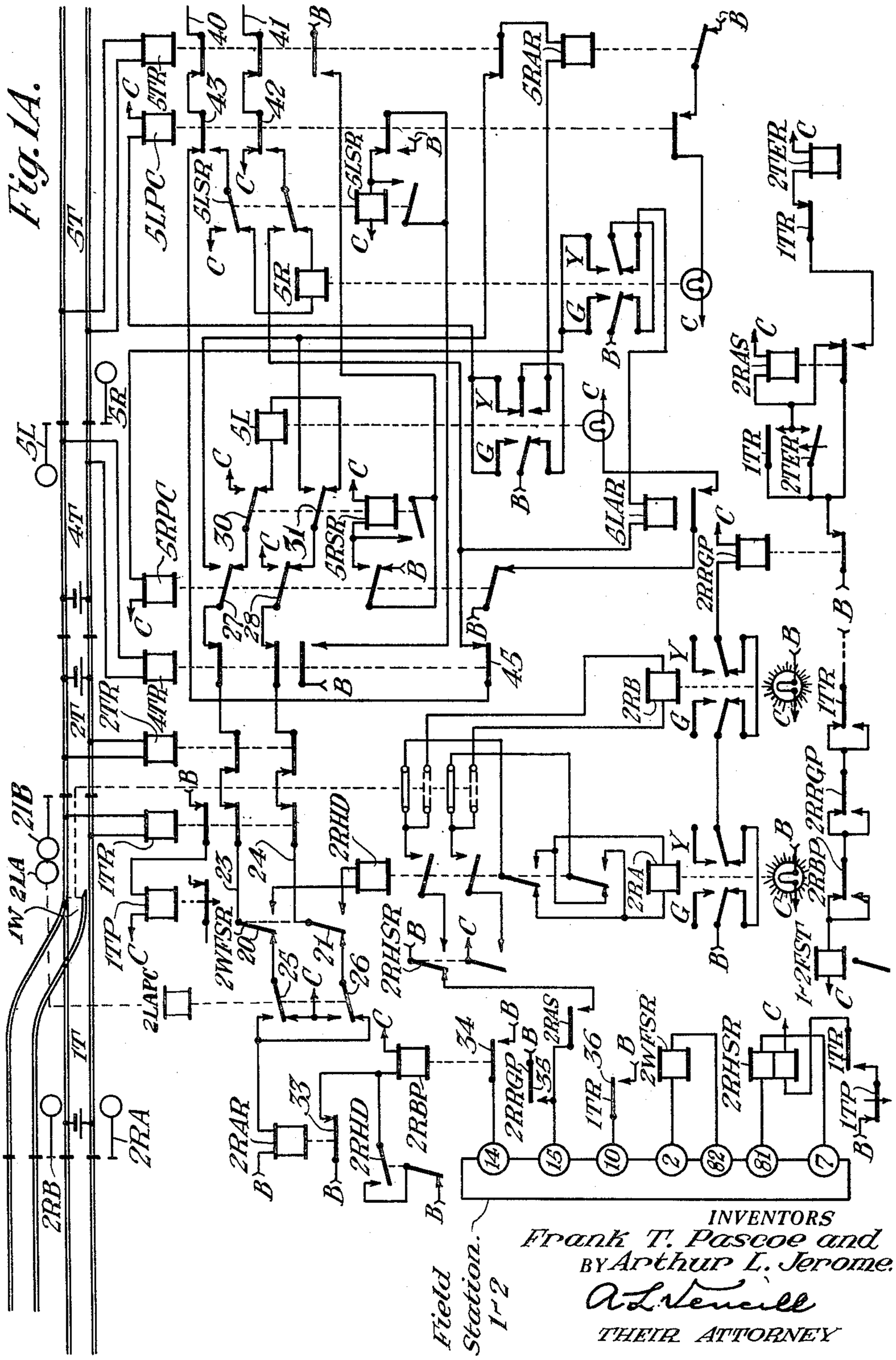
Oct. 31, 1950 F. T. PASCOE ET AL 2,528,073

TRAFFIC DIRECTION CONTROL APPARATUS FOR USE IN CENTRALIZED TRAFFIC CONTROL SYSTEMS FOR SINGLE TRACK RAILROADS

Filed May 10, 1945 4 Sheets-Sheet 1

Fig. 1A.



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Filed May 10, 1945 4 Sheets-Sheet 2

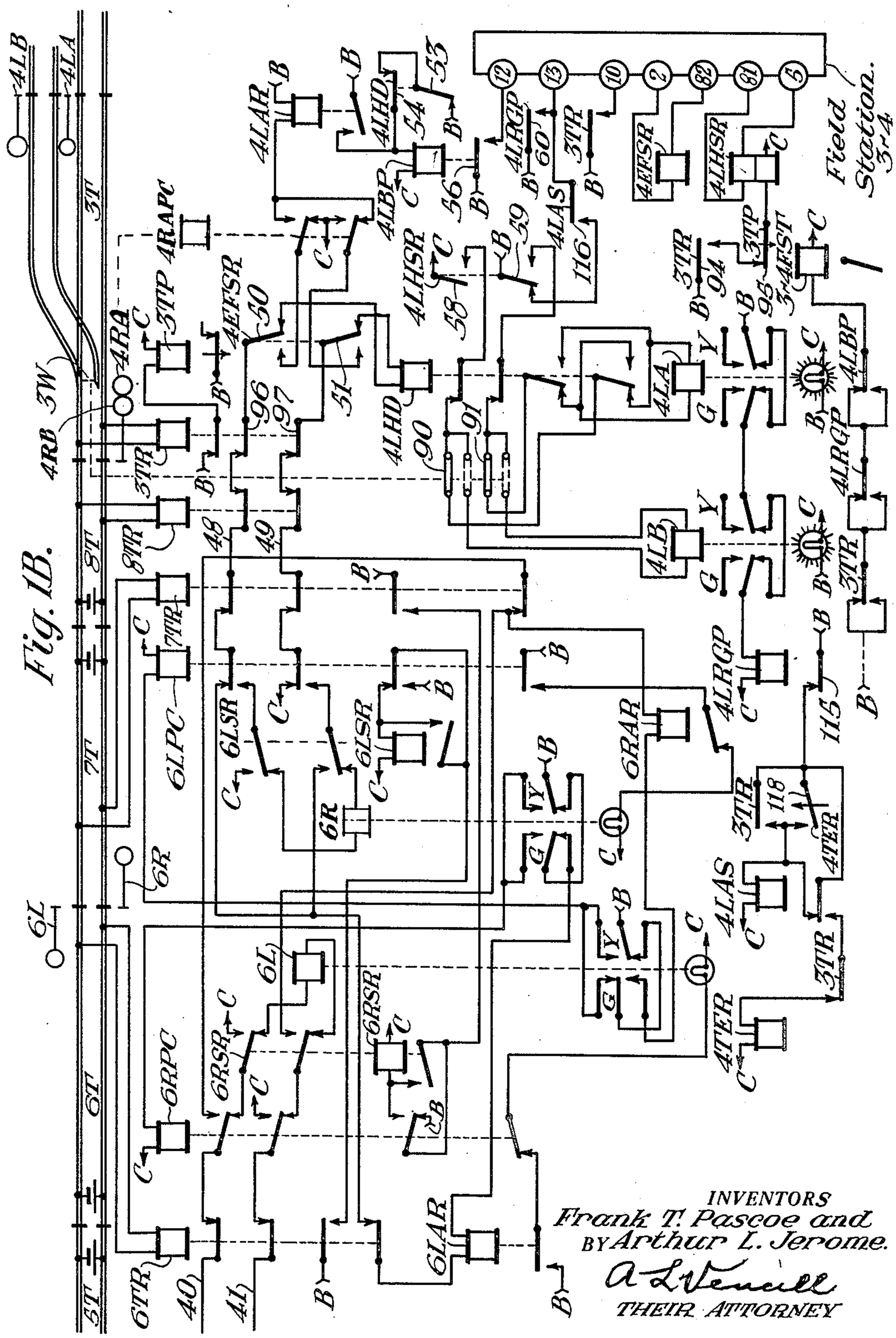

Fig. 1B.

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Filed May 10, 1945 4 Sheets-Sheet 3

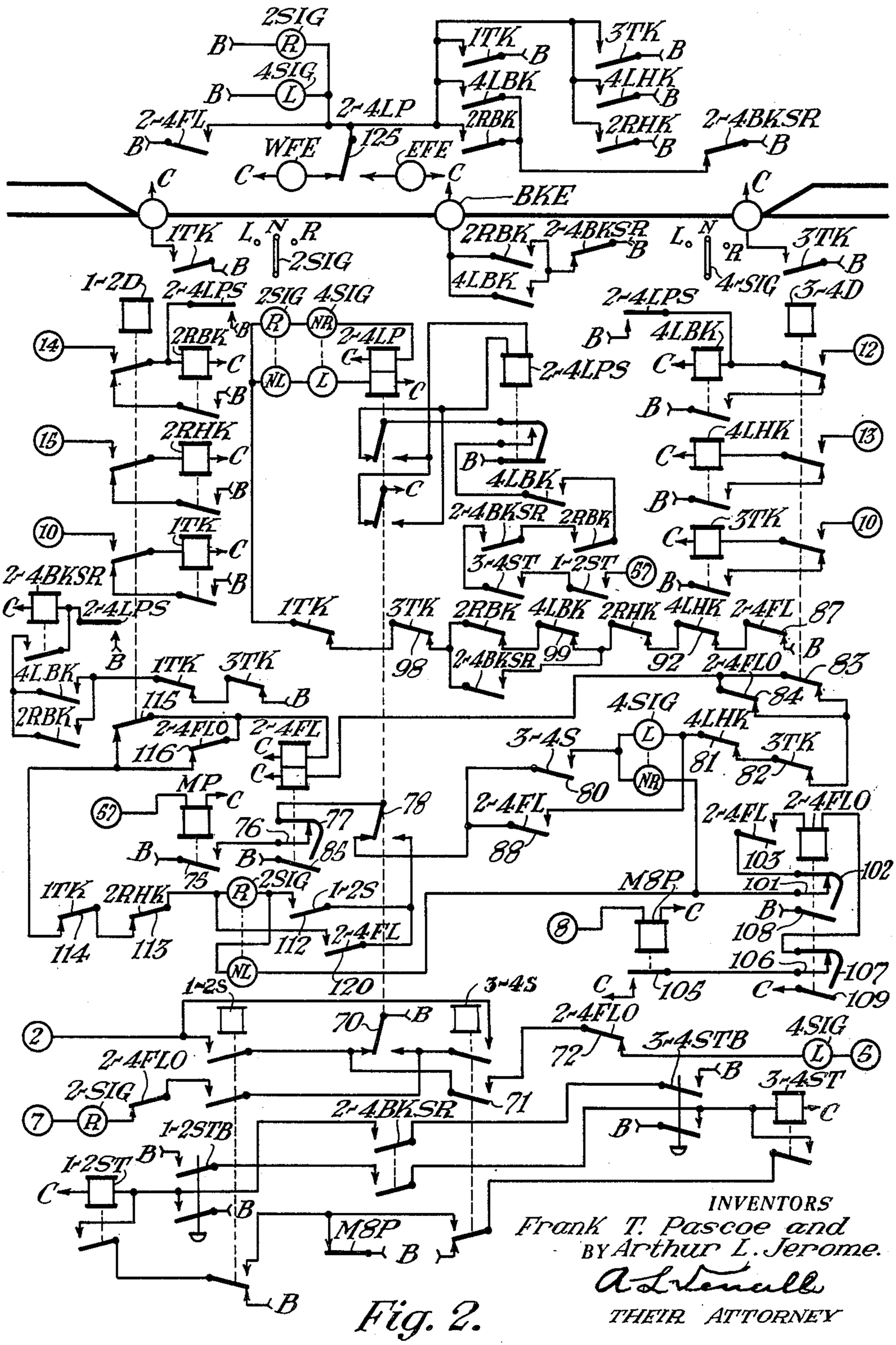

Fig. 2.

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Filed May 10, 1945 4 Sheets-Sheet 4

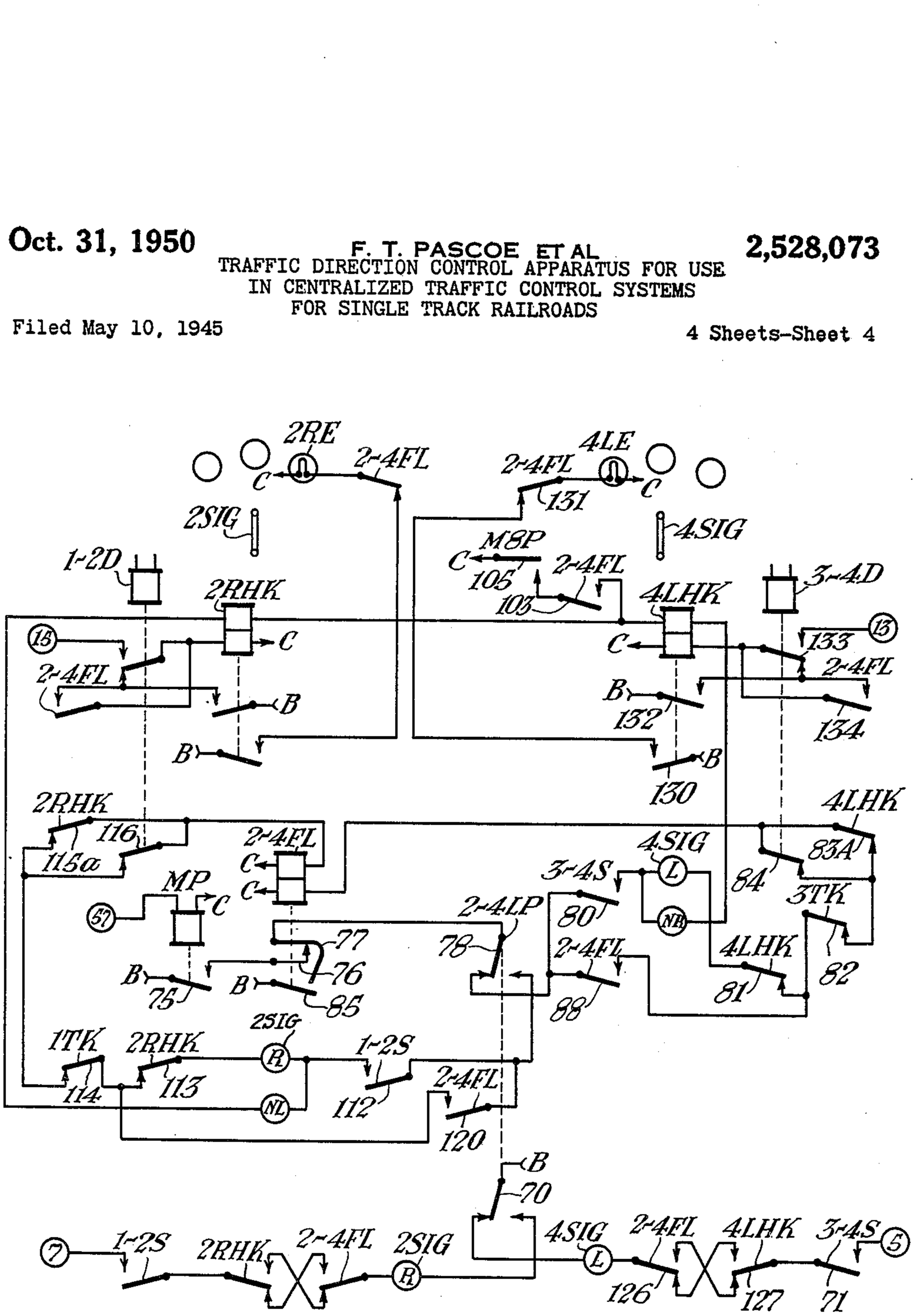

Fig. 3.

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2,528,073

UNITED STATES PATENT OFFICE

2,528,073

TRAFFIC DIRECTION CONTROL APPARATUS FOR USE IN CENTRALIZED TRAFFIC CONTROL SYSTEMS FOR SINGLE-TRACK RAILROADS

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Application May 10, 1945, Serial No. 592,947

25 Claims. (Cl. 246—3)

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Our invention relates to railway traffic controlling apparatus and particularly to improved circuits for the control of the direction of traffic movement, for use in Centralized Traffic Control machines for remote control of traffic in track stretches in which traffic may move in either direction.

In Fig. 1 of application for Letters Patent of the United States, Serial No. 501,254 of H. S. Young, filed September 4, 1943, now Patent No. 2,420,579, granted May 13, 1947, there are shown interlocked circuits at the control office governed by the control levers for the signals which govern train movements into the opposite ends of a track stretch so as to prevent interference with train movements in the event of improper manipulation of these levers and to prevent the reversal of the direction of traffic except when the single track stretch is unoccupied and the signals governing entrance of traffic into the stretch are at stop.

An object of our invention is to provide an improved system of the type described which is arranged so that the interlocked circuits in the office are governed to prevent a change in the designated traffic direction in a stretch as soon as a control code is transmitted to clear the signal at either end of the stretch.

Another object of our invention is to provide improved traffic locking circuits for C. T. C. machines which are arranged to eliminate the unlocked interval in existing circuits between transmission of a signal clearing control code and receipt of an indication code which results in locking of the traffic direction designating means in the C. T. C. machine.

A further object of the invention is to provide improved equipment of the type described which is arranged so that, after a signal clear control code has been transmitted and the traffic direction designating means has been locked, the operator can regain control of the traffic direction designating means only after it has been established that it is proper to permit a change in the designated traffic direction.

Another object of the invention is to provide an improved system of the type described which incorporates locking means which locks the traffic direction designating means as soon as a signal clear control code is transmitted and which releases the traffic direction designating means when a signal clear indication code is received, or after a signal stop control code has been transmitted and an indication code is thereafter received from the field station through which the signal is controlled.

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A further object of the invention is to provide locking means of the type described which becomes effective as soon as a signal clearing control code is transmitted, and which is automatically released when other locking means becomes effective.

Another object of the invention is to provide in a system of the type described traffic locking means in the C. T. C. machine which becomes effective as soon as a control code is transmitted to clear a signal governing entrance of traffic into a stretch, and which thereafter remains effective until it is certain that conditions in the stretch are such that it is proper for the established traffic direction to be disturbed.

A further object of the invention is to provide improved traffic locking means of the type described which employs in the C. T. C. machine a traffic locking relay which is operated when a signal clearing control code is transmitted to a field station, and which provides means in the C. T. C. machine for operating the signal indication relay when a stop signal control code is thereafter transmitted so that the locking may be released upon receipt of an indication code from the field station.

Another object of the invention is to provide improved means of the type described which is arranged so that operation of the indication lamps governed by the signal indication relay will not be altered by use of the signal indication relay in conjunction with the traffic locking means.

A further object of the invention is to provide improved traffic locking means of the type described which is arranged to insure that the locking is effected before a signal clear control code is transmitted and so that, if the locking is thereafter released, it is certain that the prescribed operations have been performed.

In practicing our invention we provide in the C. T. C. machine a traffic locking relay which is picked up upon transmission of a control code to clear a signal governing entrance of traffic into a stretch through which traffic may move in either direction. When this locking relay is picked up, it interrupts the circuit of the traffic designating relay to insure that it maintains traffic in the direction designated at the time the signal control code was transmitted. The indication codes received from the field following the signal clear control code release the locking relay but cause other relays to lock the traffic direction designating relay so that control of the traffic direction designating means is thereafter subject to traffic

conditions in the stretch. If an indication code is not received from the field which releases the locking relay, it may be released by sending a signal stop control code and thereafter receiving an indication code from the field which releases the locking relay but also includes elements which will result in locking of the traffic direction designating relay unless it is proper for the operator to have control of the traffic direction designating relay. In one form of the invention a special auxiliary relay is employed in releasing the locking relay following a signal stop control code, and in another form of the invention the signal indication relay is employed for this purpose.

We shall describe two forms of railway traffic controlling apparatus embodying our invention and shall then point out the novel features thereof in claims.

In the drawings,

Figs. 1A and 1B are a diagram of a stretch of single track railway equipped with wayside signaling apparatus governed by a centralized traffic control system,

Fig. 2 is a diagram of the circuits in the C. T. C. machine at the control office and controlling the wayside equipment shown in Figs. 1A and 1B, and

Fig. 3 is a fragmentary diagram showing a modified arrangement of circuits which may be employed in the C. T. C. machine.

Referring to Figs. 1A and 1B of the drawings, there is shown therein a stretch of single track railway extending between two passing sidings, the rails of which are divided by insulated joints to form a series of track sections 1T to 8T, inclusive, each section being provided with a conventional track circuit having a track relay for detecting the presence of a train in the section. The stretch is provided with wayside signal apparatus comprising a system of cascade-connected reversible line circuits controlled by the track relays and by two manually controllable traffic relays 2WFSR and 4EFSR of the polar stick type at the ends of the stretch. Each line circuit as shown is energized at its left hand end, for the control of the head block signal 4LA or 4LB according to the position of switch 3W, and of the intermediate signals 5L and 6L, for authorizing traffic to move in the right to left direction through the stretch. The system may be set up for authorizing traffic to move in the other direction by reversing the traffic relays 2WFSR and 4EFSR, in which case each line circuit is energized at its right hand end, for the control of the head block signal 2RA or 2RB according to the position of switch 1W, and of the intermediate signals 5R and 6R. In this application only the portions of the wayside apparatus essential to the understanding of this invention have been shown, these being arranged substantially as shown in the above identified application of H. S. Young. The remainder of the equipment, comprising the apparatus for authorizing traffic to move through the passing track area, may likewise be arranged as shown in this Young application.

As shown the wayside signals are of the well-known searchlight type and may be constructed as shown in Letters Patent of the United States No. 1,864,224, issued June 21, 1932, to W. B. Wells.

Each signal comprises a lamp and a winding which when energized operates a circuit controller and a spectacle frame for placing different colored roundels in front of the lamp. The lamps for the head block signals are connected

directly to the terminals B and C of a local source of current so that they are lighted continuously, while those for the intermediate signals are lighted upon the approach of a train, by the release of an approach relay LAR or RAR, the winding of which is included in the line circuit system. If energized by current of normal polarity, as illustrated by signal 6L, front contact G closes, and the signal is conditioned to display a green or proceed aspect when its lamp is lighted. Each signal energized by current of reverse polarity, as illustrated by signal 5L, closes a front contact Y, and its lamp if lighted displays a yellow or caution aspect. Each deenergized signal closes its back contacts G and Y and displays a red or stop indication when its lamp is lighted. The front contacts G and Y of each signal control a repeating relay LPC or RPC which governs the line circuit for the next signal in the rear, while the back contacts G and Y are checking contacts which generally are included in circuits governing opposing signals.

At intermediate locations, the signals are controlled directly over the line circuits, and directional stick relays are provided for supplying current of reverse polarity to the signal for the section in the rear of an occupied section, in the established direction, in accordance with the usual practice.

At the end locations, the signals are governed in accordance with traffic conditions in the stretch by a polarized line relay 2RHD and 4LHD which is included in the line circuit at the entrance end by the reversal of the associated traffic relay, and the signals are also governed by a manually governed signal control relay 2RHSR or 4LHSR and by contacts which reflect the position of the adjacent track switch.

For an understanding of the present invention it may be assumed that the track switches 1W and 3W remain in their normal position, in which case signal 2RA or 4LA is energized normal or reverse, when its signal control relay is reversed, in accordance with the polarity of the current supplied to its line relay, while signals 2RB and 4LB remain deenergized.

The equipment at the left-hand or west end of the stretch includes a C. T. C. system field station unit designated station 1—2, and the equipment at the right-hand or east end of the stretch includes a C. T. C. system field station unit designated station 3—4.

The field stations are connected with the office over a pair of line wires, not shown, by a code communication system which may be of the type shown in Letters Patent of the United States No. 2,229,249, issued January 21, 1941, to L. V. Lewis, or in application for Letters Patent of the United States, Serial No. 496,907, filed July 31, 1943, by A. P. Jackel, now Patent No. 2,411,375, granted Nov. 19, 1946, which system is described in Manual 506A of the Union Switch and Signal Company, Swissvale, Pa.

Consideration of the detailed mode of operation of the code communication system is not needed for an understanding of our invention and it is deemed sufficient to point out that a field station is provided at each end of each track stretch to be controlled and that coding units are provided at the office and at each field station and are connected by a pair of line wires, not shown, over which control codes are transmitted at times from the office to a selected field station, and at other times indication codes are transmitted over the same line wires from the

different field stations to the office without interference. Transmission of each code includes the temporary establishment of a plurality of communication channels, such, for example, as seven, between the office and a station to position a group of relays.

Each code includes a distinctive code call by means of which a selector relay 1—2S or 3—4S at the office, shown in Fig. 2 and a similar relay, not shown, at one station only is energized to effect temporary establishment of seven communication channels between the office and the station. The different stations have different code calls, consequently the selector relays for different stations or panels are not energized at the same time, and the same channels provide communication at different times with all of the stations.

The explanation of this invention requires only three channels employed in the transmission of control codes and five channels employed in the transmission of indication codes, and in order to simplify the disclosure the other channels and related apparatus have not been shown.

The channels employed in the transmission of control codes are designated 2, 5 and 7, and the channels employed in the transmission of indication codes are designated 10, 12, 13, 14 and 15, the numbers employed to designate these channels being the same as are employed to designate the corresponding channels in the above-identified application of H. S. Young.

It is to be understood that the system of our invention is made up of a number of unit portions generally similar to the one shown in the drawings, but as the invention may be fully understood from one such portion, only one has been illustrated in the drawings.

The office and field stations are each provided with a suitable source of direct current, such as a storage battery, not shown, the terminals of which are designated B and C in the drawings.

In most instances in the drawings the relay contacts are located directly under the winding of the relay, but in some cases in order to simplify the drawings, relay contacts are separated from the relay winding and in these instances the relay with which the contacts are associated is designated by appropriate reference characters placed above the contacts.

The equipment at each field station includes a starting relay FST, which responds to a change in position of any of the associated indicating relays to provide connection from terminal B of a source of current to the indication channels to effect delivery of indication codes over the line wires during the time that a delivery relay D at the office is energized to thereby position a group of indication relays in accordance with the condition of energization of the indication channels.

The indication relays at the office governed from the field station 1—2, at the left-hand or west end of the single track stretch, include a track indication relay 1TK which controls a lamp in the track diagram of the control machine to indicate the condition of occupancy of the detector section 1T, Fig. 1A, containing the track switch 1W, the relay 1TK being controlled by the track relay 1TR for the track section; a signal indication relay 2RHK which controls lamps, not shown herein for indicating the condition of the signals in the manner described in the above-identified application of H. S. Young, and is governed by relay 2RRGP which repeats the stop indications of the signals 2RA and 2RB; and a block indication relay 2RBK controlled by the relay 2RBP which in turn is governed by traffic conditions in the single track stretch.

The relays at the field station 3—4 at the right-hand end of the single track stretch function in a similar manner to control the relays 3TK, 4LHK and 4LBK at the office.

The block indication lamp BKE in the track diagram of the control machine is governed by the relays 2RBK and 4LBK, one of which indicates the condition of occupancy of a portion of the single track stretch and the other of which indicates the condition of occupancy of the remainder of the single track stretch.

The signal levers 2SIG and 4SIG on the panel of the control machine are the usual three-position levers for the code control of the signal control relays at the field stations at the opposite ends of the stretch. The signal levers 2SIG and 4SIG are electrically interlocked with respect to the control of train movements into the intervening single track stretch by electro-responsive means comprising a master directional polarized relay 2—4LP, as in the above identified application of H. S. Young and also in his Letters Patent of the United States No. 2,326,991.

Relay 2—4LP determines the direction for traffic movements through the stretch, and is energized whenever a signal lever is reversed with the object of clearing a signal to authorize a train to enter the stretch, provided the indicated traffic conditions are such as to make it proper to change the traffic direction. Under other conditions, relay 2—4LP is locked deenergized, and it then prevents interference with traffic if the operator should attempt to reverse the direction, or to clear an opposing signal.

With relay 2—4LP in its normal position as shown, if lever 4SIG is moved to position L, lamp WFE is lighted to designate the right to left direction, while if lever 2SIG is moved to position R with lever 4SIG in position N or R, relay 2—4LP reverses, if the locking conditions permit, and then lights lamp EFE to designate the left to right direction. In either case, the pressing of the starting button associated with the operated lever causes the transmission of a control code to the corresponding station 3—4 or 1—2 to operate the signal control relay for the signal which such lever controls, but only if relay 2—4LP occupies the corresponding normal or reverse position.

In the event the position of relay 2—4LP is changed, as for example, when relay 2—4LP is reversed by moving lever 2SIG to position R, the control code which reverses the signal control relay also reverses the associated traffic relay, and the starting button operation which initiates this code causes the transmission of a second control code by which the traffic relay at the opposite end of the stretch is restored to normal, so as to reverse the direction of energization of the line circuit system to enable signal 4RA to be cleared.

The clearing of a signal is indicated by the lighting of lamps controlled by the corresponding signal indication relay, the operation of which in response to the clearing of the signal locks relay 2—4LP deenergized. As the train governed by the signal moves through the stretch its progress is indicated by the lighting of lamps in the track diagram by the track and block indication relays as these are successively ener-

gized by indication codes initiated by the train. Relay 2—4LP is maintained deenergized until lever 2SIG is restored to position N or L, lever 4SIG to position N or R and all of those indication relays have been released and indicate that the block is vacant and that the head block signals are at stop.

The relay 2—4LP has associated therewith relays 2—4LPS and 2—4BKSR which are governed in the manner explained in detail in application for Letters Patent of the United States, Serial No. 567,188, filed December 8, 1944, by F. T. Pascoe and A. L. Jerome, now Patent No. 2,411,387, granted Nov. 19, 1946. Relay 2—4LPS is a normally energized relay the release of which indicates that the position of relay 2—4LP has been changed, and its purpose is to operate relays 2—4BKSR, 2RBK and 4LBK in response to such change. One purpose of relay 2—4BKSR is to "store" a block clear indication registered by relays 2RBK and 4LBK to enable relay 2—4LP to be operated in such manner as to prevent the locking of relay 2—4LP by these relays and the lighting of the block occupancy indicator BKE while the wayside system is being reversed and is incapable of indicating trackway conditions, in order to enable the operator to restore the original traffic direction, if for any reason its reversal cannot be consumated. Another purpose is to establish circuits for the starting relays governing transmission of control codes to the stations at opposite ends of the stretch so as to insure that control codes will be transmitted to both stations for the operation of the traffic relays, following a change in the position of relay 2—4LP.

The relay 2—4LP also has associated therewith a traffic locking relay 2—4FL and a releasing relay 2—4FLO, which are provided in accordance with the present invention in order to control the relay 2—4LP under certain conditions not provided for by any of the other relays referred to, as hereinafter explained in detail.

The push-buttons 1—2STB and 3—4STB are the starting buttons for operating the usual code starting relays 1—2ST and 3—4ST by means of which control codes are initiated and the corresponding stations selected. Each starting relay when energized initiates a control code as described in Lewis Patent No. 2,229,249 including a code call for energizing a selector relay 1—2S or 3—4S for the same panel. Each selector relay when energized releases the associated starting relay and connects terminal B of a local source of energy to selected ones of the control channels in accordance with the positions of the signal levers and of contacts of the master directional relay 2—4LP.

The equipment is arranged so that when energy is applied to channel 2 and a control code is transmitted to a field station, the traffic directional relay 2WFSR or 4EFSR at that station is operated to condition the wayside apparatus to make that end of the stretch an exit or leaving end. Similarly, the equipment is arranged so that when energy is not applied to channel 2 and a control code is transmitted to a field station the traffic direction control relay is operated to condition the wayside apparatus to make that end of the stretch an entrance end so that the signal at that point may be controlled by the wayside circuits on operation of the associated signal relay.

The equipment is also arranged so that, when energy is supplied to the code channel governing

a signal control relay, such as, for example, channel 5 or 7, and a control code is transmitted to a field station, the signal control relay at that station, such as relay 4LHSR or 2RHSR, is operated by the code to render the signal subject to the control of the wayside circuits. When energy is not supplied to the code channel governing a signal control relay, and a control code is transmitted to a field station, the signal control relay at that station is restored to normal by the code to keep the signal at stop irrespective of the wayside circuits.

The signal levers 2SIG and 4SIG are of the three-position type and each has a normal center position N, a left-hand position L, and a right-hand position R. The levers control contacts which are shown diagrammatically in the drawings, the contacts which are closed in the left-hand position of the lever being designated L; those which are closed in the right-hand position of the lever being designated R; those which are closed in either the normal or the left-hand position of the lever being designated NL; and those which are closed in either the normal or the right-hand position of the lever being designated NR.

The equipment at the office includes a relay MP which is energized from terminal 57 of the office coding unit as shown in Manual 506A of The Union Switch and Signal Company with the Signal Company with the result that relay MP is energized when and only when the office coding unit is transmitting a control code. The office equipment also includes a relay M8P which is energized from terminal 8 of the coding unit with the result that relay M8P is normally energized but is momentarily deenergized after the eighth step of each control code.

The equipment is shown in the condition which it assumes when the track stretch is vacant, the signals 2R and 4L are at stop, and the signaling apparatus prepares the stretch for westbound traffic. At this time the contacts 20 and 21 of the traffic directional relay 2WFSR at the left-hand or west end of the stretch are in their left-hand or normal positions and connect the line wires 23 and 24 over back contacts 25 and 26 of relay 2LAPC to a source of energy in series with an approach relay 2RAR. Relay 2LAPC is controlled as shown and described in the above-identified application of H. S. Young, so that it is energized only when signal 2LA is cleared. The energy supplied to the line wires 23 and 24 feeds over front contacts of track relays 1TR, 2TR and 4TR, over back contacts 27 and 28 of relay 5RPC, and back contacts 30 and 31 of relay 5RSR to the winding of signal 5L and causes this signal, when lighted, to display its yellow or caution indication. The energy supplied to line wires 23 and 24 through the winding of relay 2RAR keeps contact 33 of the relay picked up to establish a circuit for relay 2RBP and contact 34 of relay 2RBP is picked up to interrupt the circuit leading to terminal 14 of the C. T. C. system field station unit and thus cause indication codes sent to the office to release relay 2RBK.

At this time signals 2RA and 2RB are at stop so the circuit of relay 2RRGP is complete and its contact 35 interrupts the supply of energy to terminal 15 of the C. T. C. system field station unit, and as section 1T is vacant, contact 36 of relay 1TR is picked up and interrupts the supply of energy to terminal 10 of the field station unit. Accordingly, indication codes sent to the office from this station release relays 2RHK and 1TK.

As signal 5L is conditioned to display its yellow

indication, energy is supplied over back contact G and front contact Y of the signal to relay 5LPC and its contacts are picked up to cause energy of normal polarity to be supplied to line wires 40 and 41 leading to the winding of signal 6L. At this time wire 41 is connected to terminal C of a source over front contact 42 of relay 5LPC, and wire 40 is connected over front contact 43 of relay 5LPC, front contact 45 of relay 4TR, winding of relay 5LAR, and back contacts Y and G of signal 5R to terminal B of the source. The energy supplied to signal 6L causes it, when lighted, to display its green or clear indication, while energy is supplied over back contact Y and front contact G of the signal 6L to relay 6LPC with the result that its contacts are picked up and cause energy of normal polarity to be supplied to line wires 48 and 49 over a circuit similar to that described above for line wires 40 and 41. This circuit includes in series therewith the approach relay 6LAR.

The energy supplied to line wires 48 and 49 is supplied over contacts 50 and 51 of relay 4EFSR in their right-hand or reverse position to a polar relay 4LHD to pick up its neutral contacts and to cause its polar contacts to occupy their left-hand or normal positions so that polar contact 53 and neutral contact 54 provide a circuit for relay 4LBP and contact 56 of relay 4LBP interrupts the supply of energy to terminal 12 of the field station unit and causes indication codes sent to the office to release relay 4LBK.

As shown, the contacts 58 and 59 of the signal control relay 4LHSR are in their left-hand or normal positions and interrupt the circuits for supplying energy to the windings of signals 4LA and 4LB and these signals are both at stop and establish the circuit of relay 4LRGP so that its contact 60 interrupts the supply of energy to terminal 13 of the field station unit. As section 3T is vacant, contact 61 of track relay 3TR interrupts the supply of energy to terminal 10 of the field station unit, and indication codes sent to the office from this station release relays 4LHK and 3TK.

Referring to Fig. 2, which shows the equipment at the office, the contacts of relay 2—4LP are in their left-hand or normal position in which they designate west-bound traffic in the stretch shown in Figs. 1A and 1B. In addition, at this time relay 2—4LPS is energized by current supplied over its stick circuit, and relays 2—4BKSR, 2—4FL and 2—4FLO are released. As the relay 2—4FL and the indication relays 4LHK, 2RHK, 4LBK, 2RBK, 3TK and 1TK are all released, energy may be supplied to one or the other of the windings of the relay 2—4LP on movement of the signal lever 2SIG or 4SIG to thereby move the contacts of relay 2—4LP if the operator wishes to change the designated traffic direction.

For purposes of illustration it will be assumed that the operator wishes to clear the signal 4LA to authorize a westbound train to enter the stretch. In order to clear this signal, he moves lever 4SIG to its left-hand position L and presses the starting button 3—4STB to pick up the starting relay 3—4ST and cause a control code to be sent to field station 3—4. On this movement of the lever 4SIG, the circuit is completed to supply energy to the lower winding of relay 2—4LP, but as its contacts are already in their left-hand position, the supply of energy to this winding is without effect.

During transmission of the initial or station selection steps of the control code sent to station 3—4, the selector relay 3—4S at the office is picked up with the result that energy is supplied over normal polar contact 70 of relay 2—4LP, front contact 71 of relay 3—4S, back contact 72 of relay 2—4FLO, and a contact of lever 4SIG to terminal 5 of the office coding unit during transmission of the function steps of the control code sent to station 3—4, and the control code sent to station 3—4 reverses the contacts of relay 4LHSR.

In addition, during operation of the office coding unit to transmit a control code, energy is supplied to terminal 57 and picks up relay MP so that on picking up of relay 3—4S energy is supplied over front contact 75 of relay MP, contacts 76 and 77 of relay 2—4FL, normal polar contact 78 of relay 2—4LP, front contact 80 of relay 3—4S, a contact of lever 4SIG, back contact 81 of relay 4LHK, back contact 82 of relay 3TK, and back contacts 83 of relay 3—4D and 84 of relay 2—4FLO in multiple to the lower winding of relay 2—4FL. The energy supplied to this winding picks up the relay contacts so that contact 85 moves contact 77 out of engagement with contact 76 and connects terminal B of the battery to contact 77 to provide a stick circuit for relay 2—4FL and keep its contacts picked up after release of relay MP. In addition, when relay 2—4FL picks up, its contact 88 shunts contact 80 of relay 3—4S and the contact of lever 4SIG in the pick-up circuit of relay 2—4FL and thus keeps relay 2—4FL picked up after release of relay 3—4S or after lever 4SIG is moved from its position L.

When relay 2—4FL picks up, its contact 87 interrupts the circuits of relay 2—4LP to thereby prevent supply of energy to the windings of this relay and thus prevent movement of the relay contacts to change the designated direction of traffic in the track stretch controlled thereby.

As relay 2—4FL is picked up as soon as relay 3—4S picks up, which occurs during the station selection steps and prior to the function steps of the control code, and as relay 2—4FL when picked up locks relay 2—4LP to prevent a change in the designated traffic direction, there is no possibility that the contacts of relay 2—4LP can be moved to change the designated traffic direction after a control code has been sent to clear a signal. If, for example, after the control code is sent to station 3—4 to clear the signal 4LA but prior to receipt at the office of the signal clear indication code to pick up relay 4LHK, the operator moves lever 4SIG to its center or its right-hand position, and also moves lever 2SIG to its right-hand position, energy will not be supplied to the upper winding of relay 2—4LP since contact 87 of relay 2—4FL is picked up and interrupts the circuits of relay 2—4LP. Accordingly, the contacts of relay 2—4LP are certain to remain in their existing positions and maintain the direction of traffic which was designated at the time the signal control code was transmitted, in this case, westbound traffic.

If under the conditions outlined above the contacts of relay 2—4LP should be moved and a control code should thereafter be sent to station 1—2 to condition that end of the stretch to be an entrance end, it would cause the wayside equipment to attempt to establish eastbound traffic and would result in putting to stop the westbound wayside signals with resultant interference with movement of westbound traffic in the

stretch which had been authorized by clearing of signal 4LA.

Since relay 2—4FL, which is being added by this invention, operates to lock the relay 2—4LP as soon as the signal clearing control code is sent, there is no possibility that subsequent movement of the signal control levers will cause movement of the contacts of relay 2—4LP with resultant interference with the designated traffic direction.

As explained above, when the signal control code is received at field station 3—4, the contacts 58 and 59 of relay 4LHSR are reversed to cause energy to be supplied to the winding of signal 4LA over the circuit controlled by neutral and polar contacts of relay 4LHD and by contacts 90 and 91 which are governed in accordance with the position of switch 3W so as to establish the circuit of signal 4LA when and only when the switch is in its normal position. As shown, the switch 3W is in its normal position and the polar contacts of relay 4LHD are in their normal position so that energy is supplied to the winding of signal 4LA to cause it to display its green or clear indication. When signal 4LA clears, the circuit of relay 4LRGP is interrupted and it releases to cause energy to be supplied over its back contact 60 to terminal 13 of the field station unit while a contact of relay 4LRGP momentarily interrupts the circuit of the starting relay 3—4FST to cause an indication code to be sent to the office to pick up relay 4LHK to show that signal 4LA has cleared.

In addition, when relay 4LRGP releases, its contact 115 interrupts the circuit of an approach locking stick relay 4LAS and it releases to interrupt its own stick circuit, while contact 116 of the relay 4LAS establishes a circuit to supply energy to terminal 13 of the field station unit when contact 59 of relay 4LHSR is in its normal position. The relay 4LAS, when released, operates in the well-known manner to prevent movement of the switch 3W and to prevent clearing of the signal 4RA or 4RB, while the relay 4LAS may operate as explained in the above-identified application of H. S. Young to control the supply of energy to the terminal, not shown, of the field station unit which controls the indications of signals 4RA and 4RB to thereby send to the office a distinctive indication when the time locking is in effect.

When relay 4LHK picks up, it establishes a stick circuit for itself while its contact 81 interrupts the stick circuit for relay 2—4FL and its contacts release, but before contact 87 of relay 2—4FL establishes the circuit of relay 2—4LP, contact 92 of relay 4LHK is picked up to interrupt this circuit and thereby prevent movement of the contacts of relay 2—4LP while a signal governing entrance of traffic into the stretch is displaying a permissive indication.

Under some conditions transmission of indication codes from the field station to the office may be delayed and a train may accept signal 4LA and enter the single track stretch before the signal clear indication code is sent to the office. When a westbound train enters section 3T, the track relay 3TR releases to interrupt the circuit of the slow release repeater relay 3TP and cause energy to be supplied over back contact 94 of relay 3TR and front contact 95 of relay 3TP to the lower winding of relay 4LHSR during the release period of relay 3TP and contacts 58 and 59 of relay 4LHSR are moved to their normal position to interrupt the supply of energy to the

winding of signal 4LA and thus cause the signal to display its stop indication. Also on release of relay 3TR, its contacts 96 and 97 interrupt the circuit of relay 4LHD and its neutral contacts release to additionally interrupt the circuit of signal 4LA. When signal 4LA displays its stop indication, the circuit of relay 4LRGP is complete and its contact 60 interrupts one branch of the circuit leading to terminal 13 of the C. T. C. unit.

When relay 4LRGP picks up, energy is supplied over its front contact 115 and a back contact of relay 3TR to relay 4LAS and its contacts pick up to establish a stick circuit to keep the relay energized after relay 3TR picks up, while contact 116 of relay 4LAS interrupts the second branch of the circuit leading to terminal 13 of the C. T. C. field station unit, consequently indication codes which follow a control code for clearing signal 4LA do not pick up relay 4LHK unless transmitted before the train governed by the signal enters section 3T.

However, when relay 3TR is released, its contact 61 establishes the circuit for supplying energy to terminal 10 of the field station unit so that indication codes sent to the office pick up relay 3TK. The supply of energy to terminal 10 of the field station unit may be controlled by track relay 3TR through a stick repeater relay, not shown, which operates as explained in the above-mentioned Manual 506A to maintain the supply of energy to terminal 10 until an indication code has been sent to the office. This insures that the indication of occupancy of section 3T will be sent to the office even through transmission of the indication code is delayed so that section 3T is vacated before the indication is transmitted.

When the relay 3TK at the office picks up, its contact 98 interrupts the circuit of relay 2—4LP, and its contact 82 interrupts the stick circuit for relay 2—4FL and its contacts release. As contact 98 of relay 3TK interrupts the circuit of relay 2—4LP before contact 87 of relay 2—4FL releases, there is no period during which the circuit of relay 2—4LP is established, and therefore no possibility that energy may be supplied to relay 2—4LP to move its contacts and change the designated traffic direction during occupancy of the stretch.

From the foregoing it will be seen that inclusion of a contact of the indication relay 3TK for the detector section at the entrance end of the stretch in the control of relay 2—4FL insures that this relay will be released upon entrance of a train into the stretch if the relay has not already been released by receipt of a signal clear indication, and thereby makes certain that the locking of relay 2—4LP will be released when the stretch is vacated.

On release of relay 4LHD at field station 3—4 its neutral contact 54 interrupts the circuit of relay 4LBP and contact 56 of relay 4LBP releases to supply energy to terminal 12 of the field station unit and cause indication codes sent to the office to pick up relay 4LBK and cause its contact 99 to interrupt the circuit of relay 2—4LP.

On continued movement of the train through the stretch, the block and detector section indication relays control the circuits of the detector section and block occupancy lamps in the track model on the panel of the control machine, while contacts of these relays interrupt the circuits of relay 2—4LP to insure that the contacts of this relay remain in their left-hand position and maintain westbound traffic. As hereinafter explained,

the circuits of the traffic direction lamps WFE and EFE are controlled in a somewhat different manner than heretofore.

If desired, the contact 81 of relay 4LHK in the pick-up and stick circuits of relay 2—4FL may be omitted, and if this is done, the relay 2—4FL when picked up remains picked up until released by the relay 3TK, or is released in the manner explained below.

If an indication code is sent to the office after a signal clear control code has been transmitted but before the signal has cleared or a train has entered the stretch, contact 83 of relay 3—4D will pick up momentarily, but at such times this contact is shunted by contact 84 of relay 2—4FLO so the stick circuit of relay 2—4FL is not interrupted and relay 2—4FL remains picked up to interrupt the circuit of relay 2—4LP.

After a control code has been transmitted to clear a signal governing entrance of trains into one end of the stretch and before an indication code has been received in response thereto, the operator may find it advantageous to change the direction of traffic in the stretch and clear the signal governing entrance of traffic into the stretch at the other end. This equipment is arranged so that after a signal clear code has been transmitted, the operator can regain control of of the traffic direction designating relay to change the direction of traffic in the stretch only after it has been determined that it is safe for him to do so.

As explained above, when a control code is sent to clear signal 4LA, the relay 2—4FL is picked up to interrupt the circuits of the relay 2—4LP and thus prevent a change in the designated traffic direction. If the operator now decides to establish eastbound traffic in the stretch and to clear signal 2RA, he must first move signal lever 4SIG to its normal position or to its right-hand position and send a control code to field station 3—4. On this movement of the lever 4SIG the contact in the circuit leading to terminal 5 of the office coding unit is opened to cause the control code sent to stations 3—4 to move the contacts of relay 4LHSR to their normal positions and thus cause signal 4LA to display its stop indication.

When lever 4SIG is in its center or its right-hand position, but relay 2—4FL is picked up because a signal clear control code has been transmitted and has not been followed by an indication code which will release the relay 2—4FL, and a control code is sent to station 3—4, terminal B of the battery is connected to one terminal of the winding of relay 2—4FLO over the circuit which includes contacts 85 and 77 of relay 2—4FL, normal polar contact 78 of relay 2—4LP, front contact 80 of relay 3—4S which is picked up during transmission of a control code to station 3—4, contact NR of lever 4SIG, contacts 101 and 102 of relay 2—4FLO, and front contact 103 of relay 2—4FL.

As explained in Manual 506A referred to above, the supply of energy to relay M8P is temporarily interrupted during the eighth step of the control code sent to station 3—4 and the contacts of relay M8P release for a short time interval. When relay M8P releases, terminal C of the source is connected over back contact 105 of relay M8P, and contacts 106 and 107 of relay 2—4FLO to a terminal of the winding of relay 2—4FLO to complete the circuit of the relay. The contacts of relay 2—4FLO now pick up and contact 108 moves contact 102 out of engagement with contact 101 and connects terminal B of the source over front contact 103 of relay 2—4FL to one terminal of the winding of relay 2—4FLO, and contact 109 moves contact 107 out of engagement with contact 106 and connects terminal C of the source to the other terminal of the relay winding so that, after picking up of relay M8P, relay 2—4FLO is maintained energized by current supplied over a stick circuit governed by contact 103 of relay 2—4FL. When relay 2—4FLO picks up, its contact 84 in the circuit of relay 2—4FL is opened, but energy continues to be supplied to relay 2—4FL over back contact 83 of relay 3—4D so relay 2—4FL remains picked up and its contact 87 interrupts the circuits of relay 2—4LP. Also when relay 2—4FLO picks up, its contact 72 interrupts the circuit leading to terminal 5 of the office coding unit to thereby prevent supply of energy to this terminal in the event the lever 4SIG is restored to its left-hand position after picking up of relay 2—4FLO but prior to transmission of the step of the control code governed by terminal 5 of the office coding unit. Opening of contact 72 of relay 2—4FLO, therefore, guarantees that the signal control element of the control code sent to station 3—4 will cause the contacts of relay 4LHSR to be moved to their normal positions to cause signal 4LA to display its stop indication. As signal 4LA displays its stop indication the circuit of relay 4LRGP is complete and it picks up to interrupt the branch of the circuit which it controls leading to terminal 13 of field station 3—4.

The signal stop control code sent to station 3—4 causes this station to transmit an indication code to the office and when this code is received at the office the delivery relay 3—4D picks up with the result that its contact 83 in the circuit of relay 2—4FL is opened. As contact 84 of relay 2—4FLO is also open, the supply of energy to the lower winding of relay 2—4FL over the stick circuit for this winding is interrupted and the relay contacts release to additionally interrupt the relay stick circuit, while contact 103 of relay 2—4FL interrupts the circuit of relay 2—4FLO and it releases.

After release of relay 2—4FL as a result of receipt of an indication code from station 3—4 following the signal stop control code, contact 87 of relay 2—4FL in the circuits of relay 2—4LP is closed to permit energy to be supplied to relay 2—4LP if the indication code received at this time shows that it is proper to permit a change in the direction of traffic in the single track stretch. As explained below, the indication code received at this time may result in picking up of one or more of the relays 4LHK, 4LBK or 3TK to interrupt the circuits of relay 2—4LP and thus maintain the established direction of traffic in the single track stretch.

If the signal clear control code previously sent to station 3—4 resulted in clearing of signal 4LA with consequent release of relay 4LRGP, its contact 115 will interrupt the circuit of relay 4LAS and it releases to interrupt its own stick circuit, and contact 116 of relay 4LAS establishes a connection to terminal 13 of the field station unit provided contact 59 of relay 4LHSR is in its normal position.

When the signal stop control code is received at station 3—4 and signal 4LA is put to stop manually, assuming that it has not been put to stop as a result of passage of a train, the relay 4LRGP picks up but relay 4LAS remains released so that energy is supplied to the time element device 4TER. After a substantial time interval,

such as 6 minutes, the contacts of the device 4TER pick up and energy is supplied over its contact 118 to relay 4LAS to pick up its contacts to interrupt the circuit of device 4TER and establish a stick circuit for relay 4LAS.

When contact 116 of relay 4LAS is released and contact 59 of relay 4LHSR is in its normal position, the battery is connected to terminal 13 of the field station unit to cause indication codes sent to the office to pick up relay 4LHK even though signal 4LA is at stop and relay 4LRGP is picked up.

In this case, as explained in the above-identified application of H. S. Young, another indication relay 4RHK is picked up along with relay 4LHK, which prevents the display of a clear signal indication by relay 4LHK and provides a distinctive indication of the operation of the device 4TER.

If signal 4LA had been cleared by the signal clear control code and had been accepted by a train, the signal would have been put to stop by release of relay 3TR, thereby picking up relay 4LRGP, while on picking up of relay 4LRGP a pick-up circuit including its front contact 115 is established for relay 4LAS and it picks up to establish a stick circuit for itself and to interrupt the supply of energy to terminal 13 of the field station unit with the result the indication codes subsequently sent to the office do not pick up relay 4LHK.

If signal 4LA had been put to stop by entrance of a train into the stretch, the relay 3TR will be released so that its contact 61 establishes connection to terminal 10 of the field station unit to cause indication codes sent to the office to pick up relay 3TK. Also, if a train enters the stretch, the neutral contacts of relay 4LHD are released and interrupt the circuit of relay 4LBP so its contact 56 establishes the circuit to supply energy to terminal 12 of the field station unit so that indication codes sent to the office pick up relay 4LBK.

If for any reason the signal 4LA did not clear in response to the signal clear control code sent to station 3—4, the relays 4LRGP and 4LAS remain energized and in this case a train would not have entered the stretch and relays 3TR, 4LHD and 4LBP would have remained energized and indication codes sent to the office would not pick up relay 4LBK, 4LHK or 3TK.

It will be seen that after the signal stop code has been received at the field station the indication codes thereafter sent to the office show conditions at the field station. If the signal 4LA had been cleared by the signal clear control code and was put to stop by the signal stop code so that the time locking is effective, the indication code sent to the office will pick up relay 4LHK so that its contact 92 interrupts the circuits of relay 2—4LP and thus prevents a change in the designated traffic direction until the time interval determined by device 4TER expires, at which time relay 4LAS picks up and an indication code is sent to the office to release relay 4LHK. This is proper since the signal 4LA, when clear, may have caused a west-bound train to advance toward the signal to enter the single track stretch, and, after the signal is put manually to stop, this train may be unable to stop before passing the signal. If a train should overrun the signal and enter the single track stretch, it would release relays 3TR, 4LHD and 4LBP to cause indication codes to be sent to the office to pick up relays 3TK and 4LBK and interrupt the circuits of relay 2—4LP and thus prevent a change in the designated traffic direction.

Similarly, if a train had passed signal 4LA and had entered the single track stretch before the signal stop control code was received at station 3—4, the indication codes subsequently sent to the office would pick up relays 4LBK and 3TK to prevent movement of the contacts of relay 2—4LP and thus maintain the established direction of traffic.

If the signal clear control code sent to station 3—4 had not resulted in clearing of the signal, and if no train has entered the stretch, the indication code sent to the office following the signal stop control code will not pick up either of the relays 4LBK, 4LHK or 3TK, and as relay 2—4FL is released, the circuits of relay 2—4LP are complete and the operator is free to move its contacts and change the direction of traffic in the single track stretch.

From the foregoing it will be seen that relay 2—4FL operates to lock the traffic direction designating relay 2—4LP and thus maintain the established traffic direction as soon as a control code to clear a signal is transmitted. This eliminates the possibility of interference with traffic in a stretch in the interval between transmission of a signal clear control code and receipt of an indication code showing that the signal has cleared or has been accepted by a train.

It will also be seen that after a signal clear control code has been transmitted the operator can regain control of relay 2—4LP by first transmitting a signal stop control code and thereafter receiving an indication code to show whether it is proper to permit the established traffic direction to be disturbed.

If the operator desires to change the direction of traffic in the single track stretch from westbound to eastbound, he may do so providing the stretch is unoccupied and the signals governing entrance of traffic into the stretch are at stop. Under these conditions the relays controlling the circuits of the windings of relay 2—4LP are released and if lever 4SIG is in its center or its right-hand position, and lever 2SIG is moved to its right-hand position, energy is supplied to the upper winding of relay 2—4LP and its contacts are moved to their right-hand or reverse position. The change in the position of the contacts of relay 2—4LP reverses the polarity of the current supplied to relay 2—LPS, causing this relay to release to open its stick circuit and to close back contacts over which relays 2—4BKSR, 2RBK and 4LBK pick up as explained in the above-mentioned application Serial No. 567,188 of F. T. Pascoe and A. L. Jerome. If the starting button 1—2STB is now pressed, energy is supplied to relays 1—2ST and 3—4ST and they pick up to cause control codes to be sent to field stations 1—2 and 3—4. Relay 2—4LPS picks up over the connection now established to terminal 57 of the office coding unit, which as already explained is supplied with energy during the transmission of a control code. At this time contact 70 of relay 2—4LP is in its right-hand position so that energy is supplied to terminal 2 of the office coding unit during the picked-up period of selector relay 3—4S but not during the picked-up period of selector relay 1—2S. Accordingly, the control code sent to the field station 3—4 at the east end of the stretch moves the contacts of relay 4EFSR to their normal positions to disconnect line wires 48 and 49 from

relay 4LHD and connect them to a source of energy in series with relay 4LAR, thereby changing the east end of the stretch from an entrance to an exit end. Similarly, the control code sent to field station 1—2 at the west end of the stretch moves the contacts of relay 2WFSR to their reverse position to disconnect line wires 23 and 24 from the source of energy and connect them to relay 2RHD and thus convert the west end of the stretch from an exit to an entrance end.

Referring to Fig. 2, as contact 70 of relay 2—4LP is in its right-hand position, and assuming lever 2SIG is in its right-hand position, energy is supplied to terminal 7 of the office coding unit during the picked-up period of relay 1—2S and the control code sent to field station 1—2 reverses the contacts of relay 2RHSR to cause signal 2RA or 2RB to clear when the neutral contacts of relay 2RHD pick up.

On movement of the contacts of relay 2WFSR, Fig. 1A, to their reverse position, with consequent cutting off of the supply of energy to the line wires 23 and 24, the signals 5L and 6L are put to stop and relays 5LPC and 6LPC release to permit energy supplied to line wires 48 and 49 at the east end of the stretch to clear signal 6R and thus pick up relay 6RPC to supply energy to line wires 40 and 41 to clear signal 5R and pick up relay 5RPC to supply energy to line wires 23 and 24 to energize relay 2RHD and cause one or the other of the signals 2RA or 2RB to display a permissive indication.

Referring again to Fig. 2 it will be seen that when the signal clear control code is sent to station 1—2, energy is supplied to the upper winding of relay 2—4FL over the circuit including front contact 75 of relay MP, contacts 76 and 77 of relay 2—4FL, reverse polar contact 78 of relay 2—4LP, front contact 112 of relay 1—2S, contact R of lever 2SIG, back contact 113 of relay 2RHK, back contact 114 of relay 1TK, and back contact 115 of relay 1—2D and back contact 116 of relay 2—4FLO in parallel. When relay 2—4FL picks up, its contacts 85 and 77 provide a stick circuit for the relay, while its contact 120 establishes a path shunting the contact 112 of relay 1—2S and the contact R of lever 2SIG. As relay 2—4FL is picked up, its contact 87 interrupts the circuits of relay 2—4LP to insure that eastbound traffic will be maintained until, as explained above in connection with westbound traffic, it is certain that it is proper to change the direction of traffic in the stretch. The operation of the equipment following transmission of a control code to clear a signal 2R is similar to its operation following transmission of a control code to clear a signal 4L and a detailed operation of the equipment at such times is unnecessary.

The traffic direction indication lamps WFE and EFE are governed by contact 125 of relay 2—4LP so that one or the other of these lamps may be lighted depending on the position of contact 125. The circuits of the lamps WFE and EFE are also controlled by the signal levers and by the indication relays so as to be lighted when and only when it is desirable for the operator to know the direction of traffic established or to be established in the stretch with which the lamps are associated.

When, for example, neither of the levers 2SIG and 4SIG is in a position to clear a signal governing entrance of traffic into the stretch, neither of the signals 2R and 4L is displaying a permissive indication, the relay 2—4FL is released showing that no control code has been transmitted to clear signal 4L or 2R, and when, in addition, the entire stretch is unoccupied, there is no reason for the lamp WFE or EFE to be lighted and having these lamps dark at such times makes the other indication lamps on the control panel more effective since the operator can devote his entire attention to the lamps, lighting of which has some significance.

As soon as a signal lever is moved to a position to clear a signal leading into the stretch it is desirable to indicate to the operator the direction of traffic in the stretch, and to thereafter maintain this indication until conditions are such that the indication is no longer required. The circuit of lamp WFE or EFE is established as soon as a signal lever is moved to a signal clearing position, is maintained by relay 2—4FL after a signal clearing control code is transmitted, and is thereafter maintained by the signal clear indication relay or by the indication relays governed by occupancy of the stretch. When the stretch is vacated and neither of the signal levers is in a position to clear a signal leading into the stretch, the circuit of lamps WFE and EFE is interrupted and these lamps are extinguished.

A back contact of relay 2—4BKSR is included in the circuits governed by the block indication relays 4LBK and 2RBK for supplying energy to the lamps WFE and EFE. As explained in our application Serial No. 567,188, the relay 2—4BKSR, and the relays 2RBK and 4LBK are picked up on a change in the position of the contacts of relay 2—4LP and relay 2—4BKSR remains picked up until relays 2RBK and 4LBK are released by indication codes transmitted from the field stations showing that traffic has been established in the new direction, or until one of the detector section indication relays 1TK or 3TK is picked up to show that a train has entered the stretch. Inclusion of the back contact of relay 2—4BKSR in the circuits governed by relays 2RBK and 4LBK for lighting the lamps WFE and EFE prevents lighting of these lamps by energy supplied over the contacts of relays 2RBK and 4LBK at times when these relays are picked up incident to movement of the contacts of relay 2—4LP and not because of occupancy of the stretch. At such times one of these lamps may be lighted by energy supplied over another circuit, as, for example, over a contact of lever 2SIG or 4SIG or over the front contact of relay 2—4FL. However, the lamps WFE and EFE will not be lighted if no such other circuit is established following a movement of the contacts of relay 2—4LP, as might be the case if lever 2SIG is moved to its position R or lever 4SIG is moved to its position L, thereby producing movement of the contacts of relay 2—4LP, and if the lever is thereafter moved from this position before a control code is sent.

In the machine circuits shown in Fig. 2 of the drawings a special relay 2—4FLO is provided to release relay 2—4FL upon receipt of an indication code from a field station subsequent to transmission of a signal stop control code to that station. It is possible to employ the signal indication relays for this purpose, thereby eliminating the need for the relay 2—4FLO, and Fig. 3 is a fragmentary diagram showing this modification. The equipment is shown in the condition which it assumes when relay 2—4LP designates westbound traffic, the signals 4L are at stop, and a signal clear control code has not been transmitted so that relay 2—4FL is released.

If the operator wishes to clear signal 4LA, he moves lever 4SIG to the left and presses the starting button for station 3—4 to cause a control code to be sent to that station. When selector relay 3—4S picks up, energy is supplied to the lower winding of relay 2—4FL over a circuit identical with that traced in detail in connection with Fig. 2 except that contact 83A of relay 4LHK is substituted for contact 83 of relay 2—4FLO. As explained in connection with Fig. 2, when relay 2—4FL picks up, it establishes a stick circuit for itself and a contact of relay 2—4FL interrupts the circuits of relay 2—4LP to insure that the contacts of relay 2—4LP remain in their left-hand positions and maintain westbound traffic in the stretch. The stick circuit for relay 2—4FL established at this time includes its own front contact 83 and differs from the stick circuit shown in Fig. 2 in that contact 83 shunts the contact 81 of relay 4LHK in the relay pick-up circuit as well as contact 80 of relay 3—4S and contact L of lever 4SIG.

When relay 2—4FL picks up, its contact 126 establishes the circuit including back contact 127 of relay 4LHK, front contact 71 of relay 3—4S, and contact L of lever 4SIG for supplying energy to terminal 5 of the office coding unit to cause the control code sent to station 3—4 to include a signal clearing element. If a signal clear control code is sent while relay 4LHK is picked up and relay 2—4FL is released, the relay 2—4FL remains released as its pick-up circuit is interrupted by contact 81 of relay 4LHK, and, as relay 2—4FL remains released, its contact 131 maintains the circuit of lamp 4LE and it remains lighted and contact 126 of relay 2—4FL and contact 127 of relay 4LHK establish the circuit to terminal 5 of the office coding unit.

When signal 4LA clears in response to the control code, an indication code is sent to the office to pick up relay 4LHK. At the time this indication code is registered at the office the delivery relay 3—4D picks up with the result that its contact 84 in the stick circuit of relay 2—4FL is open, and when relay 4LHK picks up so that its contact 83A in the stick circuit of relay 2—4FL is also open, the stick circuit for relay 2—4FL is interrupted and the relay contacts release to additionally interrupt the relay stick circuit. The relay 3—4D is picked up for only a short time, but this period is long enough to insure release of relay 2—4FL, while on release of relay 3—4D the relay 4LHK is maintained picked up by a stick circuit in the usual manner.

When relay 4LHK picks up, a contact of the relay interrupts the circuits of relay 2—4LP to insure that it maintains the established traffic direction, and relay 4LHK is picked up and relay 2—4FL is released, energy is supplied over front contact 130 of relay 4LHK and back contact 131 of relay 2—4FL to lamp 4LE above lever 4SIG and this lamp is lighted to indicate to the operator that signal 4L is displaying a permissive indication. Also on picking up of relay 4LHK and release of relay 2—4FL the circuit leading to terminal 5 of the office coding unit is maintained so that as long as lever 4SIG remains in its position L control codes transmitted to station 3—4 will include a signal clear element and will maintain the display of a permissive indication by one of the signals 4L.

If a westbound train accepts signal 4LA and enters the stretch so that signal 4LA is put to stop, an indication code will be sent to the office to release relay 4LHK, but to also pick up other

indication relays, as explained in connection with Fig. 2 and thus lock relay 2—4LP. On release of relay 4LHK its contact 130 interrupts the circuit of lamp 4LE, its contacts 81 and 83A establish the pick-up circuit for relay 2—4FL, and its contact 127 interrupts the circuit leading to terminal 5 of the office coding unit to prevent transmission of signal clear control codes unless relay 2—4FL is picked up. On continued movement of the train through the stretch, the equipment operates substantially as explained in connection with Fig. 2.

The modification shown in Fig. 3 is arranged so that, after a signal clear control code has been transmitted to a field station, the operator can regain control of relay 2—4LP by first sending a signal stop control code to the station and thereafter receiving an indication code showing that conditions are proper to permit him to have control of relay 2—4LP.

As explained above, when the signal clear control code is sent to station 3—4, the relay 2—4FL is picked up and establishes a stick circuit for itself. If the operator now decides to convert the stretch from westbound to eastbound traffic, he moves lever 4SIG to its normal or to its right-hand position and presses the starting button 3—4STB to cause a control code to be sent to station 3—4. As explained in connection with Fig. 2, the relay M8P releases momentarily on the eighth step of the control code sent to station 3—4, at which time contact 80 of relay 3—4S is picked up. Accordingly, when relay M8P releases, energy is supplied to the upper winding of relay 4LHK over a circuit, a portion of which is common to the stick circuit for the lower winding of relay 2—4FL. The circuit for supplying energy to relay 4LHK includes contacts 85 and 77 of relay 2—4FL, contact 78 of relay 2—4LP, contact 80 of relay 3—4S, contact NR of lever 4SIG, winding of relay 4LHK, front contact 103 of relay 2—4FL, and back contact 105 of relay M8P. The energy supplied to relay 4LHK picks up the relay contacts with the result that contact 132 of relay 4LHK establishes the relay stick circuit which includes back contact 133 of relay 3—4D and front contact 134 of relay 2—4FL in multiple.

On picking up of relay 4LHK its contact 81 is opened but is bridged by contact 88 of relay 2—4FL, and contact 83A of relay 4LHK is opened but is bridged by contact 84 of relay 3—4D since operation of the office coding unit is such that relay 3—4D is certain to be released at the time relay 4LHK is picked up by energy supplied to its upper winding over the circuit governed by relay M8P. Accordingly, on picking up of relay 4LHK at this time the stick circuit for relay 2—4FL is maintained and relay 2—4FL remains picked up. As relays 2—4FL and 4LHK are both picked up their contacts 126 and 127 interrupt the circuit leading to terminal 5 of the office coding unit to insure that the control code sent to station 3—4 includes the signal stop element even if lever 4SIG should be moved to its position L.

As relay 2—4FL is picked up its contact 131 interrupts the circuit of lamp 4LE to prevent lighting of this lamp even though relay 4LHK is picked up. This is proper since picking up of relay 4LHK at this time is not the result of a signal clear indication code received from the field.

As relays 2—4FL and 4LHK are both picked up, the circuits of relay 2—4LP are interrupted,

as will be clear from Fig. 2, and the relay 2—4LP is certain to maintain westbound traffic in the stretch.

The control code sent to station 3—4 causes that station to send an indication code to the office, and, when this indication code is registered at the office, relay 3—4D picks up with the result that its contact 84 interrupts the stick circuit for relay 2—4FL and relay 2—4FL releases. When relay 3—4D picks up, its contact 133 interrupts the stick circuit for relay 4LHK and connects relay 4LHK to terminal 13 of the office coding unit. If at this time energy is not supplied to terminal 13, the relay 4LHK will be held picked up by energy supplied over front contact 134 of relay 2—4FL until relay 2—4FL releases, whereupon relay 4LHK releases. The stick circuit for relay 4LHK provided by front contact 134 of relay 2—4FL insures that relay 4LHK will remain picked up and interrupt the stick circuit for relay 2—4FL until this circuit is interrupted by release of relay 2—4FL and thereby makes release of relay 2—4FL certain at these times.

If at the time the indication code is received energy is supplied to terminal 13, as may be the case when the time locking is in effect, the relay 4LHK will remain picked up after release of relay 2—4FL. If at the time the indication code is received a train has entered the stretch, the detector section and block indication relays 3TK and 4LBK will be picked up, as explained in connection with Fig. 2.

In any event the indication code received following the signal stop control code will release relay 2—4FL and establish the circuits of relay 2—4LP unless these circuits are interrupted by one or more of the other indication relays.

As pointed out above, when a signal stop control code is transmitted following a signal clear control code but prior to receipt of the signal clear indication, the relay 2—4FL remains picked up and the relay 4LHK becomes picked up with the result that the lamp 4LE is not lighted. If the signal clear indication is received from the field, the relay 4LHK will be picked up and the relay 2—4FL will be released so that lamp 4LE will be lighted. If a signal stop control code is now transmitted, the relay 2—4FL will remain released and maintain the circuit of lamp 4LE since the pick-up circuit for relay 2—4FL is interrupted by contact 81 of relay 4LHK. Accordingly, at these times the lamp 4LE remains lighted until an indication code is received from the field to release relay 4LHK.

The equipment operates in a similar manner when relay 2—4LP designates eastbound traffic in the stretch and a control code is transmitted to clear one of the signals 2R and a detailed explanation of the operation of the equipment at such times is unnecessary.

Although we have herein illustrated and described two forms of railway traffic controlling apparatus embodying our invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of our invention.

Having thus described our invention, what we claim is:

1. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code type remote control system for transmitting control codes for controlling the signal control and traffic direction relays from a central office and for transmitting indication codes for indicating traffic conditions at said office, in combination, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes by said remote control system by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch, an auxiliary relay at the office, means for operating said auxiliary relay in response to the transmission of a control code for clearing a signal by operation of its signal control relay, an indication relay at said office for each of said signals, each signal indication relay being operated when an indication is received that the associated signal is clear and being restored to its normal position when an indication is received that the associated signal is at stop, means responsive to the operation of a signal indication relay by an indication code transmitted when a signal is clear for restoring said auxiliary relay to its normal position, and locking means at said office comprising normally closed contacts of said auxiliary relay and said indication relays in a circuit for controlling said electroresponsive means, the opening of such contacts being effective to maintain the designated traffic direction by preventing the energization of said electroresponsive means when said auxiliary relay occupies its operated position or either of said signal indication relays is in its operated position.

2. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code type remote control system for transmitting control codes for controlling the signal control and traffic direction relays from a central office and for transmitting indication codes for indicating traffic conditions at said office, in combination, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes by said remote control system by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch, an auxiliary relay at the office, means for operating said auxiliary relay in response to the transmission of a control code for clearing a signal by operation of its signal control relay, an indication relay at said office for each of said signals, each signal indication relay being operated when an indication is received that the associated signal is clear and being restored to its normal position when an indication is received that the associated signal

is at stop, means for restoring said auxiliary relay to its normal position in response to the operation of a signal indication relay by an indication code transmitted when a signal is clear, occupancy indication means at said office which is operated when an indication is received that said stretch is occupied and is restored to its normal position when an indication is received that said stretch is unoccupied, and locking means at said control office comprising normally closed contacts controlled by said auxiliary relay, said signal indication relays and said occupancy indication means in a circuit for controlling said electroresponsive means, the opening of such contacts being effective to maintain the designated traffic direction by preventing the energization of said electroresponsive means when said auxiliary relay, said occupancy indication means, or either of said signal indication relays occupies its operated position.

3. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code type remote control system for transmitting control codes for controlling the signal control and traffic direction relays from a central office and for transmitting indication codes for indicating traffic conditions at said office, in combination, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes by said remote control system by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch, an auxiliary relay at the office, means for operating said auxiliary relay in response to the transmission of a control code for clearing a signal by operation of its signal control relay, means for restoring said auxiliary relay to its normal position in response to an indication code transmitted when a train enters the stretch, occupancy indication means at said office which is operated when an indication is received that said stretch is occupied and is restored to its normal position when an indication is received that said stretch is unoccupied, and locking means at said control office comprising normally closed contacts controlled by said auxiliary relay and said occupancy indication means in a circuit for controlling said electroresponsive means, the opening of such contacts being effective to maintain the designated traffic direction by preventing the energization of said electroresponsive means when said auxiliary relay or said occupancy indication means occupies its operated position.

4. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of

said signaling system, together with a code type remote system for transmitting control codes for controlling the signal control and traffic direction relays from a central office and for transmitting indication codes for indicating traffic conditions at said office, in combination, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes by said remote control system by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch, a first auxiliary relay at the office, means for operating said first auxiliary relay in response to the transmission of a control code for clearing a signal by operation of its signal control relay, a second auxiliary relay, means effective only when said first auxiliary relay occupies its operated position for operating said second auxiliary relay in response to the transmission of a control code for putting a signal to stop by restoring its signal control relay to normal, a signal indication relay for each signal, means responsive to the indication code transmitted when a signal is clear for operating the corresponding signal indication relay, means controlled by each signal indication relay for restoring said first auxiliary relay to its normal position when such indication relay is operated, means controlled by said second auxiliary relay for rendering any indication code transmitted when said second auxiliary relay is in its operated position effective to restore said first and second auxiliary relays to their normal positions, and locking means at said office comprising a normally closed contact of said first auxiliary relay in a circuit for controlling said electroresponsive means, the opening of such contact being effective to maintain the designated traffic direction by preventing the energization of said electroresponsive means when said first auxiliary relay occupies its operated position.

5. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code type remote control system for transmitting control codes for controlling the signal control and traffic direction relays from a central office and for transmitting indication codes for indicating traffic conditions at said office, in combination, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes by said remote control system by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch, a first auxiliary relay at the office, means for operating said first auxiliary relay in response to the transmission of a control code for clearing a signal by operation of its signal control relay, a second auxiliary relay, means effective only when said first auxiliary relay occupies its operated position for operating said second auxiliary relay in response to the transmission of a control code for putting a signal to stop by restoring its signal control relay to normal, a track in-

dication relay for each end of the stretch, means responsive to the indication code transmitted when a train enters the stretch at either end for operating the corresponding track indication relay, means controlled by each track indication relay for restoring said first auxiliary relay to its normal position when such indication relay is operated, means responsive to an indication code transmitted when said second auxiliary relay is in its operated position for restoring said first and second auxiliary relays to their normal positions irrespective of the condition indicated by such code, occupancy indication means at said office which is operated when an indication is received that said stretch is occupied and is restored to its normal position when an indication is received that said stretch is unoccupied, and locking means at said office comprising normally closed contacts controlled by said first auxiliary relay and said occupancy indication means in a circuit for controlling said electroresponsive means, the opening of such contacts being effective to maintain the designated traffic direction by preventing the energization of said electroresponsive means when said first auxiliary relay or said occupancy indication means occupies its operated position.

6. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code type remote control system for transmitting control codes for controlling the signal control and traffic direction relays from a central office and for transmitting indication codes for indicating traffic conditions at said office, in combination, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes by said remote control system by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch, an auxiliary relay at the office, means for operating said auxiliary relay in response to the transmission of a control code for clearing a signal by operation of its signal control relay, an indication relay at said office for each of said signals, each signal indication relay being operated when an indication is received that the associated signal is clear and being restored to its normal position when an indication is received that the associated signal is at stop, means at the office effective when said auxiliary relay is in its operated position and a control code is transmitted for putting a signal to stop by restoring its signal control relay to normal for causing the signal indication relay for such signal to assume its operated position concurrently with the transmission of such control code means responsive to an indication code and rendered effective when one of said signal indication relays is in its operated position for restoring said auxiliary relay to its normal position, and locking means at said office comprising normally closed contacts of said auxiliary relay and of said indication relays in a circuit for controlling said electroresponsive means, the opening of such contacts being effective to maintain the designated traffic direction by preventing the energization of said electroresponsive means when said auxiliary relay or either of said signal indication relays occupies its operated position.

7. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code type remote control system for transmitting control codes for controlling the signal control and traffic direction relays from a central office and for transmitting indication codes for indicating traffic conditions at said office, in combination, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes by said remote control system by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch, an auxiliary relay at the office, means for operating said auxiliary relay in response to the transmission of a control code for clearing a signal by operation of its signal control relay, an indication relay at said office for each of said signals, each signal indication relay being operated when an indication is received that the associated signal is clear and being restored to its normal position when an indication is received that the associated signal is at stop, means at the office effective when said auxiliary relay is in its operated position and a control code is transmitted for putting a signal to stop by restoring its signal control relay to normal for causing the signal indication relay for such signal to assume its operated position concurrently with the transmission of such control code, means responsive to the indication code transmitted when a train enters the stretch for restoring said auxiliary relay to its normal position, means responsive to an indication code and rendered effective when one of said signal indication relays is in its operated position for restoring said auxiliary relay to its normal position, and locking means at said office comprising normally closed contacts of said auxiliary relay and of said signal indication relays in a circuit for controlling said electroresponsive means, the opening of such contacts being effective to maintain the designated traffic direction by preventing the energization of said electroresponsive means when said auxiliary relay or either of said signal indication relays occupies its operated position.

8. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code type remote control system for transmitting control codes for controlling the signal con-

trol and traffic direction relays from a central office and for transmitting indication codes for indicating traffic conditions at said office, in combination, a signal control lever at the office for each of said signals, each of said levers being movable between a clear and a stop position, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes by said remote control system by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch and for also governing jointly with said signal control levers the transmission of codes by said remote control system by which said signal control relays are operated to clear said signals, an auxiliary relay at the office, means for operating said auxiliary relay in response to the transmission of a control code provided such code is transmitted when the control lever for the signal at the end of the stretch which said electroresponsive means designates to be the entrance end is in its signal clear position, an indication relay at said office for each of said signals, each signal indication relay being operated when an indication is received that the associated signal is clear and being restored to its normal position when an indication is received that the associated signal is at stop, means responsive to the indication code which is transmitted when a signal is cleared for restoring said auxiliary relay to its normal position, and locking means at said office comprising normally closed contacts of said auxiliary relay and of said signal indication relays in a circuit for controlling said electroresponsive means, the opening of such contacts being effective to maintain the designated traffic direction by preventing the energization of said electroresponsive means when said auxiliary relay or either of said signal indication relays occupies its operated position.

9. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code type remote control system for transmitting control codes for controlling the signal control and traffic direction relays from a central office and for transmitting indication codes for indicating traffic conditions at said office, in combination, a signal control lever at the office for each of said signals, each of said levers being movable between a clear and a stop position, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes by said remote control system by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch and for also governing jointly with said signal control levers the transmission of codes by said remote control system by which said signal control relays are operated to clear said signals, an auxiliary relay at the office, means for operating said auxiliary relay in response to the transmission of a control code provided such code is transmitted when the control lever for the signal at the end of the stretch which said electroresponsive means designates to be the entrance end is in its signal clear position, means responsive to the indication code which is transmitted when a train enters the stretch for restoring said auxiliary relay to its normal position, occupancy indication means at said office which is operated when an indication is received that said stretch is occupied and is restored to its normal position when an indication is received that said stretch is unoccupied, and locking means at said office comprising normally closed contacts controlled by said auxiliary relay and said occupancy indication means in a circuit for controlling said electroresponsive means, the opening of such contacts being effective to maintain the designated traffic direction by preventing the energization of said electroresponsive means when said auxiliary relay or said occupancy indication means occupies its operated position.

10. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code type remote control system for transmitting control codes for controlling the signal control and traffic direction relays from a central office and for transmitting indication codes for indicating traffic conditions at said office, in combination, a signal control lever at the office for each of said signals, each of said levers being movable between a clear and a stop position, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes by said remote control system by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch and for also governing jointly with said signal control levers the transmission of codes by said remote control system by which said signal control relays are operated to clear said signals, an auxiliary relay at the office, means for operating said auxiliary relay in response to the transmission of a control code provided such code is transmitted when the control lever for the signal at the end of the stretch which said electroresponsive means designates to be the entrance end is in its signal clear position, means responsive to the indication code which is transmitted when a signal is cleared for restoring said auxiliary relay to its normal position, an indication relay at said office for each of said signals, each signal indication relay being operated when an indication is received that the associated signal is clear and being restored to its normal position when an indication is received that the associated signal is at stop, a circuit at said office governed by said signal control levers for operating said electroresponsive means to change the designated traffic direction, and locking means in said circuit comprising contacts of said auxiliary relay and of said signal indication relays which are closed only when said auxiliary relay and said signal indication relays occupy their normal positions.

11. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code type remote control system for transmitting control codes for controlling the signal control and traffic direction relays from a central office and for transmitting indication codes for indicating traffic conditions at said office, in combination, a signal control lever at the office for each of said signals, each of said levers being movable between a clear and a stop position, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes by said remote control system by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch and for also governing jointly with said signal control levers the transmission of codes by said remote control system by which said signal control relays are operated to clear said signals, an auxiliary relay at the office, means for operating said auxiliary relay in response to the transmission of a control code provided such code is transmitted when the control lever for the signal at the end of the stretch which said electroresponsive means designates to be the entrance end is in its signal clear position, means responsive to the indication code which is transmitted when a train enters the stretch for restoring said auxiliary relay to its normal position, occupancy indication means at said office which is operated when an indication is received that said stretch is occupied and is restored to its normal position when an indication is received that said stretch is unoccupied, a circuit at said office governed by said signal control levers for operating said electroresponsive means to change the designated traffic direction, and locking means in said circuit comprising contacts controlled by said auxiliary relay and said occupancy indication means wihch are closed only when said auxiliary relay and said occupancy indication means occupy their normal positions.

12. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code type remote control system for transmitting control codes for controlling the signal control and traffic direction relays from a central office and for transmitting indication codes for indicating traffic conditions at said office, in combination, a signal control lever at the office for each of said signals, each of said levers being movable between a clear and a stop position, electroresponsive means at said office for

designating the direction for traffic movements and for controlling the transmission of codes by said remote control system by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch and for also governing jointly with said signal control levers the transmission of codes by said remote control system by which said signal control relays are operated to clear said signals, a first auxiliary relay at the office, means for operating said first auxiliary relay in response to the transmission of a control code provided such code is transmitted when the control lever for the signal at the end of the stretch which said electro-responsive means designates to be the entrance end is in its signal clear position, a second auxiliary relay, means for operating said second auxiliary relay in response to the transmission of a control code provided such code is transmitted when said first auxiliary relay occupies its operated position and the control lever for the signal at the end of the stretch which said electroresponsive means designates to be the entrance end is in its stop position, means responsive to the indication code transmitted when a train enters the stretch for restoring said first auxiliary relay to its normal position, means controlled by said second auxiliary relay for rendering any indication code transmitted when said second auxiliary relay is in its operated position effective to restore said first and second auxiliary relays to their normal positions, and locking means at said office comprising a normally closed contact of said first auxiliary relay in a circuit for controlling said electroresponsive means, the opening of such contact being effective to maintain the designated traffic direction by preventing the energization of said electroresponsive means when said first auxiliary relay occupies its operated position.

13. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code communication system of centralized control including a field station for each end of the stretch for controlling the signal control and traffic direction relays from a central office and for indicating traffic conditions at said office, in combination, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes by said remote control system to said field stations by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch, an auxiliary relay at said office, means for operating said auxiliary relay in response to the transmission of a control code for operating a signal control relay to clear a signal at a field station at one end of the stretch, means for restoring said auxiliary relay to its normal position in response to an indication received from said field station provided such code indicates that a train has entered the stretch, and locking means at said office comprising a normally

closed contact of said auxiliary relay in a circuit for controlling said electroresponsive means, the opening of said contact being effective to maintain the designated traffic direction when said auxiliary relay occupies its operated position.

14. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code communication system of centralized control including a field station for each end of the stretch for controlling the signal control and traffic direction relays from a central office and for indicating traffic conditions at said office, in combination, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes by said remote control system to said field stations by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch, an auxiliary relay at said office, means for operating said auxiliary relay in response to the transmission of a control code, provided such code is one for operating a signal control relay to clear a signal at a field station at one end of the stretch, another relay at the office, means for operating said other relay in response to the transmission of another control code to said field station, provided such other control code is transmitted when said auxiliary relay occupies its operated position and is one for restoring said signal control relay to normal to put the associated signal to stop, means for restoring said auxiliary relay to its normal position in response to the transmission of an indication code from said field station to the office showing that a train has entered the stretch, means effective only when said other relay is in its operated position for restoring said auxiliary relay to its normal position in response to the transmission of an indication code from said field station to the office irrespective of the character of such code, and means at said office comprising a normally closed contact of said auxiliary relay in a circuit for said electroresponsive means the opening of such contact being effective to maintain the designated traffic direction by preventing the energization of said electroresponsive means when said auxiliary relay occupies its operated position.

15. In direction selecting means for a stretch of railway track equipped with a signaling system governed jointly by traffic direction relays at opposite ends of the stretch so that at times the stretch is conditioned for traffic movements in one direction and at other times for traffic movements in the opposite direction and having a signal at each end for governing traffic movements into the stretch and a signal control relay for each signal for manually governing the clearing thereof in accordance with the condition of said signaling system, together with a code communication system of centralized control including a field station for each end of the stretch for controlling the signal control and traffic direction relays from a central office and for indicating traffic conditions at said office, said code communication system including at the office a delivery relay for each of said field stations, each of said delivery relays being operated temporarily during receipt of an indication code from the associated field station, in combination, electroresponsive means at said office for designating the direction for traffic movements and for controlling the transmission of codes to said field stations by said remote control system by which said traffic direction relays are operated to establish the corresponding direction for traffic movements in said stretch, an auxiliary relay at said office, means for operating said auxiliary relay in response to the transmission of a control code provided such code is one for operating a signal control relay to clear a signal at a field station at one end of the stretch, another relay at the office, means for operating said other relay in response to the transmission of another control code to said field station, provided such other control code is transmitted when said auxiliary relay occupies its operated position and is one for restoring said signal control relay to normal to put the associated signal to stop, a first means for restoring said auxiliary relay to its normal position rendered effective upon the reception of an indication code from said field station at the office showing that a train has entered the stretch, a second means for restoring said auxiliary relay to its normal position, said second means becoming effective when said other relay and the delivery relay are both operated, and means at said office comprising a normally closed contact of said auxiliary relay in a circuit for said electroresponsive means, the opening of such contact being effective to maintain the designated traffic direction by preventing the energization of said electroresponsive means when said auxiliary relay occupies its operated position.

16. In locking means for a stretch of railway track equipped with a signaling system governed by traffic control means so that at times the stretch is conditioned for traffic governed by a first signal and at other times is conditioned for traffic governed by a second signal and having signal control means for manually controlling the clearing of said signals in accordance with the condition of said signaling system together with a code type communication system for controlling said signal and traffic control means from a remote office and for indicating traffic conditions at said office, in combination, electroresponsive means at said office controlling the transmission of codes by said remote control system by which said traffic control means is operated to prepare the stretch for traffic governed by said first or said second signal and for designating at the office whether traffic governed by said first or said second signal may move in said stretch, an auxiliary relay at the office, means for operating said auxiliary relay in response to the transmission of a control code provided such code is one for clearing a signal by operation of said signal control means, means for restoring said auxiliary relay to its normal position in response to an indication code transmitted when a train enters the stretch, and means at said office effective only when said auxiliary relay occupies its normal position for operating said electroresponsive means to select the direction for traffic movements in said stretch.

17. In locking means for a stretch of railway

track equipped with a signaling system governed by traffic control means so that at times the stretch is conditioned for traffic governed by a first signal and at other times is conditioned for traffic governed by a second signal and having signal control means for manually controlling the clearing of said signals in accordance with the condition of said signaling system together with a code type communication system for controlling said signal and traffic control means from a remote office and for indicating traffic conditions at said office, in combination, electroresponsive means at said office controlling the transmission of codes by said remote control system by which said traffic control means is operated to prepare the stretch for traffic governed by said first or said second signal and for designating at the office whether traffic governed by said first or said second signal may move in said stretch, an auxiliary relay at the office, means for operating said auxiliary relay in response to the transmission of a control code provided such code is one for clearing a signal by operation of said signal control means, means for restoring said auxiliary relay to its normal position in response to an indication code transmitted when a signal is cleared, and means at said office effective only when said auxiliary relay occupies its normal position for operating said electroresponsive means to select the direction for traffic movements in said stretch.

18. In locking means for a stretch of railway track equipped with a signaling system governed by traffic control means so that at times the stretch is conditioned for traffic governed by a first signal and at other times is conditioned for traffic governed by a second signal and having signal control means for manually controlling the clearing of said signals in accordance with the condition of said signaling system together with a code type communication system for controlling said signal and traffic control means from a remote office and for indicating traffic conditions at said office, in combination, electroresponsive means at said office controlling the transmission of codes by said remote control system by which said traffic control means is operated to prepare the stretch for traffic governed by said first or said second signal and for designating at the office whether traffic governed by said first or said second signal may move in said stretch, an auxiliary relay at the office, means for operating said auxiliary relay in response to the transmission of a control code provided such code is one for clearing a signal by operation of said signal control means, another relay at said office, means for operating said other relay in response to the transmission of a control code provided such code is transmitted when said auxiliary relay occupies its operated position and such control code is one for restoring said signal control means to normal to put a signal to stop, means effective when an indication is transmitted to the office that a train has entered the stretch for restoring said auxiliary relay to its normal position regardless of the position of said other relay, means effective when said other relay occupies its operated position for restoring said auxiliary relay to its normal position when an indication of any type is transmitted to the office from the field station through which said signals are governed, and means at said office effective only when said auxiliary relay occupies its normal position for operating

said electroresponsive means to select the direction for traffic movements in said stretch.

19. In locking means for a stretch of railway track equipped with a signaling system governed by traffic control means so that at times the stretch is conditioned for traffic governed by a first signal and at other times is conditioned for traffic governed by a second signal and having signal control means for manually controlling the clearing of said signals in accordance with the condition of said signaling system together with a code type communication system for controlling said signal and traffic control means from a remote office and for indicating traffic conditions at said office, in combination, electroresponsive means at said office controlling the transmission of codes by said remote control system by which said traffic control means is operated to prepare the stretch for traffic governed by said first or said second signal and for designating at the office whether traffic governed by said first or said second signal may move in said stretch, a signal lever at said office movable between a stop and a clear position and governing transmission of control codes for operating said signal control means, an auxiliary relay, means for operating said auxiliary relay in response to the transmission of a control code which is transmitted when said signal lever is in its clear position, means effective regardless of the position of said signal lever for restoring said auxiliary relay to its normal position in response to an indication code which indicates that a train has entered the stretch, and means at said office effective only when said auxiliary relay occupies its normal position for operating said electroresponsive means to select the direction for traffic movements in said stretch.

20. In locking means for a stretch of railway track equipped with a signaling system governed by traffic control means so that at times the stretch is conditioned for traffic governed by a first signal and at other times is conditioned for traffic governed by a second signal and having signal control means for manually controlling the clearing of said signals in accordance with the condition of said signaling system together with a code type communication system for controlling said signal and traffic control means from a remote office and for indicating traffic conditions at said office, in combination, electroresponsive means at said office controlling the transmission of codes by said remote control system by which said traffic control means is operated to prepare the stretch for traffic governed by said first or said second signal and for designating at the office whether traffic governed by said first or said second signal may move in said stretch, a signal lever at said office movable between a stop and a clear position and governing transmission of control codes for operating said signal control means, an auxiliary relay, means for operating said auxiliary relay in response to the transmission of a control code which is transmitted when said signal lever is positioned to effect the clearing of a signal by operation of said signal control means, means effective regardless of the position of said signal lever for restoring said auxiliary relay to its normal position in response to an indication code transmitted when a signal is cleared, and means at said office effective only when said auxiliary relay occupies its normal position for operating said electroresponsive means to select the direction for traffic movements in said stretch.

21. In a system of centralized traffic control for single track railroads having the usual stretches of single track between the ends of adjacent passing sidings, a headblock signal at each end of each stretch governing train movement into that stretch, manually operable signal levers in a remote control office for each headblock signal, manually controlled electroresponsive means at said office for each single track stretch and operating to at times permit clearing of the headblock signal at one end of the stretch and to at other times permit clearing of the signal at the other end of the stretch, a code communication system including a field station at each siding end and acting during different control code operating cycles to govern the clearing of the headblock signal at one selected field station only in accordance with the position of its signal lever and the condition of the electroresponsive means for the stretch with which the signal is associated and also acting during different indication code cycles to report to the office traffic conditions at one field station only, each of said electroresponsive means having associated therewith at least one auxiliary relay effective when operated to prevent a change in said electroresponsive means, each of said signal levers governing a circuit effective whenever a control code is transmitted to clear the signal governed by said lever to operate an auxiliary relay to prevent a change in the electroresponsive means for the track stretch with which the signal lever is associated, and means for restoring each of said auxiliary relays when an indication is received at the office that a train has entered the stretch with which the relay is associated.

22. In a system of centralized traffic control for single track railroads having the usual stretches of single track between the ends of adjacent passing sidings, a headblock signal at each end of each stretch governing train movement into that stretch, manually operable signal levers in a remote control office for each headblock signal, manually controlled electroresponsive means at said office for each single track stretch and operating to at times permit clearing of the headblock signal at one end of the stretch and to at other times permit clearing of the signal at the other end of the stretch, a code communication system including a field station at each siding end and acting during different control code operating cycles to govern the clearing of the headblock signal at one selected field station only in accordance with the position of its signal lever and the condition of the electroresponsive means for the stretch with which the signal is associated and also acting during different indication code cycles to report to the office traffic conditions at one field station only, each of said electroresponsive means having associated therewith at least one auxiliary relay effective when operated to prevent a change in said electroresponsive means, each of said signal levers governing a circuit effective whenever a control code is transmitted to clear the signal governed by said lever to operate an auxiliary relay to prevent a change in the electroresponsive means for the track stretch with which the signal lever is associated, and means for restoring each auxiliary relay when an indication code is received at the office which indicates that the signal responsive to the control code which caused such auxiliary relay to be operated has assumed its clear position.

23. In a system of centrallized traffic control for single track railroads having the usual stretches of single track between the ends of adjacent passing sidings, a headblock signal at each end of each stretch governing train movement into that stretch, manually operable signal levers in a remote control office for each headlock signal, manually controlled electroresponsive means at said office for each single track stretch and operating to at times permit clearing of the headblock signal at one end of the stretch and to at other times permit clearing of the signal at the other end of the stretch, a code communication system including a field station at each siding end and acting during different control code operating cycles to govern the clearing of the headblock signal at one selected field station only in accordance with the position of its signal lever and the condition of the electroresponsive means for the stretch with which the signal is associated and also acting during different indication code cycles to report to the office traffic conditions at one field station only, each of said electroresponsive means having associated therewith at least one auxiliary relay effective when operated to prevent a change in said electroresponsive means, each of said signal levers governing a circuit effective whenever a control code is transmitted to clear the signal governed by said lever to operate an auxiliary relay to prevent a change in the electroresponsive means for the track stretch with which the signal lever is associated, each of said auxiliary relays governing a circuit effective to operate another relay when said auxiliary relay is in its operated position and a control code is transmitted to put to stop the signal with which the auxiliary relay is associated, and means for each auxiliary relay effective when the associated other relay is operated for restoring the auxiliary relay upon receipt of an indication code from the field station governing the signal with which the auxiliary relay is associated.

24. In a system of centralized traffic control for single track railroads having the usual stretches of single track between the ends of adjacent passing sidings, a headblock signal at each end of each stretch governing train movement into the stretch, manually operable signal levers in a remote control office for each headblock signal, manually controlled electroresponsive means at said office for each of said single track stretches for designating the direction of traffic in the associated stretch, a code communication system including a field station at each siding end connected with said office by line wires, each of said single track stretches being equipped with a system of reversible circuits extending the length of the stretch for controlling the headblock signals in accordance with traffic conditions in the stretch, means at the ends of each of said stretches governed through said code communication system in accordance with the condition of the associated traffic direction designating means at the office for conditioning the system of reversible circuits for that stretch to prepare the stretch for traffic in one direction or the other, said code communication system acting during different control code operating cycles to govern the clearing of the headblock signal at one selected field station only in accordance with the condition of the system of reversible circuits for said stretch and also acting during different indication code cycles to report to the office traffic conditions at one field station only, each of said electroresponsive means having associated therewith at least one auxiliary relay effective when operated to prevent a change in said electroresponsive means, each of said signal levers governing a

circuit effective whenever a control code is transmitted to clear the signal governed by said lever to operate an auxiliary relay to prevent a change in the electroresponsive means for the track stretch with which the signal lever is associated, and means for restoring each of said auxiliary relays when an indication is received at the office that a train has entered the stretch with which the relay is associated.

25. In a system of centralized traffic control for single track railroads having the usual stretches of single track between the ends of adjacent passing sidings, a headblock signal at each end of each stretch governing train movement into the stretch, manually operable signal levers in a remote control office for each headblock signal, manually controlled electroresponsive means at said office for each of said single track stretches for designating the direction of traffic in the associated stretch, a code communication system including a field station at each siding end connected with said office by line wires, each of said single track stretches being equipped with a system of reversible circuits extending the length of the stretch for controlling the headblock signals in accordance with traffic conditions in the stretch, means at the ends of each of said stretches governed through said code communication system in accordance with the condition of the associated traffic direction designating

means at the office for conditioning the system of reversible circuits for that stretch to prepare the stretch for traffic in one direction or the other, said code communication system acting during different control code operating cycles to govern the clearing of the headblock signal at one selected field station only in accordance with the condition of the system of reversible circuits for said stretch and also acting during different indication code cycles to report to the office traffic conditions at one field station only, each of said electroresponsive means having associated therewith at least one auxiliary relay effective when operated to prevent a change in said electroresponsive means, each of said signal levers governing a circuit effective whenever a control code is transmitted to clear the signal governed by said lever to operate an auxiliary relay to prevent a change in the electroresponsive means for the track stretch with which the signal lever is associated, and means for restoring each auxiliary relay when an indication code is received at the office which indicates that the signal responsive to the control code which caused such auxiliary relay to be operated has assumed its clear position.

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No references cited.

Certificate of Correction

Patent No. 2,528,073 October 31, 1950

FRANK T. PASCOE ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 24, line 2, after the word "remote" insert *control*; column 29, line 51, for "wihch" read *which*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of January, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.