DR, causing relay 2—4DR to be deenergized and therefore causing signal 2 to return to the caution indication. On account of contacts of relay 1TR being included in the switch locking relay circuits, such, for

example, as contact 1TR—65 in the circuit previously traced for relay 1LS in Fig. 6, the circuits previously described for relays 1LS, 3LS and 5LS will now be open at these contacts of relay 1TR as well as at contacts of relay 2—4MR such, for example, as contact 2—4MR—55 in the circuits for relay 1LS, thus preventing energization of relays 1LS, 3LS and 5LS due to energization of relay 2—4MR as long as a train occupies the section extending from signal 2 to signal 12.

When the train enters the section between signals 12 and 14, relay 13TR will become deenergized, thereby opening its contact 13TR—195 in the circuit for relay 2—4DR and in the circuit for relay 18—20DR which is similar to the circuit previously traced for relay 2—4DR. Therefore, as long as the section between signals 12 and 14 is occupied, the operator cannot cause a signal for governing traffic movements into this section such, for example, as signal 20, to display the proceed indication.

The operator can, however, by returning lever 2V to the normal position and thereby consecutively deenergizing relays 2—4LP, 2—4—12LR and 2HR, cause relay 2—4MR to become energized. If the operator returns lever 2V to the normal position while a train occupies section 1TR, relay 2—4MR in Fig. 5 will become energized by a pick-up circuit passing from terminal B, through contacts 2HR—37, 4HR—38, 2—4—12LR—39, and 1TR—44, and the winding of relay 2—4MR to terminal O.

If, however, the operator should fail to return lever 2V to the normal position before the train has left the section between signals 2 and 12, he can cause relay 2—4MR to become energized, upon the lapse of a measured period of time, by setting time element device 2—4—12TE into operation and thereby completing a circuit for energizing relay 2—4—12S in Fig. 5, passing from terminal B, through contacts 2HR—37, 4HR—38, 2—4—12LR—39, back point of contact 41 of relay 2—4MR, contact 2—4—12TE—53, and the winding of relay 2—4—12S to terminal O. When relay 2—4—12S becomes energized, it will continue energized by its stick circuit which is the same as the pick-up circuit just traced except including its own contact 54 instead of contact 2—4—12TE—53 of the time element device. The operator will now return the time element device to its normal position, causing its contact 2—4—12TE—42 to complete a pick-up circuit for relay 2—4MR through contact 2—4—12S—43.

With relay 2—4MR energized, relay 13ES, when relay 1TR is energized, will become energized by its pick-up circuits previously traced, and with relay 13ES thus energized, relay 13E—WSP will again become energized by its circuit previously traced. With relay 13E—WSP energized, the operator can, if he so desires, by reversing lever 13V, complete a circuit for energizing relay 12FR, this circuit passing from terminal B, through the front point of contact 13E—WSP—31, contact 13V—32 in the left-hand position, contact 33 of relay 14FR, and the winding of relay 12FR to terminal O.

The operator can clear signal 12 by reversing lever 12V while lever 2V is in its normal position. With relay 12FR now energized, the operator can also clear signal 20 by moving lever 20V to the reverse position while lever 14V is in the normal position. The circuit for relay 18—20LP, completed by the operation of lever 20V to its reverse position while relay 12FR is energized, is similar to the circuit previously traced for relay 2—4LP and can, therefore, be readily followed on the drawings without further description.

I shall assume that all parts of the apparatus are returned to the normal condition, and that the operator reverses switches 3 and 3*a* by operation of lever 3V to the reverse position, similarly to the manner in which the operation of switch 1 to its reverse position is accomplished as previously described. I shall also assume that the operator, in order to clear signal 12, then moves lever 12V to the reverse position, thereby completing a circuit for energizing relay 12LP, this circuit passing from terminal B, through contact 6V—108, contact 105—106*a* of relay 6LP, contacts 3V—111, 3KR—112, 5KR—86, 5V—85, contact 84—84*a* of relay 12LP, contact 12V—96, and the winding of relay 12LP to terminal O. With relay 12LP thus energized, relay 2—4—12LR in Fig. 7 will become energized by current of normal polarity passing from terminal B, through the back point of contact 2—4LP—138, front point of contact 12LP—139, winding of relay 2—4—12LR, front point of contact 12LP—140, and the back point of contact 2—4LP—141 to terminal O. With relay 2—4—12LR energized by current of normal polarity, the circuit previously traced for relay 12MR will be opened at contact 2—4—12LR—46, causing relay 12MR to become deenergized. Relay 12MR, upon becoming deenergized, opens the circuits previously traced for relay 1LS through contact 12MR—60, causing relay 1LS to become deenergized and to in turn deenergize relay 1WR. Relays 3LS and 5LS will also be deenergized, similarly to relay 1LS, and hence relay 12HR will now be energized by a circuit passing from terminal B, through contacts 6MR—171, 6—8—10LR—169, 3LS—168, 3RP—157, 5NP—146, 5LS—145, front point of contact 2—4—12LR—144, contact 2—4—12LR—143 closed in the normal position, and the winding of relay 12HR to terminal O. The yellow lamp of signal 12 will now be lighted by a circuit including a front contact of relay 12HR.

From the foregoing description and the accompanying drawings, it follows that, in apparatus embodying my invention, one lever repeater or primary control relay is provided for each end of each group of intersecting routes over which a traffic movement can be made at the same time that a traffic movement is being made over another route which may be in another group of intersecting routes. A manual control device is provided for each route end. Each primary control relay has a pick-up circuit over its own back contact, for each route with which it is associated, which is controlled by a reverse contact of the manual control device for an associated route end and by a normal contact of the manual control device for the opposite end of the same route, as well as by a back contact of the primary control relay for the opposite end of the same route. Each primary control relay has a stick circuit which is controlled by a reverse contact of the manual control device for an associated route end but which is independent of the position of the manual control device for the opposite end of the route. An erroneous attempt to clear an opposing signal or an attempt to move a switch over which a route is arranged will, therefore, have no effect on a signal which is already cleared.

A traffic direction control and locking scheme is also provided in the accompanying drawings for two adjacent interlocking layouts, such, for

example, as the layouts in each direction from a passenger station.

Although I have herein shown and described only one form of 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 an interlocking control system for a plurality of railway tracks interconnected by switches to form a plurality of routes including a group of intersecting routes and another route in parallel with each of said intersecting routes, signals for the ends of said routes for governing traffic movements through the routes, a control relay for each end of said group of intersecting routes and for each end of said parallel route including a given control relay associated with a plurality of said intersecting routes, a manual control device for each end of each of said routes each having a normal and a reverse position, a pick-up circuit for each of said control relays for each route with which the control relay is associated and each of said pick-up circuits controlled by the manual control device for the associated end of the route in the reverse position and by the manual control device for the opposite end of the route in the normal position, a stick circuit for each of said control relays for each route with which the control relay is associated and each stick circuit controlled by the manual control device for the associated end of the route in the reverse position independently of the position of the manual control device for the opposite end of the route, and means controlled by each of said control relays in the energized condition for clearing a signal for a corresponding route.

2. In combination, a stretch of railway track including a plurality of intersecting routes, signals governing traffic movements in opposite directions over said routes, a control relay for each end of said stretch, a manual control device for each route end having a normal and a reverse position, a pick-up circuit for each of said control relays for each route end at the corresponding end of said stretch and each of said pick-up circuits controlled by the manual control device for the corresponding route end in the reverse position and by the manual control device for the opposite end of the route in the normal position, a stick circuit for each of said control relays for each route end at the corresponding end of said stretch and each of said stick circuits controlled by the manual control device for the corresponding route end in the reverse position independently of the position of the manual control device for the opposite end of the route, and means controlled by said control relays in the energized condition for clearing signals for corresponding routes.

3. In combination, a stretch of railway track including a plurality of intersecting routes, signals governing traffic movements in opposite directions over said routes, a control relay for each end of said stretch, a manual control device for each route end, a pick-up circuit for each of said control relays for each route end at the corresponding end of said stretch and each of said pick-up circuits controlled by operation of the manual control device for the corresponding route end and by back contacts of the control relays for both ends of the corresponding route, a stick circuit for each of said control relays for each route end at the corresponding end of said stretch and each of said stick circuits controlled by a front contact of the corresponding control relay and by the manual control device for the corresponding route end independently of the condition of the control relay for the opposite end of the stretch.

4. In combination, a stretch of railway track, signals governing traffic movements in opposite directions over said stretch, a control relay for each of said signals, a manual control device for each of said relays each having a normal and a reverse position, a pick-up circuit for each of said control relays jointly closed by its manual control device in the reverse position and by back contacts of the corresponding control relay and of the control relay for the signal at the opposite end of the stretch, a stick circuit for each of said control relays controlled by its manual control device in the reverse position and by a front contact of the corresponding relay independently of the condition of the control relay for the opposite end of the corresponding route, and means controlled by each of said control relays in the energized condition for clearing the corresponding signal.

5. In combination, a stretch of railway track including a plurality of intersecting routes, signals governing traffic movements in opposite directions over said routes, a control relay for each end of said stretch, a manual control device for each route end having a normal and a reverse position, means controlled by each of said manual control devices for energizing the control relay for the corresponding end of said stretch when said manual control device is in the reverse position and for preventing energization of the control relay for the opposite end of said stretch when said manual control device is moved out of its normal position, a polarized relay, means controlled by said control relays for energizing said polarized relay by current of normal or reverse polarity according as a first one of said control relays is energized while the second is deenergized or the first of said control relays is deenergized while the second is energized, a signal relay for each route end, means controlled by said polarized relay for energizing a signal relay for one or the other end of said stretch according as said polarized relay is energized by current of normal or of reverse polarity, and means controlled by each of said signal relays for clearing a corresponding signal.

6. In combination, a stretch of railway track including a plurality of intersecting routes having a plurality of route ends at one end of said stretch, signals governing traffic movements in opposite directions over said routes, a control relay for each end of said stretch, a manual control device for each route end having a normal and a reverse position, means controlled by each manual control device in its reverse position and by the manual control device for the opposite end of the same route in its normal position for energizing the control relay for the same end of the stretch as the manual control device which is in the reverse position, means controlled by the manual control device for the same end of the stretch in its reverse position for retaining each control relay in the energized condition independently of the position of the control device for the opposite end of the same route, and means controlled by said control relays for clearing corresponding signals.

7. In combination, a stretch of railway track

over which traffic movements may be made in either direction comprising an interlocking layout of switches and signals at one end of said stretch and a second interlocking layout of switches and signals at the other end of said stretch as well as an intermediate section of track between said interlocking layouts, an approach locking relay which becomes deenergized when said first interlocking layout is arranged for traffic movements toward said intermediate section, a second approach locking relay which becomes deenergized when said second interlocking layout is arranged for traffic movements toward said intermediate section, a route locking relay deenergized upon deenergization of said first approach locking relay and retained in the deenergized condition while a train moves through said first interlocking layout, a second route locking relay deenergized upon deenergization of said second approach locking relay and retained in the deenergized condition while a train moves through said second interlocking layout, a traffic locking relay controlled by said route locking relays and deenergized when either of said route locking relays is deenergized, a traffic lever having a first and a second position, a first and a second traffic relay, a pick-up circuit for said first traffic relay closed by said traffic locking relay in the energized condition and by said traffic lever in its first position, a pick-up circuit for said second traffic relay closed by said traffic locking relay in the energized condition and by said traffic lever in its second position, a stick circuit for each of said traffic relays closed by said traffic locking relay in the deenergized condition independently of the position of said traffic lever, and means controlled in part by said first and second traffic relays for arranging said first or second interlocking layout respectively to direct traffic movements toward said intermediate section.

8. In combination, a stretch of railway track over which traffic movements may be made in either direction, a traffic locking relay controlled to be normally energized but to become deenergized when a train approaches said stretch of track from either direction, a traffic lever having a first and a second position, a first and a second traffic control relay, a pick-up circuit closed by said traffic locking relay in the energized condition and by said traffic lever in its first or second position for energizing said first or second traffic control relay respectively, a stick circuit for each of said traffic control relays closed by said traffic locking relay in the deenergized condition for retaining each of said traffic control relays in the energized condition, and means controlled in part by said first or second traffic control relays in the energized condition for directing traffic movements in a first or second direction respectively toward said stretch of track.

9. In combination, a stretch of railway track, a first signal for a given end of said stretch for governing traffic movements in a given direction over said stretch, a second signal for the opposite end of said stretch for governing traffic movements in the opposite direction over said stretch, a first and a second control relay, manual control means for selectively energizing one or the other of said control relays, a polarized relay, means controlled by the first of said control relays in the energized condition and by the second of said control relays in the deenergized condition for energizing said polarized relay by current of normal polarity, means controlled by said first control relay in the deenergized condition and by said second control relay in the energized condition for energizing said polarized relay by current of reverse polarity, and means controlled by said polarized relay only when energized by current of normal or reverse polarity for clearing said first or said second signal respectively.

10. In combination, a stretch of railway track, a polarized relay, manually controllable means for selectively energizing said polarized relay by current of normal or reverse polarity, means controlled by said polarized relay when energized by current of normal or reverse polarity for directing traffic movements in a first direction or in the opposite direction respectively over said stretch, a first and a second approach locking relay, a control circuit for said first approach locking relay controlled in part by a back neutral contact of said polarized relay in multiple with a normal polar contact of the same relay, a control circuit for said second approach locking relay controlled in part by a back neutral contact of said polarized relay in multiple with a reverse polar contact of the same relay, and traffic governing apparatus for said stretch controlled by front contacts of said first and second approach locking relays.

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