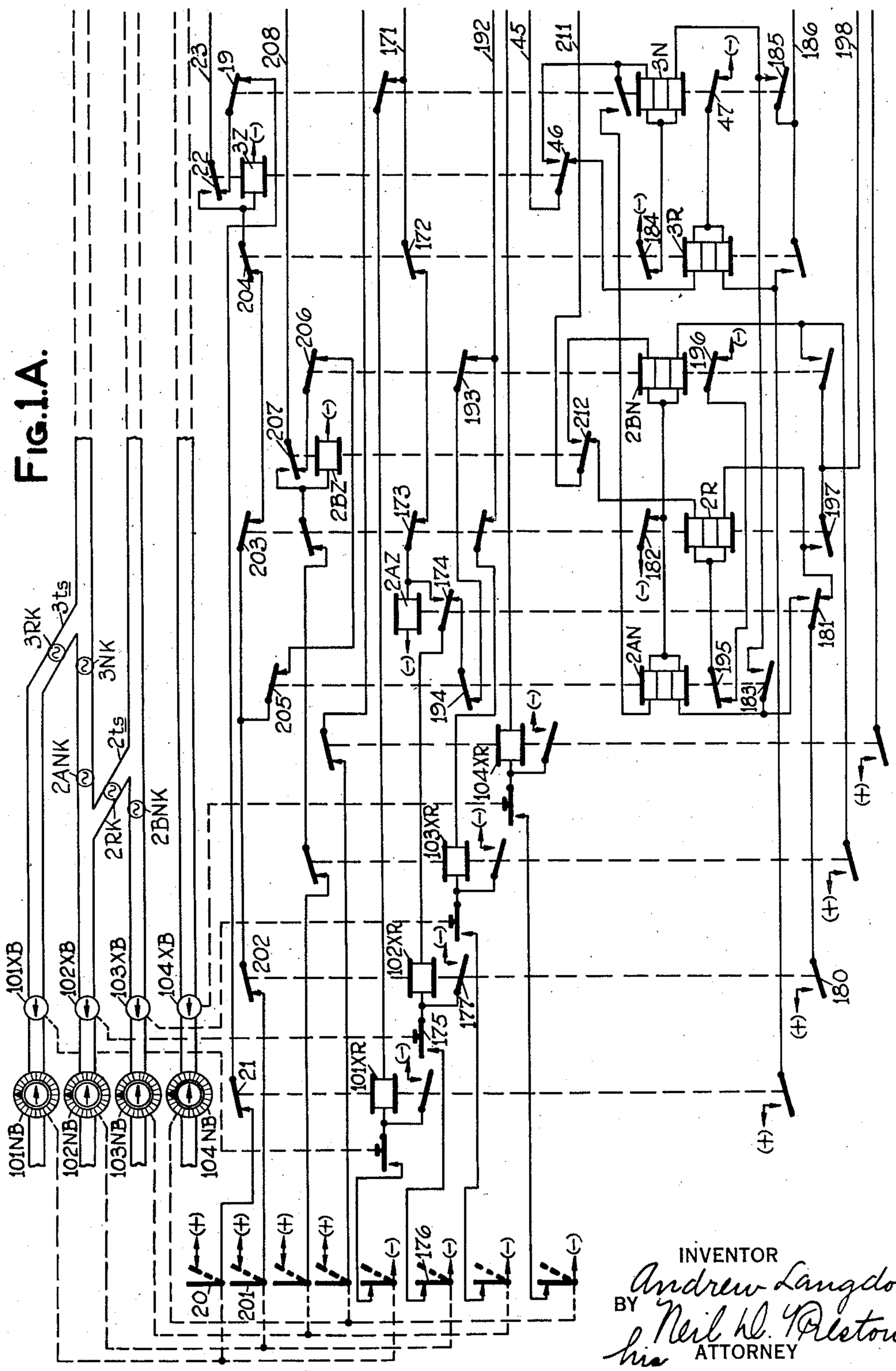
Feb. 28, 1939. A. LANGDON 2,148,865

INTERLOCKING SYSTEM FOR RAILROADS

Filed Nov. 26, 1937 8 Sheets-Sheet 1

FIG. 1.A.



INVENTOR
Andrew Langdon
BY Neil W. Pleton
his ATTORNEY

Feb. 28, 1939. A. LANGDON 2,148,865

INTERLOCKING SYSTEM FOR RAILROADS

Filed Nov. 26, 1937 8 Sheets-Sheet 2

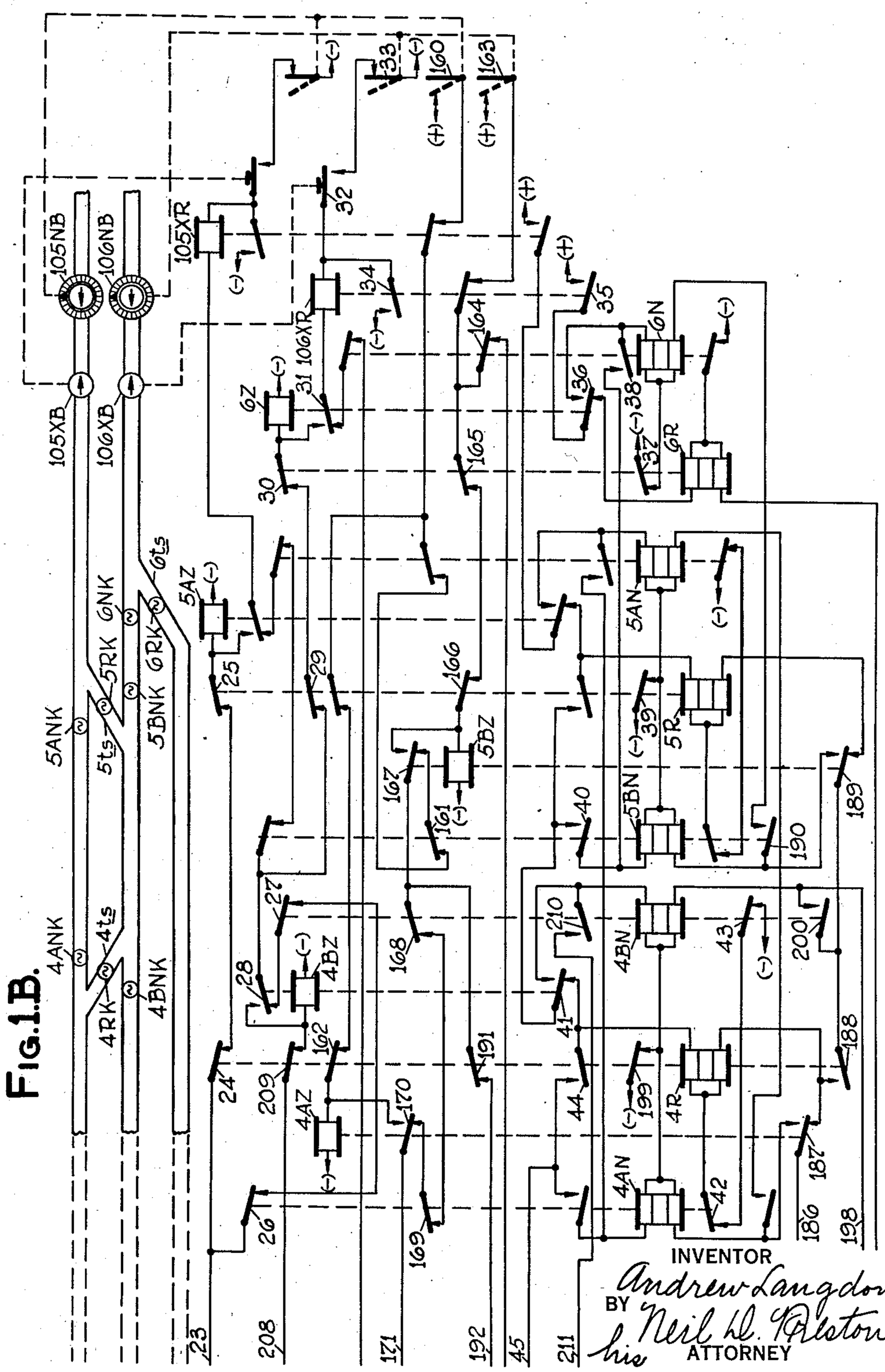


FIG. 1B.

INVENTOR
Andrew Langdon,
BY Neil H. Preston,
his ATTORNEY

Feb. 28, 1939. A. LANGDON 2,148,865

INTERLOCKING SYSTEM FOR RAILROADS

Filed Nov. 26, 1937 8 Sheets-Sheet 3

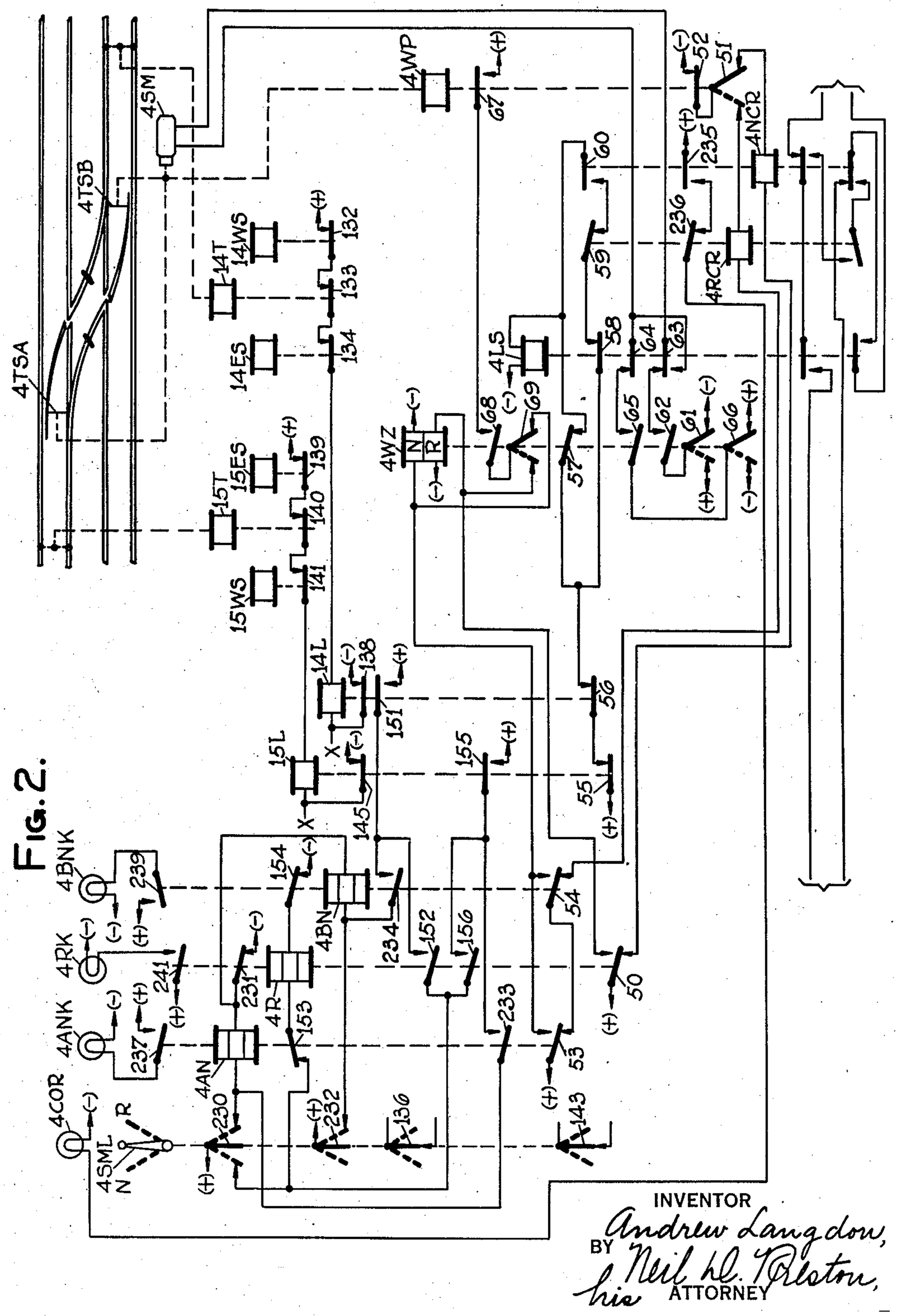


FIG. 2.

INVENTOR
Andrew Langdon,
BY Neil W. Preston,
his ATTORNEY

Feb. 28, 1939. A. LANGDON 2,148,865

INTERLOCKING SYSTEM FOR RAILROADS

Filed Nov. 26, 1937 8 Sheets-Sheet 4

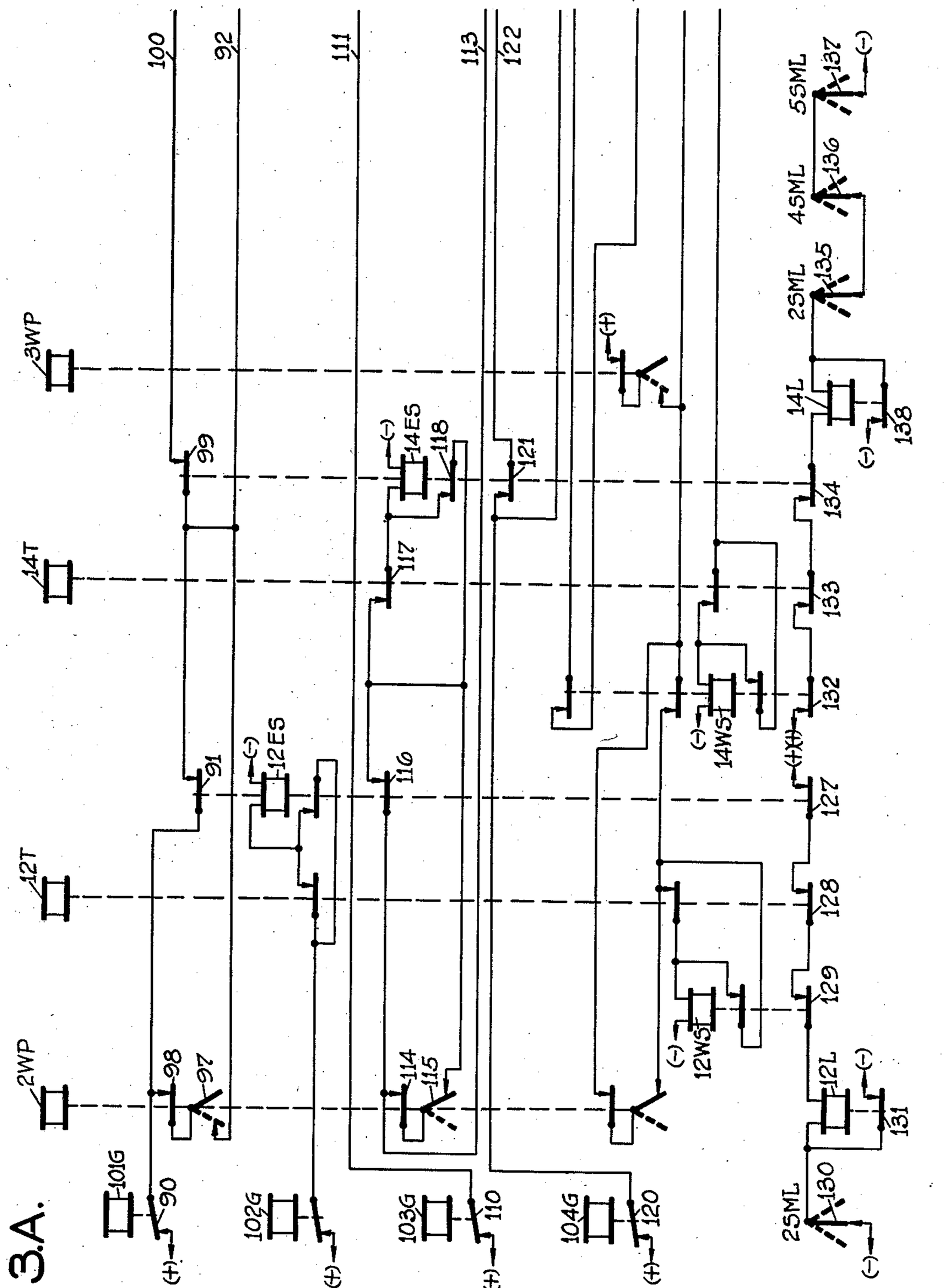


FIG. 3.A.

INVENTOR
Andrew Langdon,
BY Neil W. Pleton,
his ATTORNEY

Feb. 28, 1939. A. LANGDON 2,148,865

INTERLOCKING SYSTEM FOR RAILROADS

Filed Nov. 26, 1937 8 Sheets-Sheet 5

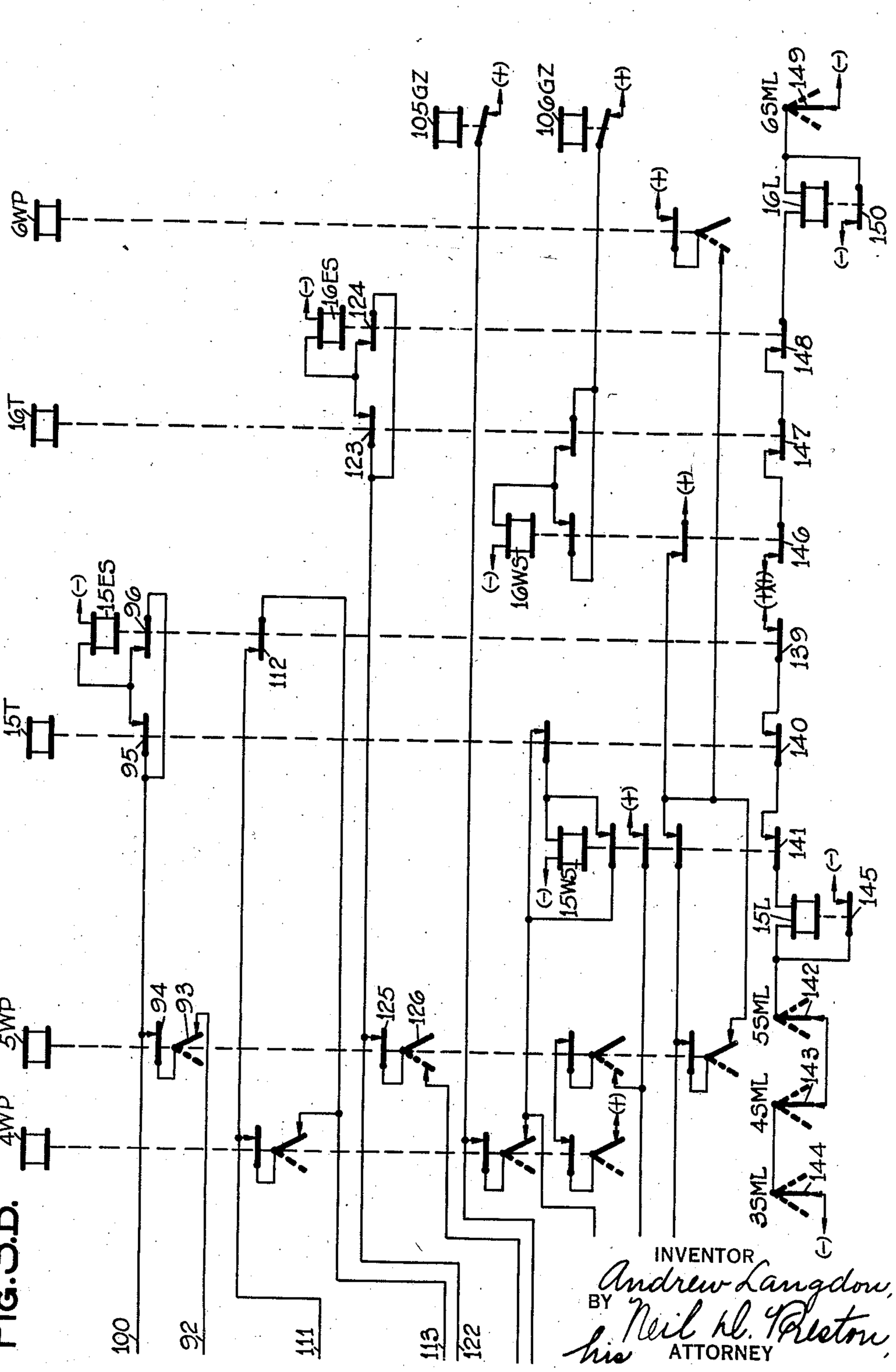


FIG. 3.B.

INVENTOR
Andrew Langdon,
BY
his Neil H. Preston,
ATTORNEY

Feb. 28, 1939. A. LANGDON 2,148,865

INTERLOCKING SYSTEM FOR RAILROADS

Filed Nov. 26, 1937 8 Sheets-Sheet 6

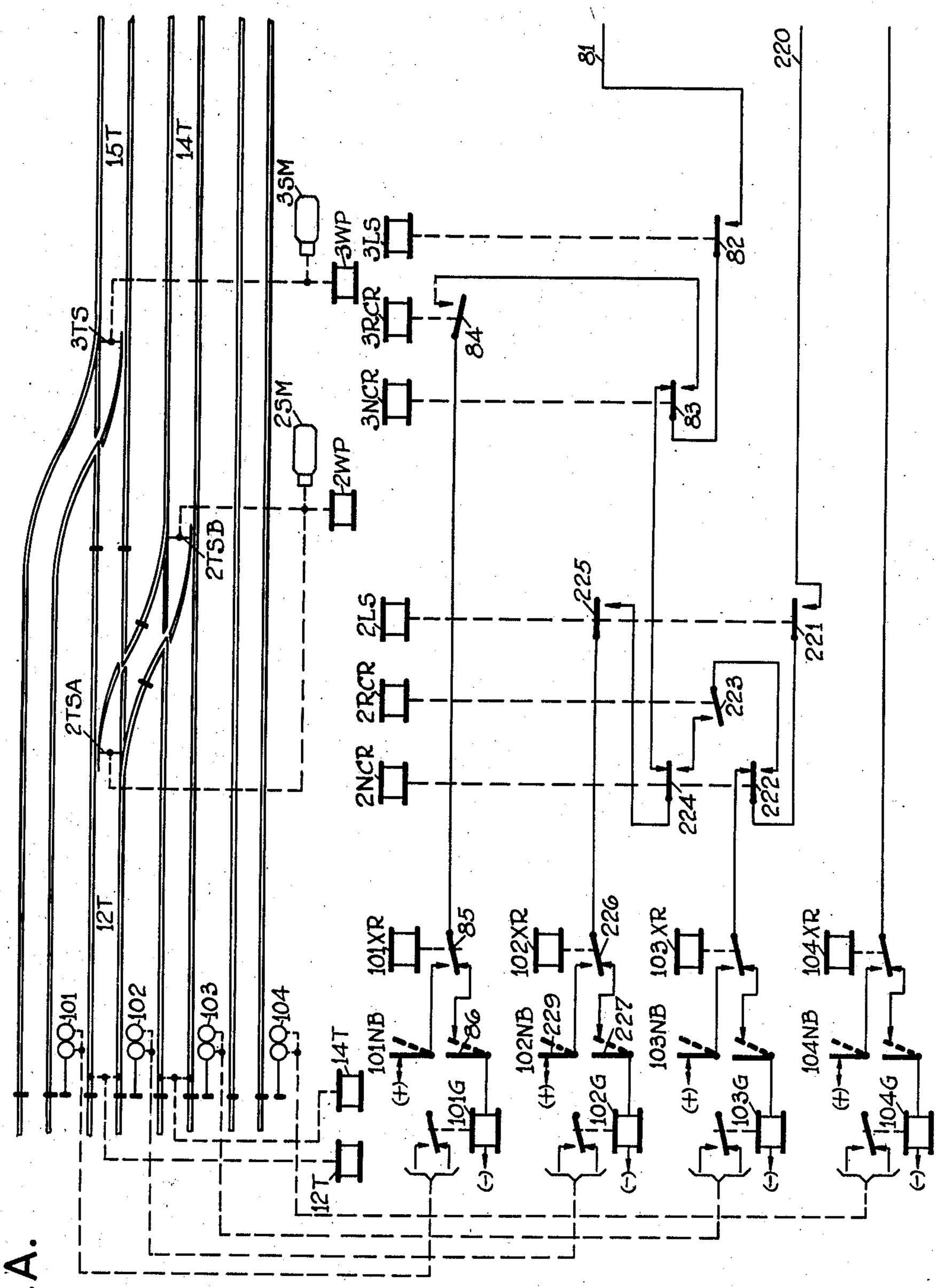


FIG. 4. A.

INVENTOR
Andrew Langdon
BY
his Neil H. Preston,
ATTORNEY

Feb. 28, 1939. A. LANGDON 2,148,865

INTERLOCKING SYSTEM FOR RAILROADS

Filed Nov. 26, 1937 8 Sheets-Sheet 7

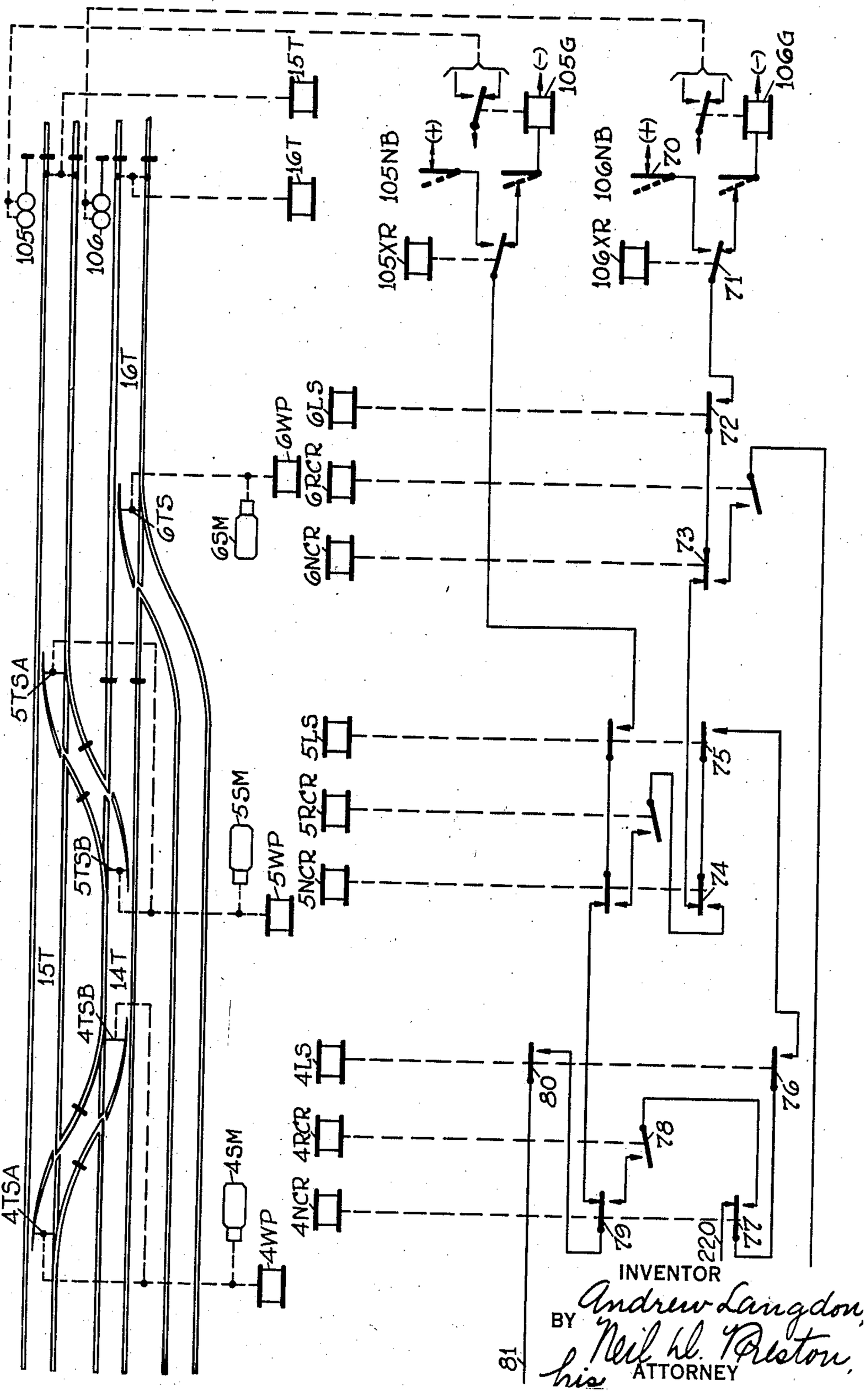


FIG. 4.B.

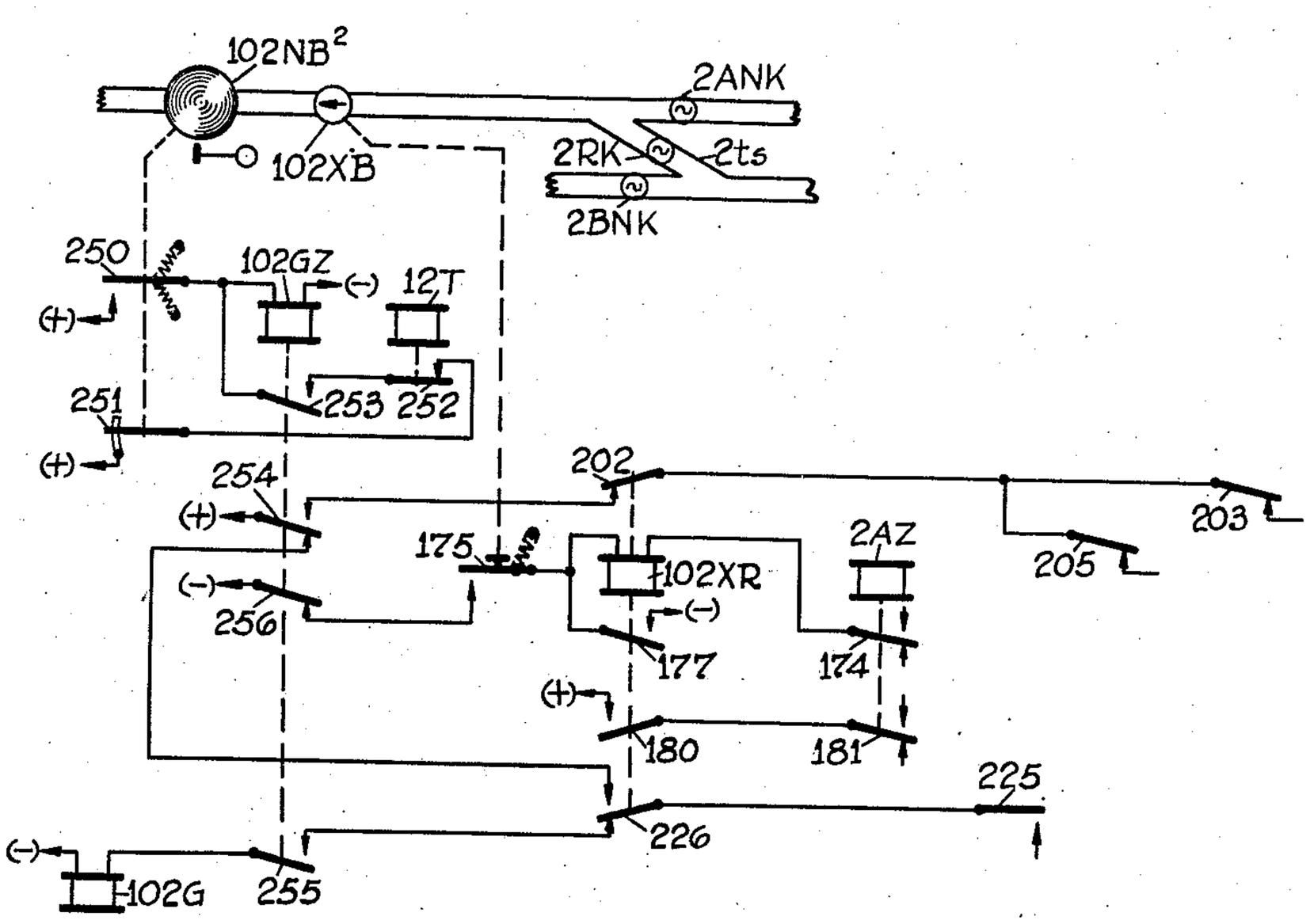
INVENTOR
Andrew Langdon,
BY Neil H. Preston,
his ATTORNEY

Feb. 28, 1939. A. LANGDON 2,148,865

INTERLOCKING SYSTEM FOR RAILROADS

Filed Nov. 26, 1937 8 Sheets-Sheet 8

FIG. 5.



INVENTOR
Andrew Langdon,
BY
Neil H. Preston,
his ATTORNEY

Patented Feb. 28, 1939

2,148,865

UNITED STATES PATENT OFFICE

2,148,865

INTERLOCKING SYSTEM FOR RAILROADS

Andrew Langdon, Brighton, N. Y., assignor to General Railway Signal Company, Rochester, N. Y.

Application November 26, 1937, Serial No. 176,466

21 Claims. (Cl. 246—134)

This invention relates to electric interlocking systems for railroads, and more particularly pertains to an interlocking system of the entrance-exit type.

The entrance-exit type of interlocking system of the present invention is to be considered an improvement over my prior application Ser. No. 119,641, filed January 8, 1937.

In a system of this character, the traffic controlling devices of an interlocking plant are controlled from a central office having a control machine with a control panel upon which is located a miniature track diagram corresponding to the actual track layout of the plant. On this combined miniature track diagram and control panel are located initiating and completing buttons for the ends of the routes. The actuation of an initiating button and a completing button at the opposite ends of a particular route, causes the operation of all of the track switches to proper positions to establish that route and also causes the clearing of the signal after the route has been established.

One of the objects of the present invention is to provide such entrance-exit control through the medium of a so-called, "self-selecting network" which is organized upon the basic fact that each track switch of an interlocking plant is trailed by traffic movements in a particular direction for that switch. If we choose an entrance point at one end of the interlocking plant, and consider all of the available routes emanating from that point in such a way as to move all of the switches which are trailed for that direction in such available routes, and then choose an exit point where we wish to leave the plant returning towards the chosen entrance point moving all of the switches which are trailed for that direction, we find that the trailing switches for the first direction are facing switches for the opposite direction and have been properly positioned to definitely select the returning route. The entire and complete route between the chosen entrance point and the chosen exit point is thus definitely established.

In accordance with the present invention, the principles of the preceding paragraph are applied to a self-selecting network so that the actuation of the initiating (or entrance) button for a given entrance point positions control selecting relays for each of the track switches in the track layout which have a trailing switch point movement relation to that entrance point. With all such control selecting relays thus positioned, the actuation of the completion (or exit) button for a particular exit point then positions switch control relays for each switch in the particular route between such entrance and exit points dependent upon the selecting relays to cause the track switches to be power operated to proper positions for that route.

One object of the present invention is to provide a network, organized in accordance with the above mentioned principles, in such cooperation with the traffic conditions in the track layout that a route once established and accepted by a train will cause the switch control relays of the self-selecting network to be maintained in their actuated conditions although the governing entrance button for that route is returned to stop or a non-controlling position. This relationship between the self-selecting network and the traffic conditions provides that the relays conditioned for the establishment of a particular route may be maintained so as to prevent a conflicting route from being established so long as a train is in that particular route.

The feature of maintaining the network in accordance with the route established is accomplished by the invention in such a way, that, as the train passes through the route, the control relays for the track switches in the rear of the train are released to allow such track switches to be employed for the establishment of new routes.

A still further object of the present invention is to so organize the self-selecting network with respect to the controlling of the track switches and signals that the completion of the manipulation for a particular route causes the operation and locking of all of the track switches in such route before the signal governing that route can be cleared.

A still further feature of the present invention is to provide the above described entrance-exit control in such a manner that the track switches are not only controllable by the composite or collective network route control, but may also be actuated to their different positions by individual auxiliary switch control levers and still provide the remaining features of the system, so that a route may be maintained after it has been established irrespective of the operation of the auxiliary switch control levers at such time.

Other objects, purposes and characteristic features of the present invention will be in part obvious from the accompanying drawings, and in part pointed out as the description of the invention progresses.

In describing the invention in detail, reference will be made to the accompanying drawings, in which like letters in the reference characters designate similar functions or relationships with the distinctiveness between such reference characters provided by the use of distinctive preceding numerals; in which like preceding numerals in the reference characters when applied to different letters represent the inclusion of such devices within a particular group; and in which:

Figs. 1A and 1B, when placed end to end, show the miniature track diagram and self-selecting network for a track layout shown in detail in Figs. 4A and 4B;

Fig. 2 shows a typical switch control circuit for one of the crossovers in the track layout shown in Figs. 4A and 4B, with the specific signal selections associated with that particular crossover;

Figs. 3A and 3B, when placed end to end, show the route locking circuits for the particular track layout selected for the embodiment of the present invention;

Figs. 4A and 4B, when placed end to end, show the track layout and signal control circuits for the embodiment of the present invention; and

Fig. 5 discloses a self-restoring entrance button and its control as employed with the self-selecting network of the present invention in place of the entrance buttons employed in Figs. 1A and 1B.

For the purpose of simplifying the illustration and facilitating in the explanation thereof, the conventional parts and circuits constituting the embodiment of the invention have been shown diagrammatically and certain conventional illustrations have been employed, the drawings having been made more with the purpose of making clear the principles and objects of the present invention together with its mode of operation, than with the idea of illustrating the actual construction and arrangement of parts that would probably be employed in practice.

The various relays and their contacts are illustrated in a conventional manner and symbols are employed to indicate connections to the terminals of batteries, or other suitable sources of electrical current supply, instead of showing all the wiring connections to such terminals.

The symbols (+) and (—) are employed to indicate the positive and negative terminals respectively of suitable batteries or other source of electrical energy; and those terminals with which these symbols are used are assumed to have current flowing from the positive terminal designated (+) to the negative terminal designated (—).

The symbols employed with any one circuit are considered to designate the terminals of the same battery, or other suitable source, but it is to be understood that as many separate sources may be provided as found necessary, or as many sources may be combined into a single source as found expedient in the practicing of the invention.

If alternating current is employed instead of direct current, the symbols should be considered to represent the instantaneous relative polarities of the respective terminals.

Where groups of devices are referred to in a general way, the letter reference characters will be used to designate such groups instead of mentioning each specific reference character of that group.

Apparatus

Track layout.—With reference to Figs. 4A and 4B, the present invention has been shown as applied to a stretch of double track interconnected by crossovers and having turnout track switches. These crossovers and track switches include track switches 2TSA—2TSB, 3TS, 4TSA—4TSB, 5TSA—5TSB, and 6TS.

The track switches are operated by power switch machines which may be of any suitable type, such for example, as shown in the patent to W. K. Howe, Patent No. 1,466,903, dated September 4, 1923. However, the motor of each switch machine is preferably controlled as shown for example, in the patent to W. H. Hoppe, et al., Patent No. 1,877,876, dated September 20, 1932, with the relay CR of such patent controlled by the relay WZ of this disclosure as more specifically shown in Fig. 2.

Each track switch TS is suitably controlled by its power operated switch machine SM. Inasmuch as the opposite ends of a crossover are usually operated at the same time, only a single switch machine SM has been shown as operating each crossover, although it is to be understood that a separate switch machine may be employed for each of the two track switches of a crossover when desired. More specifically, the switch machine 2SM operates the track switches 2TSA and 2TSB; switch machine 3SM operates the switch 3TS; switch machine 4SM operates track switches 4TSA and 4TSB; switch machine 5SM operates track switches 5TSA and 5TSB; and switch machine 6SM operates track switch 6TS.

Associated with each of the track switches and its respective switch machine is a suitable relay WP of the polar neutral type. Each relay WP is energized with one polarity or the other in accordance with the normal or reverse locked position of its track switch in correspondence with its switch machine SM, and is deenergized whenever its track switch is in operation or is unlocked. The polarized circuit for controlling each switch position relay WP is governed by its track switch TS and switch machine SM through the medium of a point detector contact mechanism, such as shown for example in the patent to C. S. Bushnell, Patent No. 1,517,236, dated November 25, 1924. It is to be understood that when two switch machines are employed for a crossover that there would probably be two such point detector contact mechanisms and that the contacts of each would be suitably included in series in the polarized circuit for the relay WP for such crossover so that both of the track switches of the crossover must be in corresponding positions and locked in order for the relay WP to be energized.

Signals 101, 102, 103 and 104 are provided for governing east-bound traffic at the west entrance to the track layout, while signals 105 and 106 are provided at the east end of the track layout to govern west-bound traffic.

The various signals are assumed to be color light signals giving the usual indications of green for clear and red for danger or stop, and yellow if an added indication is desired for caution. It is to be understood however, that these signals may be of the search light type, the semaphore type, or any other suitable type instead of the particular type chosen for the embodiment of the invention.

The track layout has been shown as divided into track circuits separated by the usual insulated joints. These track circuits are provided

with the usual track relays T and track batteries, of which the track relays 12T, 14T, 15T and 16T have been shown. The number of track circuits is determined in accordance with the usual principles of signalling in such a way that there is at least one track circuit for each parallel or non-conflicting route. These track circuits are assumed to be of the normally energized type and are wired in the usual manner to provide for fouling protection and to provide for the insulation of the track switches and crossovers, such details having been omitted for the sake of simplicity in the disclosure.

Control machine.—With reference to Figs. 1A and 1B, it will be seen that the control machine is contemplated as including a miniature track layout corresponding to the actual track layout in the field (see Figs. 4A and 4B). The construction of the miniature track diagram on the control panel may be of any suitable type employing either miniature movable switch points as representative of the track switches, or employing illuminated sections of trackway such as shown and described in the prior application of F. B. Hitchcock, Ser. No. 74,709, filed April 16, 1936, this latter form being chosen for the present embodiment.

One of the features of an interlocking system contemplated in accordance with the present invention is the location of entrance and exit buttons on the control panel in such a way that they designate the entrance and exit points on the miniature track diagram. More specifically, an entrance button NB is provided for each of the signal locations, such as entrance buttons 101NB, 102NB, 103NB, 104NB, 105NB and 106NB, these buttons being for the respective signals indicated by their preceding numerals. An exit button is provided for the exit end of each route, such as exit buttons 101XB, 102XB, 103XB, 104XB, 105XB and 106XB, it being assumed that the ends of the routes with which they are associated coincide with the signal locations indicated by their preceding numerals. However, it is to be understood that the ends of the routes may or may not correspond to the locations of the exit buttons XB on the control panel, as a route is usually considered to extend from a particular signal to the next signal governing traffic in the same direction, or at least to some arbitrarily chosen point which may or may not coincide with the next signal for the opposing direction.

The present invention contemplates that each entrance button NB is in the form of a knob which may be rotated 90° from a normal position to an operated position so that its index coincides with the fixed arrow on the signal indicator lamp located within the button, thus indicating that such signal is to allow for the passage of traffic when its indicator is illuminated. This type of entrance button remains in the position to which it is actuated so that when a signal has been cleared and a train has accepted such signal, the button must be manually restored to its normal position. Each entrance button NB is provided with suitable contacts which are closed when the button is in the normal or non-operated position and other contacts which are closed when it is in an operated or signal clearing position.

Each of the exit buttons XB is of the self-restoring push button type and has contacts which are closed only when it is in an actuated position.

It is to be understood that the entrance and exit buttons may be located on the control panel in any suitable way and still be within the scope of the present invention. For example, the entrance and exit buttons NB and XB may be physically combined in such a way that the rotation of the knob actuates the entrance contacts while the depression of the knob actuates the exit contacts.

It may be well to point out here that the present invention also contemplates that self-restoring entrance buttons may be employed in place of the stay-where-put entrance buttons of Figs. 1A and 1B. Such a self-restoring entrance button and its control has been shown in Fig. 5, where each such self-restoring entrance button requires a repeating relay GZ which can be picked up upon the momentary actuation of its entrance button and can be maintained stuck up until the acceptance of a signal by a train.

The control machine also includes an auxiliary switch control lever SML for each of the power operated switch machines, only one of which has been shown (see Fig. 2). These switch machine control levers SML are for the purpose of controlling the individual track switches under certain emergency conditions such as to operate them to free the switch points from ice or lumps of coal, and also at such times as certain optional or run-around routes are desired at times when such routes are not rendered automatically available by the self-selecting network.

A correspondence lamp COR is associated with each of the auxiliary switch machine control levers SML to indicate when the corresponding track switch is in correspondence with its control as provided either by the self-selecting network or by the individual switch machine control lever SML. Each lamp COR is unilluminated when correspondence exists and is illuminated when there is a lack of correspondence.

Although the structural details of the miniature track diagram have not been shown, it is contemplated in accordance with the present invention that each of the miniature track switches shall have associated therewith indicator lamps which are controlled in accordance with the positions of the track switch and in accordance with the locked condition of such track switch. These indicator lamps may illuminate extended portions of miniature trackway or just portions located adjacent the miniature track switches which are represented on the miniature trackway as shown in Figs. 1A and 1B, but their control has been typically illustrated in connection with the indicator lamps 4ANK, 4RK and 4BNK of Fig. 2.

System devices.—The entrance buttons NB and the exit buttons XB, as above mentioned, are respectively indicated as connected to their contacts in Figs. 1A and 1B. But there are contacts on each of the entrance buttons NB in Figs. 4A and 4B which, due to the organization of the drawings, are not connected by dotted lines to their respective entrance buttons but have been designated as associated therewith by the entrance button nomenclature. Each exit button XB has associated therewith an exit relay XR.

The contacts of the entrance button NB for one end of a route and the contacts of the exit relay XR for the opposite end of that route jointly control the positioning of the proper switch control relays for the switches and crossovers in that route.

For each crossover, switch control relays AN, R and BN (with suitable preceding numerals) are employed, while for each single switch, control

relays N and R (with suitable preceding numerals) are employed. These relays are of the neutral type and govern the operation of their respective switch machines through the medium of a polar neutral relay WZ having oppositely connected windings. These switch control relays are selected through the self-selecting network including auxiliary relays Z, certain ones of which are termed AZ and BZ when associated with a crossover. These auxiliary relays Z condition the circuits of the self-selecting network in such a manner that the energization of the N and R relays in sequence causes the sequential operation of the track switches, as will be more specifically pointed out hereinafter.

In Figs. 3A and 3B, route locking relays ES and WS have been shown with their respective control circuits governed in accordance with the G relays which control their respective signals as designated by their preceding numerals. These route locking relays are so organized that each track circuit is provided with two such relays, one for each direction. For example, the track circuit having track relay 12T (see Fig. 4A) has shown associated therewith the route locking relays 12ES and 12WS.

Each track circuit has associated therewith a lock relay L which prevents the operation of the track switch or switches in its section when traffic conditions make it unsafe for such operation. These lock relays have been shown in Figs. 3A and 3B for each of the track sections. In brief, each lock relay such as 14L, for example, includes contacts of its associated track section and contacts of the route locking relays for such track section in both its pick up and stick circuits, as well as contacts of each auxiliary switch control lever for the track switches in its associated track section in its pick up circuit alone. In other words, there is only a single lock relay for all of the track switches in that particular track section with the respective circuits for such track switches all being selected through such lock relay.

However, if it is desired to have an individual lock relay for each track switch, such lock relay for each switch may readily be provided with duplicate selections on the track relay and route locking relays of the track section in which such switch is located. The contacts of the several auxiliary switch control levers are of course allotted to the lock relays of their respective track switches. This change in the preferred form of lock relay control gives the same locking so far as traffic conditions are concerned, but the locking resulting from the operation of an auxiliary switch control lever is of course individual to its track switch.

Although the route locking circuits of Figs. 3A and 3B have been shown in their simplest form, it is to be understood that suitable approach locking features and time release therefor may be employed in connection with such route locking, all in a manner as more specifically shown and described in the prior patent granted to E. C. Larry et al., Patent No. 2,125,242 dated July 26, 1938, but it is believed to be unnecessary for an understanding of the present invention to show such features in detail.

Associated with each of the track switches is a lock stick relay, shown specifically as relay 4LS for the switch machine 4SM in Fig. 2. This lock stick relay LS is provided to maintain energy upon the switch machine so long as its track switch is being operated or is unlocked, and to remove energy from the switch machine when it is locked to permit the closing of the signal clearing circuits.

Each track switch has associated with its control relays N and R and its relay WP two correspondence relays NCR and RCR one or the other of which is energized when such track switch is in correspondence with its manual control and both of which are deenergized whenever the track switch is out of correspondence or is in operation. It may be well to note, however, that one or the other of the correspondence relays NCR or RCR is energized depending upon the position and locked condition of its track switch when there is no manual control present for such track switch. In other words, the correspondence condition is indicated with regard to the manual control only when there is such manual control actually present for the track switch.

With reference to Figs. 4A and 4B, a signal control relay G is provided for each signal for causing that signal to indicate clear or stop. These signal control relays have been specifically shown for each of the signals in the track layout and the selecting circuits have been shown in detail. However, dotted lines connecting such relays with their respective signals have been employed instead of showing the detailed circuits, it being readily understood that each relay when deenergized causes its associated signal to indicate red or stop, and when energized causes its associated signal to indicate green or clear.

It is believed that the remaining features of the present invention will be best understood by considering certain typical operations in detail.

Operation

Normal conditions.—The track switches of an interlocking plant controlled by the system of the present invention are left in their last operated positions, but for convenience in the disclosure they have been shown in their main line or normal positions. The signals are considered to be normally "at stop" with the lower or red indicator of each signal illuminated, unless as might be employed in practice, certain approach light features are employed.

All of the track circuits are considered to be unoccupied so that their respective track relays T are normally picked up.

All of the lock relays L shown are normally energized as will be readily apparent from the consideration of the lock relays 14L and 15L of Fig. 2.

All of the switch control relays N and R of the self-selecting network of Figs. 1A and 1B are normally deenergized.

In providing the indications on the control panel, although only certain ones of such indications have been shown in the present disclosure, it is preferable that they be arranged so as to give a "normally dark board". However, any desired arrangement may be employed within the scope of the present invention.

Self-selecting network.—When the operator desires to set up a route, as for example, between the signals 101 and 106, he actuates the entrance button 101NB to an operated position followed by the momentary actuation of the exit button 106XB.

The operation of the entrance button 101NB causes the energization of the Z relay for each track switch which is trailed in all of the routes emanating from the signal 101 providing such trailing movement is for a preferred or particular

position of such track switch. For the purpose of the present disclosure, the preferred or particular position of each track switch has been assumed to be the position for setting up a route over the main line or straight track, which position is conveniently termed the "normal position" in this description; but, the preferred or particular position of each track switch can be, if desired, the position for setting up a diverging route, which position is conveniently termed the "reverse position" in this description.

Following the positioning of the Z relays in response to the operation of the entrance button, the actuation of the exit button causes the energization of its exit relay, providing that there is no conflicting route which will be considered more in detail hereinafter, which exit relay applies energy to circuits selected by the relays Z to energize a switch control relay N or R for each of the track switches in that particular route connecting the designated entrance and the exit points.

Let us apply these principles of the present invention to the particular route under consideration as extending from the signal 101 to the signal 106. The relay 3Z for the track switch 3TS is not picked up inasmuch as a movement from the signal 101 is for trailing such track switch in its reverse position. The relay 4AZ is not energized because the track switch 4TSA is facing for a route emanating from signal 101 and extending to signal 106. The relay 4BZ is not energized because it is trailed reverse. But the relay 5AZ is energized, because it is trailed normal for a route emanating from signal 101 to signal 105. The relay 5BZ is not energized because its track switch 5TSB is facing in the route emanating from signal 101 and extending to signal 106. The relay 6Z is energized inasmuch as the track switch 6TS is trailed normal in the route emanating from signal 101 and extending to signal 106.

More specifically, the relay 5AZ is energized by a circuit closed from (+), through a circuit including contact 20 of entrance button 101NB in an operated position, back contact 21 of relay 101XR, back contact 19 of relay 3N, back contact 22 of relay 3Z, wire 23, back contact 24 of relay 4R, back contact 25 of relay 5R, winding of relay 5AZ, to (—).

The relay 6Z is energized by a circuit closed from (+), through a circuit including contact 20 of entrance button 101NB in an operated position, back contact 21 of relay 101XR, back contact 19 of relay 3N, back contact 22 of relay 3Z, wire 23, back contact 26 of relay 4AN, back contact 27 of relay 4BN, back contact 28 of relay 4BZ, back contact 29 of relay 5R, back contact 30 of relay 6R, winding of relay 6Z, to (—).

When the operator actuates the exit button 106XB, a circuit is closed for energizing the exit relay 106XR, from (+), through a circuit including contact 20 of entrance button 101NB in an operated position, back contact 21 of relay 101XR, back contact 19 of relay 3N, back contact 22 of relay 3Z, wire 23, back contact 26 of relay 4AN, back contact 27 of relay 4BN, back contact 28 of relay 4BZ, back contact 29 of relay 5R, back contact 30 of relay 6R, front contact 31 of relay 6Z, windings of relay 106XR, back contact 32 of exit button 106XB, back contact 33 of entrance button 106NB in a normal position, to (—). As soon as the exit relay 106XR picks up, it closes front contact 34, which applies negative potential (—), to the right hand terminal of the relay 106XR, so that the exit button 106XB may be immediately released.

The picking up of the relay 106XR closes an energizing circuit for the relay 6N, inasmuch as the relay 6Z is picked up, from (+), through a circuit including front contact 35 of relay 106XR, front contact 36 of relay 6Z, upper winding of relay 6N, back contact 37 of relay 6R, to (—).

Upon the response of relay 6N, a circuit is closed for energizing the relay 5BN from (+), through a circuit including front contact 35 of relay 106XR, front contact 36 of relay 6Z, front contact 38 of relay 6N, upper winding of relay 5BN, back contact 39 of relay 5R, to (—).

An energizing circuit is closed for the relay 4R, when relay 5BN picks up, from (+), through a circuit including front contact 35 of relay 106XR, front contact 36 of relay 6Z, front contact 38 of relay 6N, front contact 40 of relay 5BN, back contact 41 of relay 4BZ, upper winding of relay 4R, back contact 42 of relay 4AN, back contact 43 of relay 4BN, to (—).

As soon as the relay 4R picks up it opens back contact 24 which deenergizes the relay 5AZ by opening its circuit previously pointed out.

The picking up of the relay 4R also completes a circuit for the relay 3R from (+), through a circuit including front contact 35 of relay 106XR, front contact 36 of relay 6Z, front contact 38 of relay 6N, front contact 40 of relay 5BN, back contact 41 of relay 4BZ, front contact 44 of relay 4R, wire 45, back contact 46 of relay 3Z, upper winding of relay 3R, back contact 47 of relay 3N, to (—).

It will thus be seen that the relays N and R for the route from signal 101 to signal 106 have been selectively energized in succession. This sequential energization of the switch control relays for a route has been conveniently termed a "uniform cascade arrangement".

Operation of track switches

The energization of a normal or a reverse relay N or R for a track switch causes the corresponding normal or reverse operation of such track switch through the medium of suitable control circuits which have been typically illustrated in connection with the crossover including track switches 4TSA and 4TSB (see Fig. 2).

With the track switches 4TSA and 4TSB in normal positions, the relay 4WP is of course energized with a particular polarity causing its polar contacts to assume normal right-hand positions and its neutral contacts to be picked up. Under such conditions the normal correspondence relay 4NCR is energized regardless of the presence or absence of a normal control for the switch machine 4SM. In other words, the relay 4NCR is energized when one, the other, or both of the relays 4AN and 4BN are energized, or when both are deenergized. This circuit for the relay 4NCR is closed from (+), through a circuit including back contact 50 of relay 4R, windings of relay 4NCR, polar contact 51 of relay 4WP in a right-hand position, front contact 52 of relay 4WP, to (—).

Similar control is provided for the reverse correspondence relay 4RCR so that if the track switches 4TSA and 4TSB are in reverse positions, the relay 4RCR is energized irrespective of whether there is a reverse control present or not. Assuming that such a reverse condition of the track switches 4TSA and 4TSB is existing, there is an energizing circuit for the relay 4RCR closed from (+), through a circuit including back con-

tact 53 of relay 4AN, back contact 54 of relay 4BN, windings of relay 4RCR, polar contact 51 of relay 4WP in a left-hand position, front contact 52 of relay 4WP, to (—).

Under the route control above considered where relay 4R is picked up by the self-selecting network, it will be apparent that the opening of back contact 50 of relay 4R immediately deenergizes the relay 4NCR so that its contacts drop away. At the same time that the contacts of the relay 4NCR are dropping away, front contact 50 applies energy from (+), through the lower reverse winding R of the relay 4WZ, to (—). This energization of the relay 4WZ causes its polar contacts to be operated to left-hand positions and its neutral contacts to be picked up.

Under normal conditions with no route set up, the lock stick relay 4LS is energized through its pick-up circuit from (+), through a circuit including front contact 55 of relay 15L, front contact 56 of relay 14L, back contact 57 of relay 4WZ, windings of relay 4LS, to (—).

It will be noted that the picking up of the relay 4WZ in response to the switch control relay 4R opens the back contact 57 in the pick-up circuit for the lock stick relay 4LS so that this lock stick relay would drop away if it were not for its stick circuit which is made up by the dropping of the contacts of the relay 4NCR. This stick circuit for the relay 4LS is closed from (+), through a circuit including front contact 55 of lock relay 15L, front contact 56 of lock relay 14L, front contact 58 of relay 4LS, back contact 59 of relay 4RCR, back contact 60 of relay 4NCR, windings of relay 4LS, to (—).

Inasmuch as the contacts of the relay 4LS are maintained picked up with the neutral contacts of the relay 4WZ picked up, then reverse energy is placed upon the switch machine 4SM from (+), through a circuit including polar contact 61 of relay 4WZ in a left-hand position, front contact 62 of relay 4WZ, front contact 63 of relay 4LS, through the windings of the master relay (not shown) in the switch machine 4SM, front contact 64 of relay 4LS, front contact 65 of relay 4WZ, polar contact 66 of relay WZ in a left-hand position, to (—). This energization of the switch machine 4SM causes it to unlock the track switches 4TSA and 4TSB and operate them to reverse locked positions. While these track switches are unlocked and are in operation, the relay 4WP is deenergized. The open condition of front contact 52 of relay 4WP of course maintains the correspondence relays 4RCR and 4NCR deenergized, while the closure of back contact 67 of relay 4WP closes a stick circuit for the relay 4WZ from (+), through a circuit including back contact 67 of relay 4WP, front contact 68 of relay 4WZ, polar contact 69 of relay 4WZ in a left-hand position, lower reverse winding R of relay 4WZ, to (—). This application of energy to the reverse winding R of relay 4WZ maintains the relay 4WZ energized to complete the operation of the switch machine 4SM in the event that the relay 4R should be deenergized due to the operator changing his mind with regard to the establishment of the route and therefore returning the entrance button 101NB, for example, to its normal position.

Upon the completion of the operation of the track switches 4TSA and 4TSB to their reverse locked positions, the relay 4WP is energized with the opposite polarity actuating its contacts to left-hand positions and causing its neutral contacts to be picked up. This energizes the reverse correspondence relay 4RCR through the circuit above pointed out. The picking up of contact 59 of relay 4RCR opens the stick circuit for the relay 4LS so that with the relay 4WZ still picked up opening back contact 57, the relay 4LS is entirely deenergized and its contacts drop away. The opening of front contacts 63 and 64 of relay 4LS removes energy from the switch machine 4SM and the closure of the back contact 63 shunts the control wires through an obvious circuit.

If the switches 4TSA and 4TSB had already been in their reverse positions, the reverse correspondence relay 4RCR would have been energized and would have remained energized so that the energization of relay 4WZ by relay 4R would cause the immediate deenergization of relay 4LS at back contact 57. Similar operation would occur upon the energization of either or both of the relays 4AN and 4BN with the track switches 4TSA and 4TSB in normal positions, as the relay 4NCR would remain energized so that the opening of back contact 57 of relay 4WZ would cause immediate deenergization of relay 4LS.

The above description points out the operation of the track switches 4TSA and 4TSB by the switch machine 4SM which is controlled in accordance with the normal and reverse switch control relays 4AN, 4R and 4BN. However, it is to be understood that the track switches 2TSA and 2TSB are operated by the switch machine 2SM similarly controlled by the normal and reverse switch control relays 2AN, 2R and 2BN. Similarly, the switch machine 3SM is controlled by the switch control relays 3N and 3R. Also, the switch machine 5SM is controlled by the switch control relays 5BN, 5R and 5AN; while the switch machine 6SM is controlled by the relays 6N and 6R. It is believed that these various controls may readily be understood by analogy to the switch machine control typically shown in Fig. 2 of the accompanying drawings.

Signal control

With reference to Figs. 4A and 4B, it will be seen that with the entrance button 101NB in an actuated position and the exit relay 106XR picked up, energy can be applied to the signal clearing relay 101G as soon as the correspondence relays for the various switches assume proper positions for the route in accordance with the set up condition of that route and as soon as the lock stick relays for all of the track switches in the route drop away indicating the completely locked condition of such track switches.

Assuming that each of the track switches in the route from the signal 101 to the signal 106 have been properly positioned and locked, as pointed out typically in connection with the crossover including track switches 4TSA and 4TSB, there is an energizing circuit closed for the relay 101G from (+), through a circuit including lever contact 70 of entrance button 106NB in a non-operated position, front contact 71 of relay 106XR, back contact 72 of relay 6LS, front contact 73 of relay 6NCR, front contact 74 of relay 5NCR, back contact 75 of relay 5LS, back contact 76 of relay 4LS, back contact 77 of relay 4NCR, front contact 78 of relay 4RCR, back contact 79 of relay 4NCR, back contact 80 of relay 4LS, wire 81, back contact 82 of relay 3LS, back contact 83 of relay 3NCR, front contact 84 of relay 3RCR, back contact 85 of relay 101XR, lever contact 86 of entrance button 101NB in an operated position, winding of relay 101G, to (—).

position of such track switch. For the purpose of the present disclosure, the preferred or particular position of each track switch has been assumed to be the position for setting up a route over the main line or straight track, which position is conveniently termed the "normal position" in this description; but, the preferred or particular position of each track switch can be, if desired, the position for setting up a diverging route, which position is conveniently termed the "reverse position" in this description.

Following the positioning of the Z relays in response to the operation of the entrance button, the actuation of the exit button causes the energization of its exit relay, providing that there is no conflicting route which will be considered more in detail hereinafter, which exit relay applies energy to circuits selected by the relays Z to energize a switch control relay N or R for each of the track switches in that particular route connecting the designated entrance and the exit points.

Let us apply these principles of the present invention to the particular route under consideration as extending from the signal 101 to the signal 106. The relay 3Z for the track switch 3TS is not picked up inasmuch as a movement from the signal 101 is for trailing such track switch in its reverse position. The relay 4AZ is not energized because the track switch 4TSA is facing for a route emanating from signal 101 and extending to signal 106. The relay 4BZ is not energized because it is trailed reverse. But the relay 5AZ is energized, because it is trailed normal for a route emanating from signal 101 to signal 105. The relay 5BZ is not energized because its track switch 5TSB is facing in the route emanating from signal 101 and extending to signal 106. The relay 6Z is energized inasmuch as the track switch 6TS is trailed normal in the route emanating from signal 101 and extending to signal 106.

More specifically, the relay 5AZ is energized by a circuit closed from (+), through a circuit including contact 20 of entrance button 101NB in an operated position, back contact 21 of relay 101XR, back contact 19 of relay 3N, back contact 22 of relay 3Z, wire 23, back contact 24 of relay 4R, back contact 25 of relay 5R, winding of relay 5AZ, to (—).

The relay 6Z is energized by a circuit closed from (+), through a circuit including contact 20 of entrance button 101NB in an operated position, back contact 21 of relay 101XR, back contact 19 of relay 3N, back contact 22 of relay 3Z, wire 23, back contact 26 of relay 4AN, back contact 27 of relay 4BN, back contact 28 of relay 4BZ, back contact 29 of relay 5R, back contact 30 of relay 6R, winding of relay 6Z, to (—).

When the operator actuates the exit button 106XB, a circuit is closed for energizing the exit relay 106XR, from (+), through a circuit including contact 20 of entrance button 101NB in an operated position, back contact 21 of relay 101XR, back contact 19 of relay 3N, back contact 22 of relay 3Z, wire 23, back contact 26 of relay 4AN, back contact 27 of relay 4BN, back contact 28 of relay 4BZ, back contact 29 of relay 5R, back contact 30 of relay 6R, front contact 31 of relay 6Z, windings of relay 106XR, back contact 32 of exit button 106XB, back contact 33 of entrance button 106NB in a normal position, to (—). As soon as the exit relay 106XR picks up, it closes front contact 34, which applies negative potential (—), to the right hand terminal of the relay 106XR, so that the exit button 106XB may be immediately released.

The picking up of the relay 106XR closes an energizing circuit for the relay 6N, inasmuch as the relay 6Z is picked up, from (+), through a circuit including front contact 35 of relay 106XR, front contact 36 of relay 6Z, upper winding of relay 6N, back contact 37 of relay 6R, to (—).

Upon the response of relay 6N, a circuit is closed for energizing the relay 5BN from (+), through a circuit including front contact 35 of relay 106XR, front contact 36 of relay 6Z, front contact 38 of relay 6N, upper winding of relay 5BN, back contact 39 of relay 5R, to (—).

An energizing circuit is closed for the relay 4R, when relay 5BN picks up, from (+), through a circuit including front contact 35 of relay 106XR, front contact 36 of relay 6Z, front contact 38 of relay 6N, front contact 40 of relay 5BN, back contact 41 of relay 4BZ, upper winding of relay 4R, back contact 42 of relay 4AN, back contact 43 of relay 4BN, to (—).

As soon as the relay 4R picks up it opens back contact 24 which deenergizes the relay 5AZ by opening its circuit previously pointed out.

The picking up of the relay 4R also completes a circuit for the relay 3R from (+), through a circuit including front contact 35 of relay 106XR, front contact 36 of relay 6Z, front contact 38 of relay 6N, front contact 40 of relay 5BN, back contact 41 of relay 4BZ, front contact 44 of relay 4R, wire 45, back contact 46 of relay 3Z, upper winding of relay 3R, back contact 47 of relay 3N, to (—).

It will thus be seen that the relays N and R for the route from signal 101 to signal 106 have been selectively energized in succession. This sequential energization of the switch control relays for a route has been conveniently termed a "uniform cascade arrangement".

Operation of track switches

The energization of a normal or a reverse relay N or R for a track switch causes the corresponding normal or reverse operation of such track switch through the medium of suitable control circuits which have been typically illustrated in connection with the crossover including track switches 4TSA and 4TSB (see Fig. 2).

With the track switches 4TSA and 4TSB in normal positions, the relay 4WP is of course energized with a particular polarity causing its polar contacts to assume normal right-hand positions and its neutral contacts to be picked up. Under such conditions the normal correspondence relay 4NCR is energized regardless of the presence or absence of a normal control for the switch machine 4SM. In other words, the relay 4NCR is energized when one, the other, or both of the relays 4AN and 4BN are energized, or when both are deenergized. This circuit for the relay 4NCR is closed from (+), through a circuit including back contact 50 of relay 4R, windings of relay 4NCR, polar contact 51 of relay 4WP in a right-hand position, front contact 52 of relay 4WP, to (—).

Similar control is provided for the reverse correspondence relay 4RCR so that if the track switches 4TSA and 4TSB are in reverse positions, the relay 4RCR is energized irrespective of whether there is a reverse control present or not. Assuming that such a reverse condition of the track switches 4TSA and 4TSB is existing, there is an energizing circuit for the relay 4RCR closed from (+), through a circuit including back con-

tact 53 of relay 4AN, back contact 54 of relay 4BN, windings of relay 4RCR, polar contact 51 of relay 4WP in a left-hand position, front contact 52 of relay 4WP, to (—).

Under the route control above considered where relay 4R is picked up by the self-selecting network, it will be apparent that the opening of back contact 50 of relay 4R immediately deenergizes the relay 4NCR so that its contacts drop away. At the same time that the contacts of the relay 4NCR are dropping away, front contact 50 applies energy from (+), through the lower reverse winding R of the relay 4WZ, to (—). This energization of the relay 4WZ causes its polar contacts to be operated to left-hand positions and its neutral contacts to be picked up.

Under normal conditions with no route set up, the lock stick relay 4LS is energized through its pick-up circuit from (+), through a circuit including front contact 55 of relay 15L, front contact 56 of relay 14L, back contact 57 of relay 4WZ, windings of relay 4LS, to (—).

It will be noted that the picking up of the relay 4WZ in response to the switch control relay 4R opens the back contact 57 in the pick-up circuit for the lock stick relay 4LS so that this lock stick relay would drop away if it were not for its stick circuit which is made up by the dropping of the contacts of the relay 4NCR. This stick circuit for the relay 4LS is closed from (+), through a circuit including front contact 55 of lock relay 15L, front contact 56 of lock relay 14L, front contact 58 of relay 4LS, back contact 59 of relay 4RCR, back contact 60 of relay 4NCR, windings of relay 4LS, to (—).

Inasmuch as the contacts of the relay 4LS are maintained picked up with the neutral contacts of the relay 4WZ picked up, then reverse energy is placed upon the switch machine 4SM from (+), through a circuit including polar contact 61 of relay 4WZ in a left-hand position, front contact 62 of relay 4WZ, front contact 63 of relay 4LS, through the windings of the master relay (not shown) in the switch machine 4SM, front contact 64 of relay 4LS, front contact 65 of relay 4WZ, polar contact 66 of relay WZ in a left-hand position, to (—). This energization of the switch machine 4SM causes it to unlock the track switches 4TSA and 4TSB and operate them to reverse locked positions. While these track switches are unlocked and are in operation, the relay 4WP is deenergized. The open condition of front contact 52 of relay 4WP of course maintains the correspondence relays 4RCR and 4NCR deenergized, while the closure of back contact 67 of relay 4WP closes a stick circuit for the relay 4WZ from (+), through a circuit including back contact 67 of relay 4WP, front contact 68 of relay 4WZ, polar contact 69 of relay 4WZ in a left-hand position, lower reverse winding R of relay 4WZ, to (—). This application of energy to the reverse winding R of relay 4WZ maintains the relay 4WZ energized to complete the operation of the switch machine 4SM in the event that the relay 4R should be deenergized due to the operator changing his mind with regard to the establishment of the route and therefore returning the entrance button 101NB, for example, to its normal position.

Upon the completion of the operation of the track switches 4TSA and 4TSB to their reverse locked positions, the relay 4WP is energized with the opposite polarity actuating its contacts to left-hand positions and causing its neutral contacts to be picked up. This energizes the reverse correspondence relay 4RCR through the circuit above pointed out. The picking up of contact 59 of relay 4RCR opens the stick circuit for the relay 4LS so that with the relay 4WZ still picked up opening back contact 57, the relay 4LS is entirely deenergized and its contacts drop away. The opening of front contacts 63 and 64 of relay 4LS removes energy from the switch machine 4SM and the closure of the back contact 63 shunts the control wires through an obvious circuit.

If the switches 4TSA and 4TSB had already been in their reverse positions, the reverse correspondence relay 4RCR would have been energized and would have remained energized so that the energization of relay 4WZ by relay 4R would cause the immediate deenergization of relay 4LS at back contact 57. Similar operation would occur upon the energization of either or both of the relays 4AN and 4BN with the track switches 4TSA and 4TSB in normal positions, as the relay 4NCR would remain energized so that the opening of back contact 57 of relay 4WZ would cause immediate deenergization of relay 4LS.

The above description points out the operation of the track switches 4TSA and 4TSB by the switch machine 4SM which is controlled in accordance with the normal and reverse switch control relays 4AN, 4R and 4BN. However, it is to be understood that the track switches 2TSA and 2TSB are operated by the switch machine 2SM similarly controlled by the normal and reverse switch control relays 2AN, 2R and 2BN. Similarly, the switch machine 3SM is controlled by the switch control relays 3N and 3R. Also, the switch machine 5SM is controlled by the switch control relays 5BN, 5R and 5AN; while the switch machine 6SM is controlled by the relays 6N and 6R. It is believed that these various controls may readily be understood by analogy to the switch machine control typically shown in Fig. 2 of the accompanying drawings.

Signal control

With reference to Figs. 4A and 4B, it will be seen that with the entrance button 101NB in an actuated position and the exit relay 106XR picked up, energy can be applied to the signal clearing relay 101G as soon as the correspondence relays for the various switches assume proper positions for the route in accordance with the set up condition of that route and as soon as the lock stick relays for all of the track switches in the route drop away indicating the completely locked condition of such track switches.

Assuming that each of the track switches in the route from the signal 101 to the signal 106 have been properly positioned and locked, as pointed out typically in connection with the crossover including track switches 4TSA and 4TSB, there is an energizing circuit closed for the relay 101G from (+), through a circuit including lever contact 70 of entrance button 106NB in a non-operated position, front contact 71 of relay 106XR, back contact 72 of relay 6LS, front contact 73 of relay 6NCR, front contact 74 of relay 5NCR, back contact 75 of relay 5LS, back contact 76 of relay 4LS, back contact 77 of relay 4NCR, front contact 78 of relay 4RCR, back contact 79 of relay 4NCR, back contact 80 of relay 4LS, wire 81, back contact 82 of relay 3LS, back contact 83 of relay 3NCR, front contact 84 of relay 3RCR, back contact 85 of relay 101XR, lever contact 86 of entrance button 101NB in an operated position, winding of relay 101G, to (—).

The energization of the relay 101G changes the indication of the signal 101 from stop to clear to allow the passage of a train over the route thus set up.

Route locking

As soon as a signal clears to allow the passage of traffic over a route, the route locking for that route is rendered effective so that the route is maintained locked so long as the signal is cleared, and so long as a train is in the route even after the signal has been returned to stop. Inasmuch as a train cannot occupy all of the track sections of a route at the same time upon entering such route, it is necessary to provide means for maintaining a route locked in advance of the train even after the entering signal has been returned to stop (either manually or automatically). It is of course to be understood that the releasing of the route locking in the absence of a train in the route may be contingent upon certain approach locking conditions as described in the above mentioned prior patent granted to E. C. Larry et al., Patent No. 2,125,242 dated July 26, 1938.

This type of route locking, conveniently termed directional rear releasing route locking, usually employs an east stick relay ES and a west stick relay WS for each of the track sections of the track layout, and these relays have circuits selected through the switch position repeating relays WP, the track relays T and the signal control relays G.

With reference to Figs. 3A and 3B, it will be seen that the relays G, one for each of the signals of Figs. 4A and 4B are shown in block form at the left of Fig. 3A and at the right of Fig. 3B. Along the top of Figs. 3A and 3B are the switch position repeating relays WP and the track relays T shown in block form. At the bottom of these Figs. 3A and 3B are shown the lock relays L, one for each track section, selected through contacts of the directional stick relays ES and WS, the track relays T, and the contacts of the auxiliary switch machine control levers SML.

The directional stick relays ES and WS together with the lock relays L are normally energized by circuits readily apparent from the drawings, but in order to make the description entirely clear with regard to the operation of the system, the operation of these directional stick relays will be pointed out in detail with regard to the route above established from which operation of the route locking for the various other routes will be understood by analogy.

With the above route set up, the track switch 3TS is in a reverse position so that the polar contacts of relay 3WP are in left-hand positions, and similarly the track switches 4TSA and 4TSB are reversed while the track switches 5TSA, 5TSB and 6TS are in normal positions.

Under such conditions, the relay 15ES is energized by a circuit closed from (+), through a circuit including back contact 90 of relay 101G, front contact 91 of relay 12ES, wire 92, polar contact 93 of relay 5WP in a right-hand position, front contact 94 of relay 5WP, front contact 95 of relay 15T, windings of relay 15ES, to (—). It is noted that the front stick contact 96 of relay 15ES shunts the front contact 95 of track relay 15T. Also, the polar contact 97 of relay 2WP and front contact 98 provides a shunt circuit for the front contact 91 of relay 12ES when the track switches 2TSA and 2TSB are reversed which eliminates the control of the relay 12ES from the relay 15ES under such conditions. Also, it is noted that front contact 99 of relay 14ES over wire 100 shunts the contacts 93 and 94 of relay 5WP. In other words, the relay 15ES is not controlled by relay 14ES except when the track switches 5TSA and 5TSB are reversed.

The relay 14ES is energized by a circuit closed from (+), through a circuit including back contact 110 of relay 103G, wire 111, front contact 112 of relay 15ES, wire 113, front contact 114 of relay 2WP and polar contact 115 of relay 2WP in a right-hand position in multiple with front contact 116 of relay 12ES, front contact 117 of relay 14T, winding of relay 14ES, to (—). It is noted that front stick contact 118 of relay 14ES shunts the front contact 117 of relay 14T, and contact 112 of relay 15ES is effective because the contacts of relay 4WP are reversed.

Relay 16ES is energized by a circuit closed from (+), through a circuit including back contact 120 of relay 104G, front contact 121 of relay 14ES, wire 122, front contact 123 of relay 16T, windings of relay 16ES, to (—). It is noted that front stick contact 124 of relay 16ES shunts front contact 123 of relay 16T. Relay 14ES has its contact 121 shunted from the control of relay 16ES by contacts 125 and 126 of relay 5WP when the track switches 5TSA and 5TSB are reversed.

From the above description, it is seen that with the route established from signal 101 to signal 106, the relay 16ES is dependent for its energization upon the relay 14ES at front contact 121, while the relay 14ES is in turn dependent upon the relay 15ES at front contact 112. The relay 15ES is dependent upon the deenergized condition of the relay 101G at back contact 90. Thus, upon the clearing of the signal 101 by the picking up of the relay 101G, as above described, the relays 15ES, 14ES and 16ES are successively deenergized in that order. The directional stick relays WS for the corresponding track sections are not deenergized, as they are dependent upon the clearing of the signal 106 for the opposite direction for their deenergization with this particular route set up, nor are these relays WS affected by the passage of a train in an eastbound direction through the route, as will be mentioned more in detail hereinafter.

With the directional stick relays ES and WS all picked up and the track sections unoccupied, the lock relays L for the various track sections are energized by their respective circuits. More specifically, lock relay 12L is energized by a circuit closed from (+), through a circuit including front contact 127 of relay 12ES, front contact 128 of relay 12T, front contact 129 of relay 12WS, windings of relay 12L, lever contact 130 of lever 2SML in a non-operated position, to (—). It is noted that front contact 131 of relay 12L applies negative potential (—) to the left-hand terminal of the relay 12L to shunt out the lever contact 130 from the stick circuit for the relay 12L.

Lock relay 14L is normally energized by a circuit closed from (+), through a circuit including front contact 132 of relay 14WS, front contact 133 of relay 14T, front contact 134 of relay 14ES, winding of relay 14L, lever contact 135 of lever 2SML in a non-operated position, lever contact 136 of lever 4SML in a non-operated position, lever contact 137 of lever 5SML in a non-operated position, to (—). It is noted that front stick contact 138 of relay 14L applies negative potential (—) to the right-hand terminal of the

relay 14L to shunt out the lever contacts from the stick circuit for the relay 14L.

The relay 15L is energized by a circuit closed from (+), through a circuit including front contact 139 of relay 15ES, front contact 140 of relay 15T, front contact 141 of relay 15WS, windings of relay 15L, lever contact 142 of lever 5SML in a non-operated position, lever contact 143 of lever 4SML in a non-operated position, lever contact 144 of lever 3SML in a non-operated position, to (—). It is noted that the stick contact 145 of relay 15L applies negative potential (—) to the left-hand terminal of the relay 15L to shunt out the contacts of the levers SML from the stick circuit of relay 15L.

The lock relay 16L is energized by a circuit closed from (+), through a circuit including front contact 146 of relay 16WS, front contact 147 of relay 16T, front contact 148 of relay 16ES, windings of relay 16L, lever contact 149 of lever 6SML in a non-operated position, to (—). It is noted that the front contact 150 of relay 16L applies negative potential (—) to the right-hand terminal of the lock relay 16L to shunt out the contact 149 of lever 6SML from the stick circuit of the lock relay 16L.

The deenergization of the relays 15ES, 14ES and 16ES causes the deenergization of the lock relays 15L, 14L and 16L at open front contacts 139, 134 and 148 respectively.

As above mentioned, each track switch or crossover is provided with a lock stick relay LS which includes contacts of the lock relay L of the section (or sections) in which such switch is included. In other words, the dropping of any lock relay L locks all of the track switches included in its associated track section by opening the pick up and stick of their respective lock stick relays LS. The lock stick relay LS for a crossover of course includes contacts of two lock relays L inasmuch as the opposite ends of the crossover are in separate track sections, all of which has been typically illustrated in connection with the lock stick relay 4LS of Fig. 2 which includes front contacts 55 and 56 of the lock relays 15L and 14L respectively.

In brief, the clearing of the signal 101 upon the picking up of the signal control relay 101G deenergizes the directional stick relays for the eastbound direction for the route set up, and which relays in turn deenergize the lock relays L for each of their track sections so as to lock all of the track switches in such route.

Not only does the dropping of the lock relay L for a section lock all of the track switches in such section by opening the pick up and stick circuits for the lock stick relays LS, but it also provides stick circuits for the switch control relays N and R of all the track switches in that section. This has been typically illustrated in connection with the control relays 4NA—4R—4NB for the track switches 4TSA and 4TSB in Fig. 2 of the accompanying drawings.

With the switch control relay 4R picked up causing the track switches 4TSA and 4TSB to be reversed, then upon the dropping of lock relays 14L and 15L stick circuits are provided for the relay 4R which maintain it energized under the various conditions to be pointed out in detail in connection with the passage of a train and the restoration of the route to normal.

One stick circuit for the relays 4R is closed from (+), through a circuit including back contact 151 of relay 14L, front contact 152 of relay 4R, back contact 153 of relay 4AN, center winding of relay 4R, back contact 154 of relay 4BN, to (—).

The other stick circuit for the relay 4R is closed from (+), through a circuit including back contact 155 of relay 15L, front contact 156 of relay 4R, back contact 153 of relay 4AN, middle winding of relay 4R, back contact 154 of relay 4BN, to (—).

In a similar manner each of the N and R relays for the remaining track switches of the route are stuck up dependent upon their lock relays L. It will, of course, be apparent that if the reverse relay R for a track switch is for a single track switch instead of a crossover that it will have but a single stick circuit instead of two, as pointed out in connection with the relay 4R. Also, it might be mentioned in this connection that for a single switch there is but a single N relay and a single R relay. All of this route locking becomes effective after the establishment of the route and the clearing of the signal for such route, and in this way provides that the directional stick relays ES or WS and the lock relays L which repeat them are deenergized only for the track sections included in the route established.

Passage of a train.—Let us assume that a train accepts the clear signal 101 and proceeds through the route toward the signal 106. The entrance of the train into the track section including track relay 15T deenergizes such track relay and opens the front contact 95 included in the pick up circuit for the directional stick relay 15ES. Thus, the operator, as soon as he observes the proper indication on the control panel of the passage of the train into the track section in the rear of signal 101, returns the entrance button 101NB to its normal at stop position which opens the energizing circuit for the relay 101G at lever contact 86 (see Fig. 4A). The dropping of the relay 101G changes the indication of the signal 101 from clear to stop and also closes back contact 90 to prepare the pick up circuit for the relay 15ES (see Figs. 3A and 3B), but this relay 15ES cannot pick up by reason of the open front contact 95 of track relay 15T. In other words, the operator returns the signal to stop but the directional stick relays in advance of the train remain deenergized. This holding deenergized of the relays 15ES, 14ES and 16ES for the route under consideration maintains the lock relays 15L, 14L and 16L dropped away so as to maintain the relays 3R, 4R, 5BN and 6N stuck up through their stick circuits which will be readily understood by analogy to the stick circuit pointed out in connection with the relay 4R of Fig. 2.

As the train passes through the route and leaves the track section including track relay 15T and enters the track section including track relay 14T, the dropping of the track relay 14T opens front contact 117 in the pick up circuit of the relay 14ES so that the relay 14ES is maintained deenergized although the relay 15ES is picked up upon the leaving of the train from the track section including the track relay 15T. In other words, as soon as the track relay 15T picks up, the relay 15ES is energized through its pick up circuit because the relay 101G has been dropped away. The deenergization of the relay 14T maintains relays 14ES and 16ES deenergized to hold the route in advance of the train, but the picking up of the relay 15ES closes the pick up circuit for the lock relay 15L which in turn releases the stick circuits for the track switches in its section. The track switch 3TS is entirely released because

the relay 3R has its stick circuit open by the picking up of the relay 15L. One of the stick circuits for the relay 4R is opened, but inasmuch as the track relay 14T is still deenergized the other stick circuit for the relay 4R is still closed.

As the train passes into the track section including the track relay 16T, such track relay is dropped away holding the relay 16ES deenergized although the relay 14ES picks up upon the picking up of track relay 14T. The picking up of the relay 14ES releases the other stick circuit for the relay 4R and also releases a stick circuit for the relay 5BN (not shown). In other words, with the train on the track section 16T a route could be established from the signal 103 to the signal 105 although the train had not entirely passed out of the first route.

Assuming that the train entirely passes out of the route allowing the picking up of the track relay 16T and the directional stick relay 16ES, the lock relay 16L picks up releasing the relay 6N. Under such conditions the system has been restored to normal conditions insofar as the deenergization of the self-selecting network is concerned and the picking up of various of the relays which are normally energized. However, it is to be understood that the track switches are left in their last operated positions until further manual control either through the entrance-exit manipulation or by the auxiliary switch control levers. We may now consider some of the results effected by the maintaining stuck up of the N and R relays in the self-selecting network due to the presence of a train.

Prevention of route pre-conditioning.—Let us assume that the route from signal 101 to signal 106 above described, is set up and that the train has just passed the signal 101 so that the operator has returned the entrance button 101NB to its stop position. It might happen that the operator would desire to set up a conflicting route such as from the signal 105 to signal 101 and to do this he actuates the entrance button 105NB to an operated position followed by the actuation of the exit button 101XB. However, any control resulting from such manipulation of the entrance-exit buttons in conflict with the route between the signal 101 and the signal 106 is prevented. Such prevention of the establishment of a conflicting route not only actually prevents the conflicting route from being set up but also prevents any of the devices from being positioned and maintained in such a way that the second route can be established following the passage of the train through the first route beyond the point of conflict.

For example, assuming that the entrance button 101NB has been restored to normal so that the opening of contact 20 removes energy from all of the Z relays which may be depending upon it, such as the relay 6Z for the route under consideration. Also, the exit relay 106XR is deenergized and drops away. But the relays 3R, 4R, 5BN and 6N are stuck up by the route locking due to the presence of a train on track section 15T, as above described. The actuation of the entrance button 105NB closes contact 160 to apply energy to the circuits for the Z relays of the switches which may be trailed in the routes emanating from such entrance point, but the relay 5BN is stuck up for reasons above described opening at back contact 161 certain of the circuits for the routes emanating from such point, and the relay 4R is stuck up for reasons above described opening back contact 162 preventing the energization of relay 4AZ and various of the circuits emanating from the entrance point.

In other words, any energy that may be applied by the operation of an entrance button fails to reach any Z relay beyond the point of conflict between the two routes by reason of an interlock which occurs at the point of conflict in the routes. The actuation of the exit button 101XB cannot pick up the exit relay 101XR as there is no energy passed on to it by reason of the open back contact 161 of relay 5BN and 162 of relay 4R. Thus, if the operator really desires such route from signal 105 to signal 101 to be established, he must operate the entrance button 105NB followed by the operation of the exit button 101XB following the passage of the train in the first route (from signal 101 to signal 106) beyond the point of conflict, which in this case will be as soon as the train leaves the track section 14T.

Optional route selection.—The system of the present invention is so organized that a preferred one of two routes between two points is set up when those two points are designated as entrance and exit points with the additional feature that the inferior of the two optional routes is selected and caused to be set up when there is a route conflicting with the preferred route. Such conflicting route may be set up ready for the passage of traffic thereover or there may be a train in such conflicting route between its entrance point and the point of conflict with the preferred or superior of the optional routes. This automatic selection between two possible routes between two points is accomplished by positive circuit selections included in the self-selecting network and will perhaps be best understood by considering the operations involved.

Let us assume that the operator desires to set up a route from the signal 106 to the signal 102 with the system in its present normal condition. To do this he actuates the entrance button 106NB followed after a short interval of time by the actuation of the exit button 102XB.

The operation of the entrance button 106NB closes a circuit for energizing the relay 5BZ from (+), through a circuit including lever contact 163 in an operated position, back contact 164 of exit relay 106XR, back contact 165 of relay 6R, back contact 166 of relay 5R, winding of relay 5BZ, to (—).

When the relay 5BZ picks up a circuit is closed for the relay 2AZ from (+), through a circuit including lever contact 163 in an operated position, back contact 164 of relay 106XR, back contact 165 of relay 6R, back contact 166 of relay 5R, front contact 167 of relay 5BZ, back contact 168 of relay 4BN, back contact 169 of relay 4AN, back contact 170 of relay 4AZ, wire 171, back contact 172 of relay 3R, back contact 173 of relay 2R, windings of relay 2AZ, to (—).

Upon the response of the relay 2AZ current is passed on from heel of contact 173 through front contact 174 of relay 2AZ so that the actuation of exit button 102XB closes contact 175 to complete the circuit through the relay 102XR and lever contact 176 in a non-operated position, to (—). The picking up of the contacts of the exit relay 102XR closes front contact 177 to apply negative potential (—) to the left-hand terminal of the exit relay 102XR so that the exit button 102XB can be immediately released.

The picking up of the exit relay 102XR applies energy to the completion network for selectively energizing the N and R relays for the various track switches in the route to be set up.

More specifically, relay 2AN is energized by a circuit closed from (+), through a circuit including front contact 180 of relay 102XR, front contact 181 of relay 2 AZ, lower winding of relay 2AN, back contact 182 of relay 2R, to (—).

The response of the relay 2AN applies energy to the relay 3N through a circuit closed from (+), through a circuit including front contact 180 of relay 102XR, front contact 181 of relay 2AZ, front contact 183 of relay 2AN, lower winding of relay 3N, back contact 184 of relay 3R, to (—).

The response of the relay 3N closes an energizing circuit for the relay 4R from (+), through a circuit including front contact 180 of relay 102XR, front contact 181 of relay 2AZ, front contact 183 of relay 2AN, front contact 185 of relay 3N, wire 186, back contact 187 of relay 4AZ, lower winding of relay 4R, back contact 42 of relay 4AN, back contact 43 of relay 4BN, to (—). The picking up of the relay 4R passes energy on to energize the relay 5BN through a circuit closed from the back point of contact 187 of relay 4AZ, through front contact 188 of relay 4R, front contact 189 of relay 5BZ, lower winding of relay 5BN, back contact 39 of relay 5R, to (—).

The picking up of the relay 5BN passes energy on from the front point of contact 189 through front contact 190 of relay 5BN, through lower winding of relay 6N, back contact 37 of relay 6R, to (—).

From the above, it is seen that the relays N and R for the various switches in the route to be set up from signal 106 to signal 102 are sequentially energized in accordance with the uniform cascade arrangement. Irrespective of the direction in which a route is to be set up, this cascade arrangement of the N and R relays causes them to pick up sequentially beginning from the exit end of the route and returning towards the entrance point.

Inasmuch as the selections for the energization of the relays N and R for the various track switches are determined by the Z relays, it is readily apparent that the track switches 2TSA and 2TSB are caused to be operated normal and the track switches 4TSA and 4TSB are caused to be operated reverse due to the fact that the relay 2AZ is picked up in response to the operation of the entrance button 106NB. This causes the route from the signal 106 to the signal 102 to be set up over the track switches 4TSA and 4TSB in reverse positions as the preferred route. The manner in which this is accomplished by causing the operation of the various track switches in response to their N and R relays will be readily understood by analogy to the description pointed out in connection with such operation with reference to Fig. 2 of the accompanying drawings.

It will also be understood how the route is locked upon the clearing of the signal and relays N and R stuck up in accordance with the principles previously pointed out.

If at the time that the operator actuated the entrance button 106NB followed by the operation of the exit button 102XB, a route had been set up between the signal 101 and the signal 105, the route between signals 102 and 106 would have been set up over the track switches 2TSA and 2TSB in reverse positions.

More specifically, if a route is set up between the signals 101 and 105, the relays 3R, 4AN and 5AN are picked up. While the signal is still clear and the entrance button 101NB or entrance button 105NB is still in an operated position, these relays of the network are maintained picked up for such reasons, but after the entrance of the train into such route, the entrance button controlling that route may then be restored to normal, so that these relays 3R, 4AN and 5AN are maintained picked up by reason of their stick circuits closed by their lock relays for the track section with which they are included.

Therefore, upon the operation of the entrance button 106NB, the relay 2AZ is not energized by reason of the fact that the relay 4AN is picked up opening its back contact 169 to prevent the passing of energy on to the relay 2AZ. However, the exit relay 102XR must be energized and it is provided with a circuit which is closed from (+), through a circuit including lever contact 163 of entrance button 106NB in an operated position, back contact 164 of relay 106XR, back contact 165 of relay 6R, back contact 166 of relay 5R, front contact 167 of relay 5BZ, back contact 191 of relay 4R, wire 192, back contact 193 of relay 2BN, back contact 194 of relay 2AN, back contact 174 of relay 2AZ, windings of relay 102XR, exit contact 175 of exit button 102XB, lever contact 176 of entrance button 102NB in a non-operated position, to (—).

With the relay 2AZ deenergized, the exit relay 102XR closes a pick up circuit for the relay 2R from (+), through a circuit including front contact 180 of relay 102XR, back contact 181 of relay 2AZ, lower winding of relay 2R, back contact 195 of relay 2AN, back contact 196 of relay 2BN, to (—).

The pick up of the relay 2R passes energy on from the back point of contact 181 through front contact 197 of relay 2R, wire 198, lower winding of relay 4BN, back contact 199 of relay 4R, to (—). The pick up of the relay 4BN passes energy on from wire 198 through front contact 200 of relay 4BN, a front contact 189 of relay 5BZ, lower winding of relay 5BN, back contact 39 of relay 5R, to (—). The picking up of the relay 5BN passes energy on through front contact 190 to the relay 6N as previously explained.

From the above, it will thus be seen that the track switches 2TSA and 2TSB are caused to be reversed and the track switches 4TSA and 4TSB are maintained in normal positions by reason of the fact that a route has been set up over a route which conflicts with the superior of two optional routes.

Similar operations occur when a route is to be set up from the signal 102 to the signal 106 (the opposite direction from the optional routes above considered) but in such a case the superior route is over the track switches 2TSA and 2TSB reversed. However, there needs to be this explanation that there is no intervening track switch between the track switches 2TSB and 4TSB corresponding to the track switch 3TS between the track switches 2TSA and 4TSA so that the inferior route over the track switches 4TSA and 4TSB in reverse positions is not automatically set up due to traffic conditions with the chosen track layout. However, if the track circuits are divided so as to have an insulated joint between the track switches 2TSB and 4TSB with or without an intervening turnout track switch, such automatic selection can readily be accomplished with respect to the setting up of a route from the signal 102 to the signal 106.

The same selection between optional routes may be accomplished manually for both directions of traffic as will be explained hereinafter, it first being desirable to point out why the track switches 2TSA and 2TSB are reversed upon the

operation of the entrance button 102NB followed by the operation of the exit button 106XB.

The operation of the entrance button 102NB closes a circuit for energizing the relay 3Z from (+), through a circuit including lever contact 201 in an operated position, back contact 202 of relay 102XR, back contact 203 of relay 2R, back contact 204 of relay 3R, windings of relay 3Z, to (—).

The picking up and closure of front contact 22 of relay 3Z passes energy on to energize the relay 5AZ, through wire 23, back contact 24 of relay 4R, back contact 25 of relay 5R, windings of relay 5AZ, to (—).

An energizing circuit is also closed for the relay 4BZ from (+), through a circuit including lever contact 201 of entrance button 102NB in an operated position, back contact 202 of relay 102XR, back contact 205 of relay 2AN, back contact 206 of relay 2BN, back contact 207 of relay 2BZ, wire 208, back contact 209 of relay 4R, windings of relay 4BZ, to (—).

The picking up of the contacts of relay 4BZ passes energy on from the back point of contact 209 through front contact 28 of relay 4BZ, back contact 29 of relay 5R, back contact 30 of relay 6R, windings of relay 6Z, to (—).

The picking up of the relay 6Z passes energy on from the heel of contact 30 through front contact 31 of relay 6Z, windings of relay 106XR through the actuated back contact 32 of exit button 106XB, non-actuated lever contact 33 of entrance button 106NB, to (—). As soon as the exit relay 106XR picks up its front contact 34 applies negative potential (—) to the right hand terminal of the relay 106XR so that the exit button 106XB may be immediately released.

The picking up of the exit relay 106XR closes an energizing circuit for the relay 6N as previously pointed out and the picking up of the relay 6N in turn causes the energization of the relay 5BN through a circuit previously pointed out.

The response of the relay 5BN closes an energizing circuit for the relay 4BN from (+), through a circuit including front contact 35 of relay 106XR, front contact 36 of relay 6Z, front contact 38 of relay 6N, front contact 40 of relay 5BN, front contact 41 of relay 4BZ, upper winding of relay 4BN, back contact 199 of relay 4R, to (—).

This energization of the relay 4BN causes a circuit to be closed for the relay 2R from the front point of contact 41 of relay 4BZ, through a circuit including front contact 210 of relay 4BN, wire 211, back contact 212 of relay 2BZ, upper winding of relay 2R, back contact 195 of relay 2AN, back contact 196 of relay 2BN, to (—).

The picking up of the relay 2R deenergizes the relays 3Z and 5AZ by the opening of the contact 203.

The energization of the relays N and R for the various track switches of course causes the control of such track switches through the operation of their respective WZ relays as more particularly pointed out for the track switch 4TSA and 4TSB of Fig. 2. Thus, the correspondence relays for the various switches are positioned in accordance with the route set up and the lock stick relays LS are deenergized so that a signal clearing circuit is closed for energizing the relay 102G from (+), through a circuit including lever contact 70 of entrance button 106NB in a non-operated position, front contact 71 of relay 106XR, back contact 72 of relay 6LS, front contact 73 of relay 6NCR, front contact 74 of relay 5NCR, back contact 75 of relay 5LS, back contact 76 of relay 4LS, front contact 77 of relay 4NCR, wire 220, back contact 221 of relay 2LS, back contact 222 of relay 2NCR, front contact 223 of relay 2RCR, back contact 224 of relay 2NCR, back contact 225 of relay 2LS, back contact 226 of relay 102XR, lever contact 227 of entrance button 102NB in an operated position, windings of relay 102G, to (—).

The picking up of the relay 102G causes the signal 102 to change its indication from stop to clear.

It is thus seen that the preferred route as provided by the present disclosure is the first diverging route which the train can take in the direction of travel of such train, but it is to be understood that other arrangements can be employed within the scope of the present invention.

Manual control of track switches.—Each of the track switches is provided with an auxiliary individual switch control lever which can be used to individually operate the track switches to free the track switches from snow and ice, lumps of coal, and the like, and can cause the selection of inferior routes which would not, under the circumstances, be selected by the self-selecting network. This has been specifically shown in connection with the track switches 4TSA and 4TSB of Fig. 2 where a switch machine control lever 4SML is shown as capable of energizing either the relays 4R or both the relays 4AN and 4BN providing there is no conflict with the network conditions.

For example, if the lever 4SML is operated from its usual center position to a normal operating position N, it closes a circuit for the relay 4AN from (+), through a circuit including lever contact 230 in a right hand position, center winding of relay 4AN, back contact 231 of relay 4R, to (—). At the same time, a circuit is closed for the relay 4BN from (+), through a circuit including lever contact 232 in a right hand position, middle winding of the relay 4BN, back contact 231 of the relay 4R, to (—).

In other words, both of the relays 4AN and 4BN respond to the lever 4SML providing the relay 4R is deenergized. If the relay 4R were energized because of certain network conditions or because the relay 4R was being maintained stuck up by the presence of a train in a route that had been previously set up and cleared, then the lever 4SML could not energize the normal control relays.

On the other hand if the lever 4SML is operated from its usual center position to a reverse controlling position, a circuit is closed for the relay 4R from (+), through a circuit including lever contact 230 of lever 4SML in a left hand position, back contact 153 of relay 4AN, central winding of relay 4R, back contact 154 of relay 4BN, to (—). It will then be apparent that the relay 4R cannot be picked up if either of relays 4AN or 4BN is picked up because of network conditions, or traffic conditions.

The energization of the relays 4AN and 4BN causes the energization of the relay 4WZ to a normal position by reason of the closure of front contact 53, while the energization of the relay 4R causes the reverse energization of the relay 4WZ, by reason of the closure of front contact 50. Depending upon whether the relay 4WZ is energized to normal or reverse positions, the switch machine 4SM is caused to operate the track switches 4TSA and 4TSB to normal or reverse positions, it being understood that the picking up of one of the switch control relays 4AN, 4R or 4BN causes the dropping of the correspondence

relays as previously pointed out so that the relay 4LS is maintained stuck up through its stick circuit even though the relay 4WZ is picked up for causing the operation of switch machine 4SM. The relay 4LS remains stuck up only until the track switches have been operated into correspondence with the particular switch control relay N or R then picked up.

It may be desirable in some cases to not only operate the track switch to a normal or a reverse position by the movement of the lever 4SML to a corresponding normal or reverse position from its central position, but it may be desirable to move the lever 4SML directly from its normal position to its reverse position (or the opposite) to cause the reverse operation of the switch machine 4SM in such cases as when the track switch is to be freed from snow or ice, or the like.

When the lever 4SML has been operated to its normal position followed by the response of the relays 4AN, 4BN and 4WZ, upon the completion of the normal operation of the track switches 4TSA and 4TSB by the switch machine 4SM, the correspondence relay 4NCR picks up opening back contact 60 and dropping the relay 4LS because back contact 57 of the relay 4WZ is picked up.

Thus, upon the operation of the lever 4SML immediately to its reverse position, it is necessary to first pick up the relay 4LS before the switch machine 4SM can again receive energy. This is done by the arrangement of the system of the present invention inasmuch as the energization of the reverse winding of the relay 4WZ changes the direction of magnetic flux in the polar-neutral relay structure so that the neutral contacts must drop away for an appreciable period before they are again picked up. The picking up of the reverse switch control relays 4R causes the deenergization of the relay 4NCR and the energization of the reverse winding R for the relay 4WZ which causes the stick circuit for the relay 4LS to be prepared at back contacts 59 and 60 and upon the momentary closure of the back contact 57 of the relay 4WZ, the relay 4LS immediately picks up and sticks up.

It should be noted that lever 4SML can be actuated to an opposite position while the track switches 4TSA and 4TSB are in midstroke and have the switch machine 4SM properly respond. This is because the relay 4LS remains stuck up so long as the switches are in midstroke by reason of back contacts 59 and 60 of the correspondence relays 4NCR and 4RCR respectively, and the relay 4WZ is caused to drop away by neutralization of its flux in its two opposing windings thus breaking the stick circuit closed by back contact 67 of relay 4WP and permitting the relay to pick up in its opposite polar position.

The conditions for manual control above considered have been merely for the operation or control of a track switch or crossover to free it from snow or ice or operate it to a different position for the passage of a hand car or the like, but there are certain conditions of operation which are involved dependent upon traffic conditions and routes previously set up.

For example, assuming that a route is set up from the signal 102 to the signal 105 in which case the relay 4AN has been picked up by the self-selecting network and upon the clearing of the signal 102 the directional route stick relays are dropped away so that the relay 15ES is deenergized in turn deenergizing the relay 15L. Such deenergization of the lock relay 15L closes a stick circuit for a switch control relay for each of the track switches included in its section as, for example, in the case of the stick circuit for the relay 4AN closed from (+), through a circuit including back contact 155 of relay 15L, front contact 233 of relay 4AN, middle winding of the relay 4AN, back contact 231 of the relay 4R, to (—).

With such conditions set up, not only would the operation of the lever 4SML, for example, to a reverse position fail to energize the relay 4R by reason of open back contact 153, but the movement of the lever 4SML to a reverse position opens the central non-operated contact 143 (see Fig. 3B) so that upon the passage of the train through the route, instead of the usual releasing of the locking for such route, the relay 15L does not have its pick up circuit closed although relay 15ES picks up.

In other words, the operation of an auxiliary switch control lever while a route is set up not only fails to operate the associated track switch but also fails to precondition a new route, and requires that the lever SML be restored to its usual central position before the route is unlocked and released for the subsequent setting up of a new route thereover. Although the present invention provides this characteristic relationship of the auxiliary switch control levers to the route control by the self-selecting network, such feature is not in conflict with the use of these auxiliary switch control levers for the purpose of setting up routes for the network which are not automatically provided for under the particular circumstances.

For example, the operator may anticipate that he desires to release a train to go over a route from the signal 101 to the signal 105 but does not wish to do so at the time that he desires to send a train from the signal 106 to the signal 102. If the self-selecting network were wholly relied upon to establish a route between the signals 106 and 102 such route would be established over the track switches 4TSA and 4TSB reversed, as above described, which condition would be in conflict with the desired setting up of a route at a later but contemporaneous time between the signals 101 and 105. Thus, the operator can cause the optional route to be set up over the track switches 2TSA and 2TSB reversed by either of two manipulations, that is, either by the operation of the lever 4SML to a normal position or the operation of the lever 2SML (not shown) to a reverse position. The operation of the lever 2SML (not shown) to a reverse position picks up the relay 2R so that upon the operation of the entrance button 106NB the relay 2AZ is not picked up by reason of open back contact 173 so that upon the picking up of the exit relay 102XR the closure of contact 180 causes the energization of the relay 2R and 4BN through circuits of the network as will be apparent from the above description.

Similarly, the operation of the lever 4SML to a normal position causes the energization of the relays 4AN and 4BN which would likewise prevent the energization of the relay 2AZ by reason of the open back contacts 168 and 169 and accomplish the same purpose as if the lever 2SML (not shown) were operated.

Considering more specifically the operation in the case where the lever 4SML is moved to its normal position, the relays 4AN and 4BN are picked up and the clearing of the signal 106 causes the deenergization of all of the route

locking relays WS for the particular route. The deenergization of the relay 14WS causes the lock relay 14L to be dropped away. This completes a stick circuit for the relay 4BN from (+), through a circuit including back contact 151 of relay 14L, front contact 234 of relay 4BN, middle winding of the relay 4BN, back contact 231 of relay 4R, to (—).

The clearing of the route causes the sticking up of the relay 4BN. This provides that as soon as the route is set up, the operator may return the lever 4SML to a central position so that as the train passes through the route the switch control relays of the network can be released in accordance with the usual operation. If the lever 4SML is not returned to its usual central position, then the contact 136 remains open and the relay 14L cannot be picked up as the train passes beyond the track section 14T. In other words, a new route cannot be set up over the track switches 4TSA and 4TSB in a different position unless the lever 4SML is returned to its usual central position nor are the relays 4AN and 4BN released in the usual manner to extinguish the lock lamps as will be described in detail a little later.

In a similar manner the operation of either the levers 2SML (not shown) or the lever 4SML determines the route to be set up if the route in the opposite direction from the signal 102 to the signal 106 is desired.

Although the present invention is more particularly concerned with the control features of an interlocking system of the entrance-exit manipulation type, it has shown at least three of the indications which are preferably employed with a system of this type. More specifically, a correspondence lamp COR is preferably associated with each of the auxiliary switch control levers SML, one of which has been typically shown in Fig. 2 as a correspondence lamp 4COR. This lamp is illuminated, whenever the track switch is unlocked or is out of correspondence with the then present manual control, by reason of a circuit closed from (+), through a circuit including back contact 235 of relay 4NCR, back contact 236 of relay 4RCR, indicator lamp 4COR, to (—).

The present invention also contemplates that route indicators are associated with the track diagram upon which the entrance-exit buttons are located. That is, an indicator lamp is associated with each position of each miniature track switch in such a way that whenever that track switch is included in a route set up or whenever it is locked, that indicator lamp is illuminated. This has been typically illustrated in Fig. 2 with respect to the crossover including track switches 4TSA and 4TSB, but it is to be understood that similar control is provided for the remaining indicator lamps shown in Figs. 1A and 1B.

With reference to Fig. 2, it will be seen that whenever a route is set up over the track switch 4TSA in a normal position, the relay 4AN is picked up closing front contact 237 which energizes the indicator lamp 4ANK through an obvious circuit. Similarly, if a route is set up over the track switch 4TSB, the energization of the relay 4BN closes an obvious circuit through its front contact 239 to energize the indicator lamp 4BNK. Likewise, when a route is set up over the track switches 4TSA and 4TSB in reverse positions, the relay 4R is picked up closing front contact 241 to energize the indicator lamp 4RK.

With reference to Figs. 1A and 1B, it will be seen that the energization of the indicator lamp for each track switch in a route distinctively displays to the operator the particular route set up, as well as the positions of the several track switches involves in the route. These indicators may, if desired, be so capable of illuminating adjacent track portions as to provide a complete line of light from the entrance end of an established route to the exit end of such route.

Inasmuch as each of the relays 4AN—4R—4BN is provided with a holding stick circuit which is controlled in accordance with the associated lock relays (as above described), it will be apparent that the track portions of an established route will remain illuminated in advance of a train even after the governing signal has been restored to stop, and will become unilluminated in the rear of such train as it passes through a route. This is because of the rear release route locking employed.

Self-restoring entrance buttons.—In the above description it has been considered that stay-where-put entrance buttons NB are employed as shown in Figs. 1A and 1B, but it is to be understood that the present invention may employ, and is particularly applicable to, entrance buttons of the self-restoring type as shown in Fig. 5 typically for the entrance button 102NB, it being understood that each of the entrance buttons of Figs. 1A and 1B can have substituted therefore similar self-restoring entrance buttons and associated control means as shown in this Fig. 5.

With reference to Fig. 5, the entrance button $102NB^2$ is shown as being of the self-restoring type having contacts 250 and 251 which are maintained in a normal central position. The depression or actuation of the entrance button $102NB^2$ causes the closure of back contact 250, but the contact 251 is of the sliding type and is maintained closed under such conditions. When the entrance button $102NB^2$ is pulled outwardly the contact 250 remains open and the contact 251 is also opened. In other words, this is a three-position button where the central position is normal and where the actuation of the button closes a circuit for picking up a GZ relay associated therewith specifically shown as relay 102GZ for the particular entrance button shown in Fig. 5. The pick up circuit for relay 102GZ for the actuation of the entrance button $102NB^2$ is readily apparent, and as soon as the relay is once picked up it is maintained stuck up by a circuit closed from (+), through a circuit including entrance button contact 251 in a normal or actuated position, front contact 252 of track relay 12T, front contact 253 of relay 102GZ, windings of relay 102GZ, to (—).

In other words, the actuation of any self-restoring entrance button NB^2 causes the picking up of a relay which is maintained stuck up dependent upon the track circuit immediately in the rear of such signal, so that, upon the passage of a train past the signal, the dropping of the track relay causes the dropping of the relay GZ automatically. In the event that the train should not accept the signal and cause the dropping of the relay GZ automatically, then the operator can manually cause the dropping of this relay by pulling out the controlling entrance button NB^2, for example, opening contact 251 of entrance button $102NB^2$.

The picking up of the relay 102GZ accomplishes all of the purposes of the operation of the entrance button 102NB of Fig. 1A. More specifically, the closure of front contact 254 corresponds

to the closure of contact 201 and completes the same circuit through back contact 202 and through the remaining circuits with which it is connected. Similarly, the closure of front contact 255 corresponds to the closure of lever contact 227 of Fig. 4A for completing the circuit for relay 102G through back contact 226 of the exit relay 102XR, and the remaining circuit selections shown in the other figures of the drawings. When the relay 102GZ is dropped away, back contact 256 is closed which corresponds to the non-operated contact 176 of the entrance button 102NB. The picking up of the exit relay 102XR upon the operation of the exit button 102XB is allowed only provided the entrance button 102NB² has not been actuated. Similarly, back contact 254 allows the clearing of a signal for passage of traffic toward the signal 102 only provided the relay 102GZ is deenergized and this contact corresponds to the contact 229 of the entrance button 102NB shown in Fig. 4A.

This control shown for relay 102GZ and the manner in which it is associated with the self-restoring button 102NB² and self-selecting network is to be understood as typical of the control provided for each of the self-restoring buttons provided according to this form of the present invention.

The use of self-restoring entrance buttons in combination with the self-selecting network of the present invention, wherein the N and R switch control relays are maintained stuck up while a train is passing through the route, is particularly useful, inasmuch as the automatic restoration of a governing signal to stop upon the passage of a train past the signal still allows the self-selecting network to be maintained, as above described in detail, so that a conflicting route cannot be set up by the operator, nor even conditioned on the net-work.

It will of course be noted that the operation of a self-restoring entrance button will be stored and can be left stored in the GZ relay even though a route is not set up, but it can be returned to stop by the operator by simply pulling such entrance out. If it is left stored in the GZ relay then upon the passage of the train through the first route beyond the point of conflict, all that is necessary on the part of the operator is to actuate the button XB for the desired route and it will be immediately set up by the self-selecting net-work, but at no time can a route be preconditioned so as to be set up automatically upon the passage of a train past the point of conflict.

An interlocking system of the entrance-exit manipulation type has thus been shown and described, and it is desired to be understood that this form is selected to facilitate in the disclosure of the present invention, rather than to limit the number of forms which it may assume, and it is to be further understood that various modifications, adaptations and alterations may be applied to the specific form shown to meet the requirements of practice without in any manner departing from the spirit or scope of the present invention, except as limited by the appended claims.

Having described my invention, I now claim:

1. In a track switch and signal control system for railroads, a track layout including several track switches and providing a plurality of conflicting routes between entrance and exit points, a signal for each entrance point, an entrance button for each entrance point, an exit button for each exit point, a normal and a reverse switch control relay for each track switch for controlling the operation of such track switch, means interlocking said normal and reverse switch control relays so that only one can be picked up at the same time, means controlled by the joint actuation of an entrance button and an exit button for the opposite ends of a particular route to selectively energize a switch control relay for each track switch between the corresponding entrance and exit points as required to set up that route, means controlled by an operated entrance button for clearing the signal at the corresponding entrance point when a route is completely set up emanating from that entrance point, and route locking means initiated for any given route by the clearing of a signal for that route and maintained effective by the presence of a train in the route for maintaining energized said selectively energized normal and reverse switch control relays for the entire route ahead of the train, irrespective of the actuated condition of said entrance and exit buttons.

2. In a switch and signal control system of the entrance-exit type for railroads, a track layout including a plurality of power operated track switches operable to provide a plurality of routes through the track layout, certain of said routes being conflicting, a control panel having thereon a miniature track diagram of said track layout, manually operable entrance and exit buttons disposed on said panel adjacent the entrance and exit ends of said routes, route establishing circuits one for each route energized by the joint actuation of the entrance and exit buttons belonging to the ends of that route, relay means responsive to the energization of a route establishing circuit for operating the switches in that route to the normal or reverse position as required and for governing the clearing of a signal at the entrance end of such route, said relay means acting upon the energization of any given route establishing circuit to open the route establishing circuits for all routes conflicting with such given route, route locking means rendered effective by the clearing of any given signal for train movement over a given route for preventing power operation of the track switches involved in that route and for maintaining energized said relay means associated with that route during movement of a train over such route, whereby manipulation of the freely movable entrance and exit buttons is ineffective to exert a control to change the position of the switches in an established route while a train is travelling over that route.

3. In a track switch and signal control system for railroads, a track layout having a plurality of power operated track switches between signals at entrance and exit points of such track layout operable to provide a plurality of routes some of which are conflicting routes; manually operable contact means for said entrance and exit points; a circuit network having a route establishing circuit for each route, the energization of each route establishing circuit being effected by the joint actuation of said manually operable contacts for the entrance and exit points of such route; relay means responsive to the energization of a given route establishing circuit of said network for controlling the operation of all the track switches involved in that route and for clearing a signal to allow the passage of a train, said relay means having contacts included in other route establishing circuits of said network to allow only one route circuit of a plurality of route circuits cor-

responding to conflicting routes to be energized at one time; and route locking means rendered effective, after a route has been set up and a signal therefor cleared, to maintain the energization of the particular relay means initially energized by the corresponding route circuit while the route is occupied by a train and irrespective of the deenergization of such route circuit.

4. In a switch and signal control system for railroads of the character described for governing the operation of track switches and the clearing of signals for a track layout providing a plurality of routes, certain of said routes being conflicting, a control panel having thereon a miniature track diagram of the track layout, manually operable entrance and exit buttons on said panel adjacent the signal locations at the entrance and exit ends of the various routes, a normal and a reverse switch control relay for each switch for governing the operation thereof to the normal or the reverse position, route establishing circuits one for each route energized by the joint actuation of the entrance and exit buttons belonging to the ends of that route for governing the energization of the normal or the reverse switch control relay of the switches in that route as required to set up that route, means operated by each normal or reverse switch control relay, when energized, to position its associated switch for a given route and to prevent energization of the route establishing circuits for all routes conflicting with such given route, and route locking means effective during the movement of a train over a given established route for maintaining energized the normal or the reverse switch control relay then energized for those switches only involved in that given route in spite of the deenergization of the associated route establishing circuit, whereby energization by manipulation of entrance and exit buttons of the route establishing circuit for any route in conflict with a given route that has been established and occupied by a train is prevented.

5. In a switch and signal control system of the character described, a track layout having power operated track switches operable to provide various routes and signals for governing train movement over said routes, manually operable entrance and exit buttons associated with the entrance and exit ends of said routes, normal and reverse switch control relays for each switch for governing the operation thereof to the normal or the reverse position, a circuit organization providing a route establishing circuit for each route effective when energized to govern the energization of the normal or the reverse switch control relay for each of the track switches involved in that route, contacts operated in response to the actuation of entrance and exit buttons for energizing the route establishing circuit for a route by the joint actuation of the two entrance and exit buttons belonging to the ends of that route, each normal and reverse switch control relay having a back contact included in said circuit organization to interrupt the route establishing circuits for all routes requiring the switch corresponding to the respective normal or reverse switch control relay then energized to be in the other position, a stick circuit for each normal and reverse switch control relay, and rear release route locking means rendered effective by the clearing of a signal for a given route to close the stick circuits for the switch control relays of the switches involved in that route only, said route locking means acting during the movement of a train through such route to maintain closed the stick circuits of the switch control relays of the switches ahead of that train and permit opening of the stick circuits for the switches behind that train, whereby manipulation of the entrance and exit buttons is not effective to operate switch control relays to set up any route in conflict with an established route occupied by a train until such train has advanced in its movement to a point where such conflict no longer exists.

6. In a switch and signal control system of the character described for governing train movement over the various routes of a railway track layout, a control panel having thereon a miniature track diagram of the track layout, manually operable entrance and exit buttons on said track diagram adjacent the entrance and exit ends of the routes, normal and reverse switch control relays for each switch for governing operation thereof to the normal or reverse position, switch position indicating lamps associated with the lines of said track diagram at the switch locations and governed by the respective normal and reverse switch control relays of the corresponding switch, means responsive to the joint actuation of the entrance and exit buttons at the opposite ends of a given route for energizing the normal or reverse switch control relay for each of the switches involved in that route as required to set up the route and for governing the clearing of the signal at the entrance end of the route; route locking means effective while a train is moving through an established route for maintaining the normal or reverse switch control relays then energized for the switches in advance of that train, said route locking means being ineffective for those switches in the rear of the train as it travels through the route, whereby a visual indication of the position of the track switches in an established route is displayed on the control panel and is maintained while a train travels through such route until such train has advanced beyond a switch.

7. In a traffic controlling system for railroads, a track layout including several track switches providing a plurality of conflicting routes between entrance and exit points; a signal at the entrance end of each route; a control panel; an entrance button on said control panel for each signal location; an exit button on said panel for the exit end of each route; normal and reverse switch control relays for each switch for governing the operation thereof to the normal or reverse position; route establishing means responsive to the joint operation of entrance and exit buttons associated with the ends of a given route for governing the switch control relays of all of the track switches in that route for governing the operation of the corresponding switches to the normal or reverse position as required and for clearing a signal at the entrance end of that route after said switches have assumed such positions; route locking means rendered effective by the clearing of a signal for a given route for maintaining in their said condition the switch control relays of the switches in that route in advance of a train; indicating means on said control panel for visually indicating the position of the respective switches; and circuit means for governing said indicating means for each switch distinctively in accordance with the operated condition of the normal and reverse switch control relays for that switch, whereby a visual indication is displayed to show the existing positions of the

switch or switches in advance of a train occupying an established route independently of the condition of the associated route establishing means.

8. In a switch and signal control system of the entrance-exit type for governing train movement over a track layout including a number of power-operated track switches operable to provide various routes between signal locations, certain of said routes being conflicting, wayside signals at the ends of said routes; a control panel having thereon a miniature track diagram of said track layout, manually operable contact means disposed on said panel adjacent the signal locations and constituting entrance and exit buttons, normal and reverse switch control relays for governing the operation thereof to the normal or reverse position, indicating lamps on said track diagram in places corresponding to switch locations for visually indicating the position of each switch, energizing circuits for the indicating lamps of each switch governed by the corresponding normal and reverse switch control relays, route establishing circuit means responsive to the joint actuation of the entrance and exit buttons associated with the signal locations at the opposite ends of a given route for selectively energizing the normal or reverse switch control relays for all of the track switches included in that route and for governing the clearing of a signal for the entrance ends of such route, means effective after all of the track switches in a given route have been positioned for that route and the signal at the entrance end thereof has been cleared for maintaining in their existing condition the switch control relays of the switches in that route while a train is passing through the route even though said signal assumes its stop position and the route establishing circuit means for that route assumes its normal deenergized condition, whereby a visual indication of an established route is displayed on said track diagram while a train is occupying such route.

9. In a traffic controlling system for railroads, a track layout providing a plurality of conflicting routes having several track switches between entrance and exit points, a signal for each entrance point, manually operable contact means for said entrance and exit points, control relay means for causing the positioning of each of said track switches, circuit means responsive to the actuation of the manually operable contact means for the entrance point to each route for distinctively conditioning each control relay means for each track switch in any route emanating from that point which can be trailed by a train movement from the entrance point for that route, circuit means responsive to the actuation of said manually operable contact means for a point at the exit end of a particular one of said routes emanating from an entrance point having its manually operable contact means actuated for distinctively conditioning said control relay means for each switch which is facing for a train movement from the entrance point for that route in accordance with the position which such switch must assume to set up that route, circuit means for clearing the signal for each entrance point when a route is completely set up emanating from that point, route locking means rendered effective by the clearing of a signal for each route for locking each track switch in advance of a train for such route only, and means controlled by such route locking means for maintaining said switch conditioning means for each track switch included in a particular route set up in the distinctive condition required for setting up that route so long as said route locking is maintained effective by a train, irrespective of the restoration to normal of said manually operable contact means for the entrance and exit points of such route.

10. In a switch control system for railroads, a track layout including a plurality of power-operated track switches to set up different routes between entrance and exit points, control buttons for said entrance and exit points, a selecting relay for each of said track switches, normal and reverse control relays for each of said track switches, circuit means effective upon the actuation of the control button for a given entrance point to energize a selecting relay for each track switch trailed for a particular position in each of the routes emanating from such entrance point, circuit means responsive upon the actuation of the control button at the exit end of one of said routes emanating from said given entrance point to energize in sequence the normal or reverse control relay for each of the several track switches in such route depending upon the energized or deenergized condition of the selecting relay for each switch and the position of each switch required to set up that route, a source of power, and circuit means controlled by each energized normal or reverse control relay for applying energy to its respective track switch from said source, whereby said power-operated track switches are successively connected to said source of energy.

11. In a traffic controlling system for railroads; a track layout providing a plurality of conflicting routes between entrance and exit points over power operated track switches; a signal for each entrance point; manually operable contact means for said entrance and exit points; normal and reverse control relays for governing the power operation of each of said track switches; a route establishing network effective upon the actuation of the manually operable contact means for an entrance point to a route and the manually operable contact means for the exit point to that route to energize the normal or reverse relay for each track switch as required to set up that route, said network including back contacts of said normal and reverse relays in such a manner that the energization of the normal or reverse control relays for the track switches of a given route prevent the energization of the normal or reverse control relays for all conflicting routes; an auxiliary control lever for each of said track switches, circuit means associated with each of said auxiliary control levers rendering it effective to energize the normal or reverse control relay for the associated track switch only providing the opposite control relay for that track switch is not energized by said route establishing network, whereby a track switch can be controlled either by said route establishing network through an entrance exit manipulation or individually by said auxiliary control lever for that switch but cannot be controlled by both at the same time; circuit means associated with each route through the track layout and rendered effective when that route is set up and the manually operable contact means for the entrance and exit points to that route have been operated to clear the signal at the entrance end of such route; route locking means rendered effective by the clearing of a signal for a route for locking each track switch in that route; and means controlled by said route locking means for maintaining energized the normal and

reverse switch control relays for an established route when a train has accepted that route irrespective of the restoration to normal of said manually operable contact means for the entrance and exit ends of that route; whereby the track switches of such route cannot be controlled to a new position by either said route establishing network or by their respective auxiliary control levers.

12. In an interlocking system for railroads, a track layout having a plurality of track switches to set up different routes, manually operable control buttons for the ends of the routes, a self-selecting circuit network including normal and reverse switch control relays and responsive to the actuation of the buttons for the opposite ends of a given route for energizing the proper switch control relays to cause the operation of the track switches to set up that route, such energization of such switch control relays governing said network to prevent the energization of switch control relays for all conflicting routes, and means for maintaining energized the normal and reverse switch control relays required to set up a route while a train is in that route irrespective of the restoration of the control buttons at the opposite ends of such route.

13. In a switch control system of the character described for a track layout including crossovers operable to provide two optional routes between common entrance and exit points; a signal at said entrance point, selecting means for each crossover which, when energized, corresponds to a particular position of that crossover and when deenergized to the other position; manually operable buttons associated with said entrance and exit points; circuit means responsive to the operation of the button for an entrance point for governing the energization of said selecting means for the crossover more remote from such entrance point to conform with one of said optional routes; means associated with the crossover near said entrance point for rendering said circuit means ineffective if one of the track switches of such crossover is included in some other route, thereby conditioning said selecting means for said remote crossover to conform with the other of said optional routes; means responsive to the operation of the button for the exit point for operating said remote crossover to a position in accordance with the condition of its selecting means and for also operating said near crossover to the position required to establish the particular optional route for the operated condition of said remote crossover, circuit means responsive to the joint operation of the manually operable button for the entrance point and the manually operable button at the exit point for clearing said signal at said entrance point only after one or the other of said optional routes has been set up, route locking means rendered effective by the clearing af said signal for train movement over either of said optional routes for preventing power operation of the track switches involved in the particular route which is set up during movement of a train over such route, and means governed by said route locking means and effective whenever a given route is established and occupied by a train for preventing the setting up of a route in conflict with the particular optional route then set up.

14. In a switch control system for railroads; a track layout including a plurality of power operated track switches to set up different routes between entrance and exit points; control buttons for said entrance and exit points; a selecting relay for each of said track switches; normal and reverse switch control relays for each of said track switches; circuit means effective upon the actuation of the control button for a given entrance point to energize a selecting relay for each track switch trailed for a particular position in each of the routes emanating from such entrance point, said circuit means including back contacts of said normal and reverse switch control relays in such a manner that the energization of the normal and reverse relays of the track switches for a given one of the routes deenergizes the selecting relays for all other routes emanating from said given entrance point; circuit means effective upon the actuation of the control button for the exit end of one of the routes emanating from said given entrance point to energize in succession the normal or reverse control relay for each of the several track switches in such route, said circuit means including contacts of each of said selecting relays for the switches trailed from said given entrance point to select either the normal or reverse switch control relay of such switches for energization, said circuit means providing for the energization of a normal or reverse switch control relay for each of the remaining track switches corresponding to the particular position in which such track switch is trailed from said exit point, and said circuit means including a front contact of each energized normal or reverse switch control relay for passing energy onto the next succeeding switch control relay to be energized; a source of energy; and circuit means controlled by each energized normal or reverse switch control relay for applying energy to its respective track switch from said source to operate such switch to a corresponding normal or reverse position.

15. In a switch and signal control system for railroad track layouts having power operated switches for providing a plurality of routes over which traffic is governed by signals at entrance and exit points, a control panel having a miniature track diagram of said track layout, control buttons on said control panel for said entrance and exit points, a selecting relay for each of said track switches, normal and reverse switch control relays for each of said track switches, initiation circuit means effective upon the actuation of the control button for a given entrance point to energize a selecting relay for each track switch trailed for a particular position in each of the routes emanating from such entrance point, completion circuit means responsive upon the actuation of the control button for the exit end of one of said routes emanating from said given entrance point to energize the normal or reverse switch control relay for each of the several track switches in such route depending upon the energized or deenergized condition of the selecting relay for each switch trailed from said given entrance point and to energize the normal or reverse control relay for each of the remaining switches as required to set up that route, signal control circuit means jointly governed by said control buttons at the entrance and exit ends of an established route and in accordance with the positions of the switches in such route for clearing a signal at the entrance point, route locking means rendered effective by the clearing of a signal for any given established route for preventing power operation of the track switches involved in such route during movement

of a train over such route, and means governed by said route locking means and effective whenever a given route is established and occupied by a train for preventing energization of the initiation and completion circuits for a route or routes in conflict with such given route.

16. In a system for control of power operated track switches and signals for governing traffic over a plurality of routes between entrance and exit points; a control panel having a miniature track diagram of said track layout; control buttons on said control panel at points corresponding to said entrance and exit points; normal and reverse switch control relays for each of said track switches; route establishing circuit means controlled by the joint actuation of the control buttons for the opposite ends of any given route to energize the normal and reverse switch control relays for the track switches as required to set up that route, said route establishing circuit means including back contacts of said normal and reverse switch control relays in such a manner as to prevent the actuation of control buttons for the opposite ends of a route conflicting with such given route from controlling said route establishing circuit means to energize normal and reverse switch control relays; circuit means jointly controlled by said control buttons for the entrance and exit ends for an established route for clearing a signal at the entrance to such route; route locking means rendered effective upon the clearing of a signal for an established route and maintained effective by the presence of a train in such route to prevent the operation of the track switches in such route, an auxiliary stick circuit for each of said normal and reverse switch control relays; and means governed by said route locking means and effective whenever an established route is occupied by a train for energizing the stick circuits for the normal and reverse switch control relays energized for such established route; whereby the route establishing circuit means for a route or routes in conflict with an established route cannot be energized by actuation of said control buttons.

17. In a switch and signal control system for railroads; a track layout having power operated track switches for providing a plurality of routes for train movement between signal locations; a control panel having a miniature track diagram of said track layout; manually operable control buttons on said control panel for each of said signal locations; normal and reverse switch control relays for each of said track switches; route establishing circuit means controlled by the joint actuation of the control buttons for the opposite ends of any given route to energize the normal and reverse switch control relays for the track switches as required to set up that route, said route establishing circuit means including back contacts of said normal and reverse switch control relays in such a manner as to prevent the actuation of control buttons for the opposite ends of a conflicting route from controlling said route establishing circuit means to energize normal and reverse switch control relays; an auxiliary stick circuit for each of said normal and reverse switch control relays; and means responsive to the presence of a train in any given established route for energizing the auxiliary stick circuits for the normal and reverse relays energized to establish that route irrespective of the deenergization of said route establishing circuit means.

18. In a switch and signal control system for railroads; a track layout having power operated track switches to provide a plurality of routes for train movement between signal locations; a control panel having a miniature track diagram of said track layout; manually operable entrance and exit buttons on said control panel for said signal locations, said buttons being of the self-restoring type; an entrance relay and an exit relay for each signal location, a pick-up circuit for each entrance relay controlled by its associated entrance button; a stick circuit for each entrance relay closed dependent upon the unoccupied condition of the route in advance of its associated signal; a pick-up circuit for each exit relay controlled by its associated exit button; a stick circuit for each exit relay closed dependent upon the availability of any given route to that exit point and the picked up condition of the entrance relay for the entrance point to such given route; normal and reverse switch control relays for each of said track switches for controlling the power operation of such track switches; route establishing circuit means controlled by the picked up condition of an entrance relay and an exit relay at the opposite ends of any given route to energize the normal and reverse switch control relays for the track switches as required to set up that route, said route establishing circuit means including back contacts of said normal and reverse switch control relays in such a manner as to prevent the energization of the normal and reverse switch control relays of a route conflicting with said given route; circuit means controlled by the entrance and exit relays of an established route for clearing the signal at the entrance end of such route; an auxiliary stick circuit for each of said normal and reverse switch control relays; and means responsive to the presence of a train in any given established route for energizing the auxiliary stick circuits for the picked up normal and reverse switch control relays of that established route; whereby the entrance of a train into an established route having its signal cleared, causes the deenergization of the entrance and exit relays at the opposite ends of that route and the putting to stop of the signal at the entrance end of such route, and whereby the entrance of a train into an established route maintains the normal and reverse switch control relays energized for such route to thereby prevent the establishment of a conflicting route so long as the train is present although the route establishing circuit means for such route is deenergized.

19. In an interlocking system for railroads; a track layout including a plurality of power operated track switches to form different routes between signal locations, said layout including at least two alternative routes between the same signal locations one of which alternative routes is preferred and the other of which is secondary; a control panel having a miniature track diagram of said track layout; control buttons on said control panel for said signal locations; a normal and a reverse relay for each track switch for governing the power operation of such track switch to the normal or reverse positions respectively; route establishing circuit means controlled by the joint actuation of the control buttons for the opposite ends of any given route to energize the normal and reverse switch control relays for the track switches as required to set up that route, said route establishing circuit means including back contacts of said normal and reverse switch control relays in such a manner as to prevent the energization of normal and reverse switch control relays for the track

switches in routes not available because of conflict with a route already established, said circuit means being normally effective in the case of alternative routes to energize the normal and reverse relays to establish the preferred route only but in case such preferred route is not available said means being effective to energize the normal and reverse relays to establish the secondary route only; circuit means controlled jointly by said control buttons for the opposite ends of an established route for clearing a signal at the entrance to such route; an auxiliary stick circuit for each of said normal and reverse switch control relays; and means governed by the presence of a train in an established route for energizing the stick circuits for the normal and reverse switch control relays energized to establish such route; whereby the presence of a train in an established route maintains the normal and reverse relays for the track switches in that route in energized positions thereby effecting automatically the selection of the secondary route upon the operation of the control buttons for the opposite ends of said alternative routes when the preferred route is not available because of conflict with an occupied route.

20. In a system for control of power operated track switches and signals for governing traffic over a plurality of routes between entrance and exit points; a control panel having a miniature track diagram of said track layout; control buttons on said control panel at points corresponding to said entrance and exit points; normal and reverse switch control relays for each of said track switches; route establishing circuit means controlled by the joint actuation of the control buttons for the opposite ends of any given route to energize the normal and reverse switch control relays for the track switches as required to set up that route, said route establishing circuit means including back contacts of said normal and reverse switch control relays in such a manner as to prevent the actuation of control buttons for the opposite ends of a route conflicting with such given route from controlling said route establishing circuit means to energize normal and reverse switch control relays for switches included in said given route; circuit means jointly controlled by said control buttons for the entrance and exit ends for an established route for clearing a signal at the entrance to such route; route locking means rendered effective upon the clearing of a signal for an established route and maintained effective by the presence of a train in such route to prevent the operation of the track switches in such route ahead of the train but permitting the operation of the switches in such route behind the train, an auxiliary stick circuit for each of said normal and reverse switch control relays; and means governed by said route locking means and effective whenever an established route is occupied by a train for energizing the stick circuits for the normal and reverse switch control relays for the switches ahead of the train and those over which the train is passing but deenergizing the stick circuits for the normal and reverse switch control relays for the switches behind the train whereby the route establishing circuit means for a route or routes in conflict with an established route cannot be energized by actuation of said control buttons but are arranged to permit such energization as soon as such conflict ceases.

21. In a system for control of power operated track switches and signals for governing traffic over a plurality of routes between entrance and exit points; a control panel having a miniature track diagram of said track layout; self-restoring control buttons on said control panel at points corresponding to said entrance and exit points; normal and reverse switch control relays for each of said track switches; route establishing circuit means controlled by the momentary actuation of the control buttons for the opposite ends of any given route to energize the normal and reverse switch control relays for the track switches as required to set up that route, said route establishing circuit means including back contacts of said normal and reverse switch control relays in such a manner as to prevent the actuation of control buttons for the opposite ends of a route conflicting with such given route from controlling said route establishing circuit means to energize normal and reverse switch control relays; circuit means jointly controlled by said momentary actuation of said control buttons for the entrance and exit ends of said given route and by said route establishing circuit means for an established route for clearing a signal at the entrance to such route; means for maintaining said route establishing means active to energize the normal and reverse switch control relays for that given route having had the control buttons momentarily actuated at its opposite ends until a train enters such given route; route locking means rendered effective upon the clearing of a signal for an established route and maintained effective by the presence of a train in such route to prevent the operation of the track switches in such route ahead of the train and over which such train is passing, an auxiliary stick circuit for each of said normal and reverse switch control relays; and means governed by said route locking means when rendered effective for energizing the stick circuits for the normal and reverse switch control relays energized for such established route.

ANDREW LANGDON.