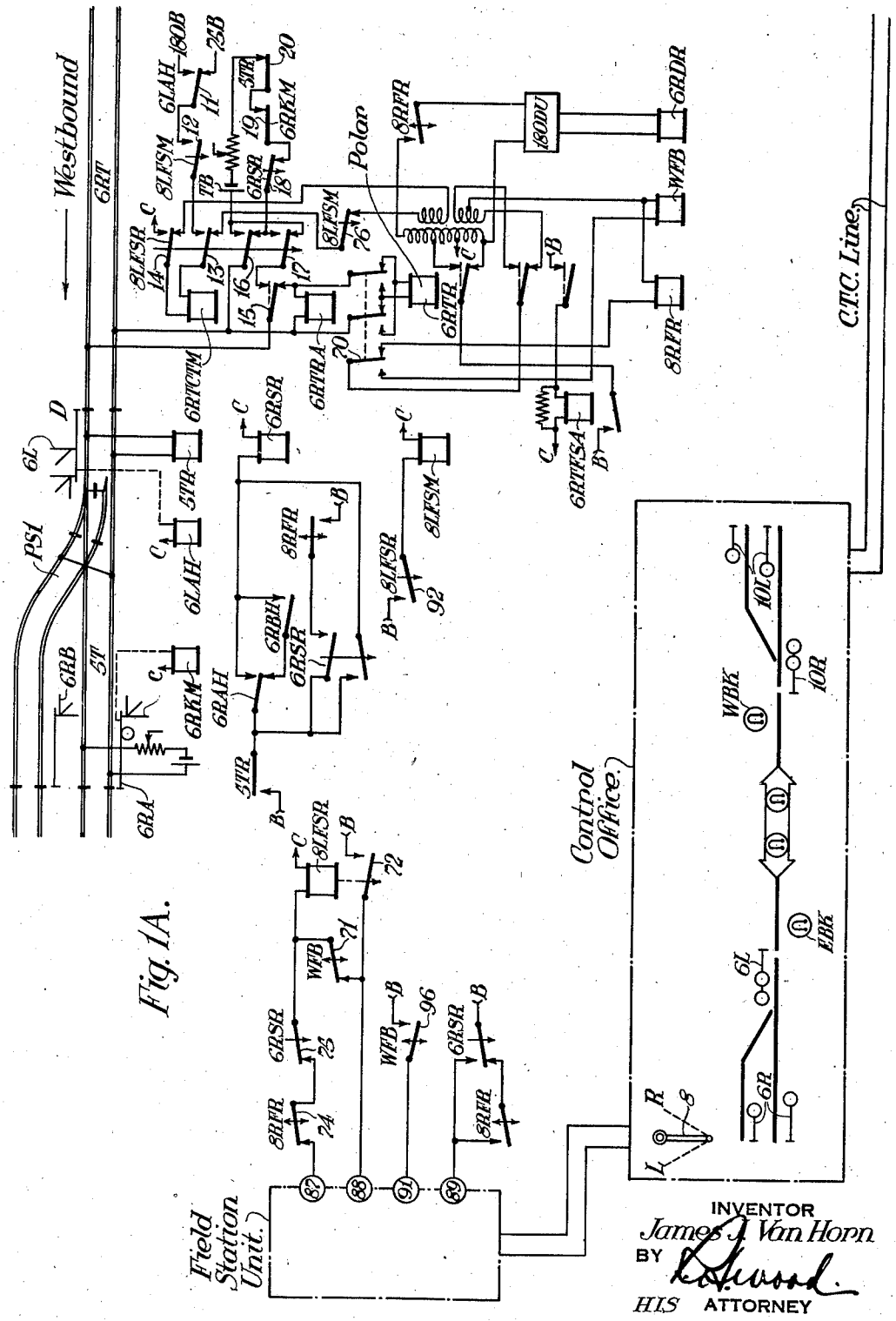
Nov. 4, 1947. J. J. VAN HORN 2,430,314

CODED TRACK CIRCUIT RAILWAY TRAFFIC CONTROLLING APPARATUS AND SWITCH CONTROL

Filed Sept. 13 1941 4 Sheets-Sheet 1



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Filed Sept. 13, 1941 4 Sheets-Sheet 2

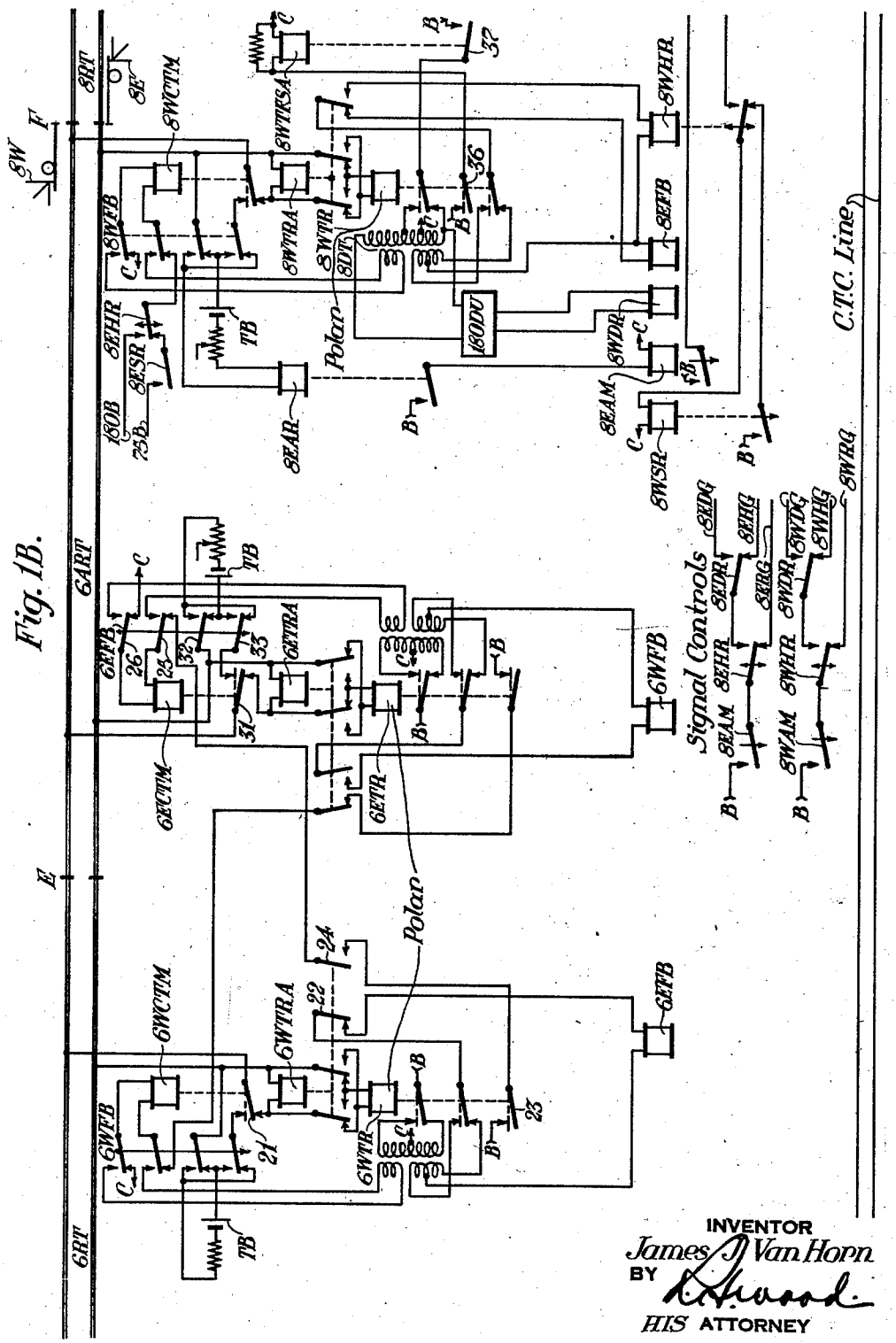


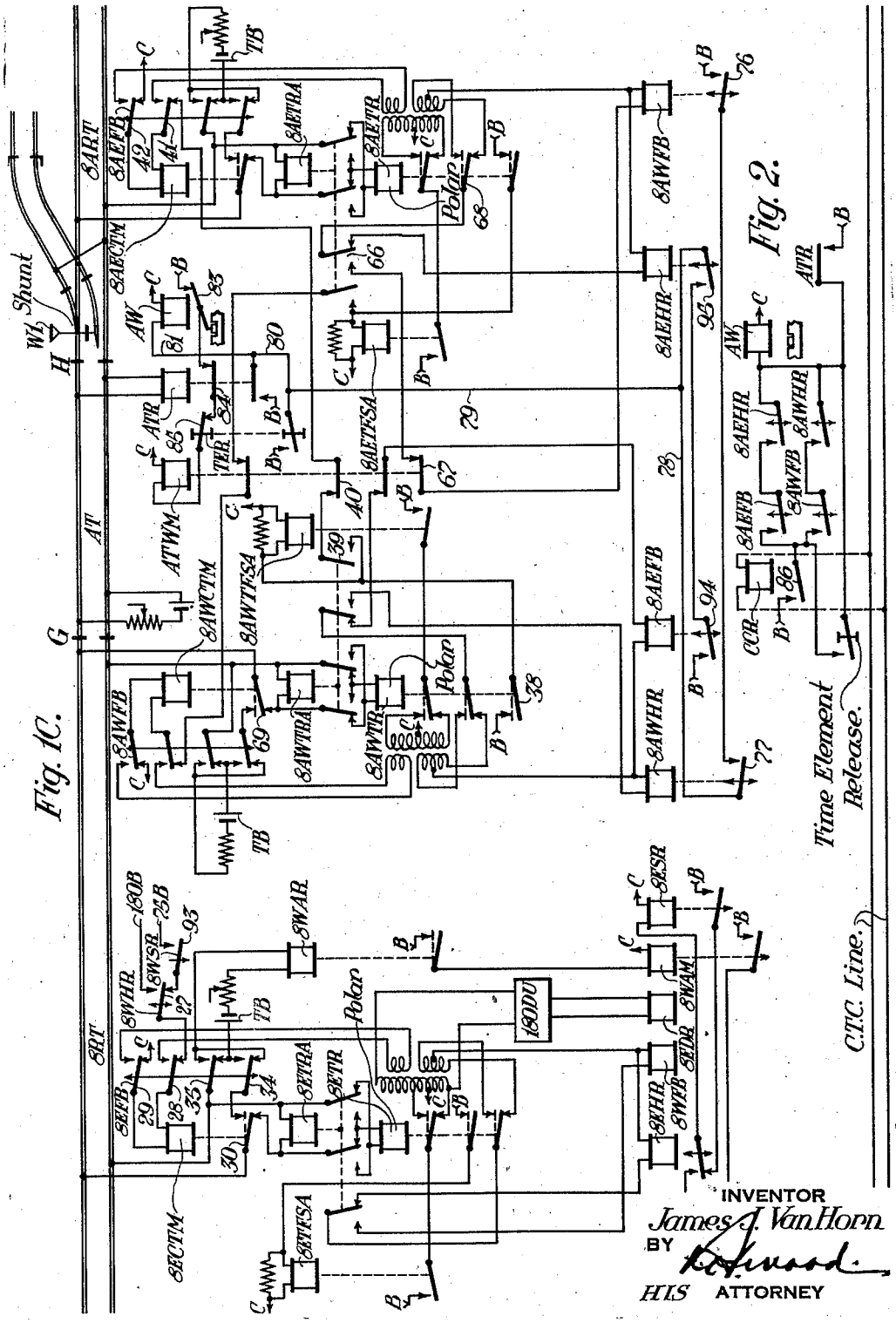
Fig. 1B.

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Filed Sept. 13, 1941 4 Sheets-Sheet 4

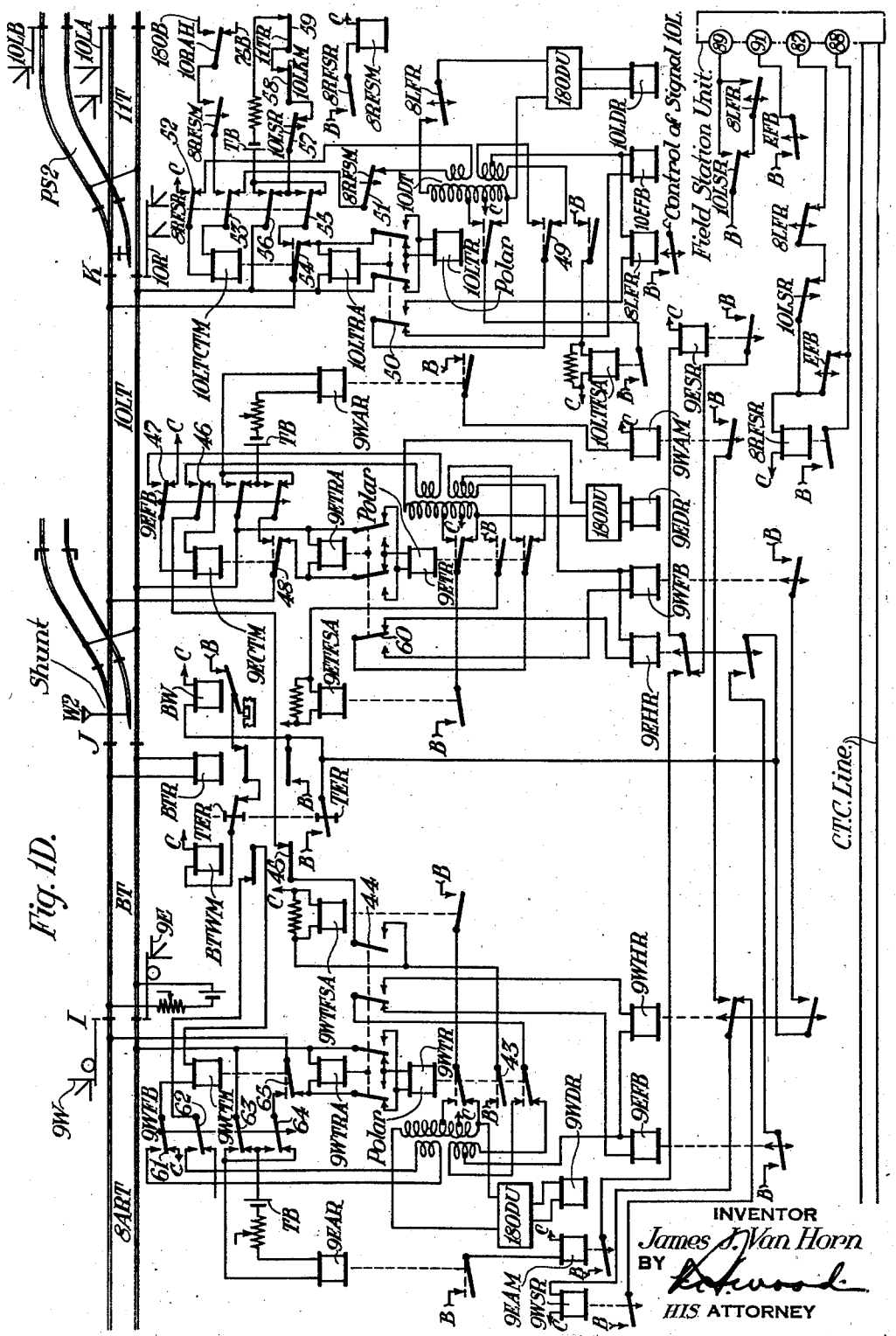


Fig. 1D.

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UNITED STATES PATENT OFFICE

2,430,314

CODED TRACK CIRCUIT RAILWAY TRAFFIC CONTROLLING APPARATUS AND SWITCH CONTROL

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Application September 13, 1941, Serial No. 410,717

8 Claims. (Cl. 246—3)

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My invention relates to railway traffic controlling apparatus and is more particularly directed to the control of traffic in a single track, two-direction system wherein centralized traffic control or other suitable manual control is used for establishing the traffic direction A distinguishing feature of my system is that it is of the normally deenergized track circuit type and dispenses with all control line wires except for the C. T. C. coded line circuit, if C. T. C. is used. The present invention is an improvement on the invention disclosed in my copending application for Letters Patent of the United States Serial No. 410,504, filed on September 12, 1941, for Railway traffic controlling apparatus, now Patent No. 2,344,573, dated March 21, 1944.

One object of my invention is to provide a normally deenergized track circuit system of signaling for traffic moving in either direction on a single track, employing no control line wires for the usual signaling functions. Another object of my invention is to provide means for retaining the established traffic direction as long as a train is approaching or occupying the single track stretch, solely by means of the track circuit apparatus, without dependence on any circuits or apparatus at the point of control from which the C. T. C. code emanates. A further object of my invention is to provide complete automatic control of electric switch locks A still further object of my invention is to provide a code system of this general character which has a flexibility, safety, and reliability comparable to coded A. P. B. systems employing control line wires. Other objects, purposes and characteristic features of my invention will be apparent from the description which follows:

I accomplish the foregoing objects as follows. I transmit a suitable C. T. C. code to the field station at the exit end of the single track stretch which results in the application of a normal or master track circuit code of normal relative polarity at that end for setting up traffic in the desired direction over the stretch. This track circuit code is cascaded over the track circuits of the single track stretch to the entrance end where it initiates the supply of a reverse or feed back code of reverse relative polarity during "off" intervals of the master code. The feed back code is cascaded back to the exit end and when there received, as will be the case when the stretch is unoccupied, permits the reversal of the traffic direction, but when not received at the exit end, as will be the case during occupancy, the absence of feed back code is used to prevent cutting off

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the master coded track circuit energy, thus making it possible to retain the new traffic direction as long as a train is approaching or occupying the single track stretch. I make use of polarity of the master and feed back track circuit codes for performing the selective functions which prevent conflicting moves and which provide safe operation. I also employ these codes for the control of electric switch locks whereby, in order to permit a train to leave a siding switch, it is merely necessary for the operator to set up traffic in the proper direction, as required by the train on the siding. If a train occupying a siding desires to follow a train on the main track, no action on the part of the operator is required.

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

Figs. 1A to 1D inclusive, of the accompanying drawings when placed end to end with Fig. 1A at the left, are a diagrammatic view showing a single track, two-direction signaling system embodying my invention. Fig. 2 is a diagrammatic view showing a portion of the apparatus of Fig. 1 applied to manual electric switch lock control, also embodying my invention.

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

In this system, I employ but two codes, these being the usual 75 and 180 per minute codes which are adequate for providing a three indication system. These codes are merely illustrative since other code rates and either more or fewer codes may be used as demanded by practical operating requirements of the particular system.

Referring to the drawings, I have shown a stretch of single track between two passing sidings PS1 and PS2, this stretch being divided into track circuit sections by means of the usual insulated rail joints at locations D, E, F, G, H, I, J, and K. Locations D, F, I, and K are signal locations; E and G are ordinary cut-section locations; and H and J are cut section locations necessitated by the presence of turnouts and electric track switches in that vicinity. Two track switch locations are shown, one of these G—H being at a cut section, the other I—J being at a signal location.

At each end of the stretch is a field station unit connected by the usual C. T. C. line with a control office (Fig. 1A) from which are transmitted control codes for selectively operating a traffic direction control relay at each of the field stations. The field stations, in turn, transmit certain indication codes to the control office when

conditions are proper, thereby informing the operator of the indications provided by the headblock signals and of the traffic conditions within the stretch. This C. T. C. apparatus, of itself, forms no part of my present invention and it is unnecessary to show this apparatus in detail, for an understanding of my invention. Reference may be had to Letters Patent of the United States No. 2,229,249, granted to L. V. Lewis on January 21, 1941, for a detailed description of a C. T. C. system such as can be used herein, and I have used the same reference numbers as are used in that patent to designate certain terminal wires of the field station unit which perform analogous functions.

The traffic lever 8 at the office controls traffic movement over the single track stretch. When in its right-hand or R position, this lever permits eastbound moves and when in its left-hand or L position, it permits westbound moves. The center position of the lever may be used to cause the track circuits to become deenergized. This lever will ordinarily be a part of the C. T. C. machine and when moved, initiates the transmission of a suitable control code over the C. T. C. line wires which extend throughout the territory controlled by the C. T. C. machine. As mentioned hereinbefore, this code causes selective response of certain traffic direction relays which condition the single track stretch for movement of traffic in the desired direction. The specific control for the traffic direction relays, whether manual, automatic or otherwise, is unimportant and may take numerous suitable forms, as required by the particular installation.

The basic operation of my system depends on the transmission of a master track circuit code over the track circuit and the transmission of a feed back code in the reverse direction over the track circuit during off intervals between impulses of the master code, if the track circuit is then unoccupied. This general type of operation is well known and is disclosed in Reissue Letters Patent of the United States No. 21,783, granted to Herman G. Blosser on April 29, 1941. In order to obtain proper selective response of the apparatus to each of these two codes, I employ current impulses of positive relative polarity for the master track circuit code, impulses of negative relative polarity being used for the feed back code.

With the apparatus in the condition in which it is illustrated, the last move having been eastbound, I shall assume that the operator wishes to reverse the traffic direction so as to permit a westbound train to enter the single track stretch. Since the last move is assumed to have been eastbound, the eastbound polarized track relays such as 6ETRA (having last responded to master code of positive relative polarity) have their contacts occupying the normal position, whereas the westbound polarized track relays such as 6WTRA were last energized on feed back code of negative relative polarity so that the latter relays have their contacts in the reverse position. To reverse the traffic direction, the operator will move lever 8 to its left-hand or L position so as to transmit a suitable code to cause energization of terminal 87 of the field station unit (Fig. 1A) and so to energize relay 8LFSR, assuming that relays 8RFR and 6RSR are both deenergized so that their back contacts 74 and 75 are both closed. These last two relays check that the stretch is normal and is unoccupied by an eastbound train, as will be described hereinafter. Once relay 8LFSR picks up, it closes a stick circuit for itself over its front contact 72 and the back contact 71 of relay WFB so that the traffic direction cannot be changed until relay WFB is subsequently picked up.

The pick-up of relay 8LFSR applies current of normal polarity coded at the 75 or 180 code rate according as the home relay 6LAH for signal 6L is deenergized, or energized, respectively, to the track section 6RT. This current comprises the master code and is applied to the track in the following manner. The pick-up of relay 8LFSR picks up relay 8LFSM over front contact 92 so that a coding circuit is established for the code repeating relay 6RTCTM which may be traced from wire 75B, back point of contact 11 of relay 6LAH, front contact 12 of relay 8LFSM, front point of contact 13 of relay 8LFSR, relay 6RTCTM, and front point of contact 14 of relay 8LFSR, to terminal C. The coding action of relay 6RTCTM, when relay 8LFSR is up, applies master track circuit code of positive relative polarity from the track battery TB over an obvious circuit which includes the coding contact 15 of relay 6RTCTM, front points of contacts 16 and 17 of relay 8LFSR, back contact 18 of relay 6RSR, and front contacts 19 and 20 of relays 6RKM and 5TR, respectively. Relay 6RSR is the stick relay for following moves, and relay 6RKM is the usual approach locking relay, 5TR being the track relay for section 5T.

This 75 code of positive polarity will be received at the cut section location E and will energize the polarized relay 6WTRA over an obvious circuit which includes the back point of contact 21 of relay 6WCTM. The polar contacts of relay 6WTRA will accordingly be reversed from the position shown and will become closed in the normal position so that the biased polar relay 6WTR will begin to respond to the master track circuit code. This response of relay 6WTR will occur only if the position of the polar contacts of relay 6WTRA corresponds with the polarity of the track circuit code being received as otherwise the armature of relay 6WTR would be held against the backstop in its deenergized position due to the biased polar characteristic of this relay. Relay 6EFB will remain deenergized because its circuit is interrupted at polar contact 22 of relay 6WTRA.

The code operation of contact 23 of relay 6WTR will cause code response of the code repeater relay 6ECTM by virtue of a circuit which includes the coding contact 23, normal contact 24 of relay 6WTRA, and back contacts 25 and 26 of relay 6EFB. Accordingly, master track circuit code of positive polarity will be repeated from section 6RT around the cut section location E and into section 6ART. The code supply circuit extends from battery TB, and includes the front point of contact 31 of coding relay 6ECTM and the back points of contacts 32 and 33 of relay 6EFB. This master code of positive polarity will be detected by relays 8WTRA and 8WTR at location F in the same manner as at location E and will be decoded in well-known manner by the decoding apparatus which includes the decoding transformer 8DT, the 75 and 180 code detecting relay 8WHR and the 180 code detecting relay 8WDR. Relay 8WTFSA is a slow acting repeater of the front contact 36 of relay 8WTR and controls the application of current to the decoding transformer 8DT over its front contact 37. If the code is 75 (as assumed), only relay 8WHR will be energized so that signal 8W will display a caution indication,

but if the code is 180, both relays 8WHR and 8WDR will be energized so that signal 8W will display a clear aspect.

The track circuit 8RT will be supplied with 180 master code of positive polarity because relay 8EFB will be deenergized and relay 8WHR will be energized, thus causing operation of relay 8ECTM on 180 code. The coding circuit for relay 8ECTM extends from the 180 code wire 180B, over the front point of contact 27 of relay 8WHR and the back points of contacts 28 and 29 of relay 8EFB, to the common source terminal C. The master track circuit code will be applied from battery TB over the front point of contact 30 of relay 8ECTM, back contacts 34 and 35 of relay 8EFB, and the winding of the approach relay 8WAR. The approach relay need be used only if it is desired to approach light the intermediate signal 8W as a means of conserving the energy of the signal lighting source. Receipt of 180 code of positive polarity at location G will energize the polarized relay 8AWTRA in a direction such that its polar contacts will reverse from the position shown, whereby relay 8AWTR will also follow 180 code, as previously explained in connection with locations E and F.

The section G—H is a short detector section necessitated by the presence of the track switch for the turnout at location H. No code is supplied to the track circuit AT of this section, but the control of the electric switch lock AW is accomplished in a novel manner by the apparatus embodying my invention and this control will be described hereinafter. For the present, it will be sufficient to state that relay ATWM will be energized when this detector section is unoccupied, so that a coding circuit will be established for repeating the code from section 8RT into the section 8ART, around the detector section.

Relay 8AECTM will accordingly follow 180 code supplied over coding contact 38 of relay 8AWTR, polar contact 39 of relay 8AWTRA, front contact 40 of relay ATWM, and back points of contacts 41 and 42 of relay 8AEFB. Relay 9WTR at location I will respond to the code delivered by relay 8AECTM, as before, and in so doing will repeat the code into section 10LT by virtue of the code operation of relay 9ECTM. The circuit for this relay is similar to that traced for relay 8AECTM and includes coding contact 43 of relay 9WTR, polar contact 44 of relay 9WTRA, front contact 45 of relay BTWM, and back points of contacts 46 and 47 of relay 9EFB. The short detector section BT is similar to the section AT and is necessitated by the presence of the track switch for the turnout at location J.

The 180 master code of normal relative polarity supplied to section 10LT over the front point of contact 48 of coding relay 9ECTM will operate relay 10LTR at the 180 code rate and so will cause an impulse output to be delivered from the decoding transformer 10DT for operating the slow acting relay 8LFR. The circuit for this relay extends over the rectifying contact 49 of relay 10LTR and polar contact 50 of relay 10LTRA. The pick-up of relay 8LFR will cause terminal 89 of the field station unit to become energized so that an indication code showing unoccupancy of the stretch will be transmitted to the control office. The coding action of decoding transformer 10DT will supply an impulse code from the transformer 10DT over the back contact 51 of relay 8RFSM and the back points of contacts 53 and 52 of relay 8RFSR, for operating the relay 10LTCTM. Operation of this relay will cause a

feed back code of negative relative polarity to be supplied from battery TB to the track circuit 10LT during the "off" intervals in the master track circuit code. The circuit for supplying this reverse or feed back code includes the front point of contact 54 of relay 10LTCTM, back points of contacts 55 and 56 of relay 8RFSR, back contact 57 of relay 10LSR, and front contacts 58 and 59 of relays 10LKM and 11TR, respectively. Thus feed back code will not be applied unless track circuit 11T is unoccupied and the entrance signal 10L is at stop. The stick relay 10LSR for signal 10L (indicated by back contact 57) performs the same function as relay 6RSR at location D and is controlled in an identical manner with that shown for the latter relay, over contacts of the corresponding relays associated with signal 10L. Accordingly, the control for relay 10LSR will be clear without a repeated showing in the drawing. Similarly, the approach locking stick relay 10LKM and track relay 11TR have been indicated merely by their contacts 58 and 59 which correspond with contacts 19 and 20 of relays 6RKM and 5TR. The purpose served by these contacts in checking the stop position of the headblock signal 10L and the unoccupancy of the approach section is so clear and well known that it is deemed unnecessary to complicate the disclosure by showing additional control circuits.

Continuing the description of feed back code transmission, at location J, the negative polarity feed back code will be received by relay 9ETRA which will now reverse its contacts from the position shown in the drawing, thus making it possible for the biased polar relay 9ETR to follow the impulses of the negative polarity code. Relay 9WFB will now become energized over polar contact 60 of relay 9ETRA in its reverse or right-hand position, and relay 9EHR will continue deenergized. The pick-up of relay 9WFB closes an impulse circuit for relay 9WCTM over the front points of contacts 61 and 62 and prepares a negative polarity feed back code track feed circuit over its front contacts 63 and 64 which circuit supplies the feed back code to section 8ART over the front point of contact 65 of relay 9WCTM. At location H, the negative polarity feed back code will reverse the polarized relay 8AETRA, so that relay 8AWFB will be picked up on the impulse output, over polar contact 66 of relay 8AETRA in its reverse position, front contact 67 of relay ATWM, and rectifying contact 68 of relay 8AETR. In an analogous manner, the pick-up of relay 8AWFB will cause impulse operation of relay 8AWCTM at location G and the supply of negative polarity feed back code to section 8RT over the front point of coding contact 69 of this relay.

Similarly, the negative polarity feed back code will be repeated into section 6ART through the pick-up of relay 8WFB, and into section 6RT through the pick-up of relay 6WFB. At location D, this negative feed back code will reverse relay 6RTRA and cause pick-up of the westbound block indicator relay WFB over polar contact 70 in its left-hand position. The pick-up of relay WFB will open the stick circuit for the westbound traffic direction relay 8LFSR at back contact 71, but this relay will not release because its other stick circuit which includes its own front contact 72, a circuit between terminals 88 and 87 of the field station unit (closed under the assumed condition), and back contacts 74 and 75 of relays 8RFR and 6RSR will be closed. However, a code can now be transmitted from the control office to

release relay 8LFSR. The pick-up of relay WFB causes the transmission of an indication code which lights the west-bound block indicator lamp WBK which indicates that the stretch in unoccupied and that the westbound headblock signal 10L is at stop, since feed back code has now been cascaded from the entrance to the exit end. Since relay 8LFR at location K is energized a control code may now be transmitted to the field station for clearing the headblock signal 10L so as to permit traffic to enter the stretch.

The clearing of signal 10L releases the approach locking stick relay 10LKM in the usual and well-known manner so that front contact 58 will open and will interrupt the supply of feed back code to the stretch. In consequence, relay WFB at location D will release, closing the stick circuit for relay 8LFSR at its back contact 71 (front contact 72 of 8LFSR now being closed) to maintain the established traffic direction, since relay 8LFSR cannot now be released by the operator without first restoring signal 10L to stop provided the stretch is still unoccupied. Accordingly, the absence of feed back code prevents cutting off the master code at location D, thus retaining the established traffic direction. Once the stretch is occupied, there is no possibility of the feed back code getting through to energize relay WFB at location D, so that the absence of feed back code provides traffic locking against a reversal of traffic by the operator, solely by means of track circuit apparatus and independently of any apparatus at the control office. Once the train clears the stretch, feed back code will get through, as will be described hereinafter, so that relay WFB will pick up, permitting a change in the traffic direction.

When relay 8LFSR is energized to apply master code to the single track stretch and the feed back code is being received to energize relay WFB at location D, there is a possibility that when relay 8LFSR is later deenergized following the completion of a traffic movement, the feed back code may operate relay 6RTCTM over the back points of contacts 13 and 14 of relay 8LFSR. Such undesired operation would ordinarily continue until interrupted manually. To prevent this condition, I employ a slow release repeater relay 8LFSM of relay 8 LFSR, interposing a back contact 76 of this relay into the feed back circuit for relay 6RTCTM. Relay 8LFSM should be sufficiently slow in releasing to permit the coding action to stop before the back contacts of this relay become closed.

I shall now assume that after the master track circuit code has been cascaded from the exit end D to the entrance end K and the headblock signal 10L has been cleared for a move in the westbound direction, a train enters the section 11T. The clearing of signal 10L will open the feed back code circuit at front contact 58 of relay 10LKM. When the train passes the signal and enters track section 11T the feed back circuit continues to be held open at contact 59 of relay 11TR. Subsequently, when section 10LT is occupied, the master code is shunted out and the code responsive apparatus at location K will cease operating. The feed back circuit will continue to remain open at back contact 57 of relay 10LSR which became energized when the train entered track section 11T with the home relay for signal 10LA or 10LB energized. The control or relay 10LSR is not shown as it is analogous to the control of relay 6RSR at location D. The master code will, however, remain effective in section 8ART and in the

remaining sections. Nothing significant will happen when the train enters the detector section BT except that the track relay BTR will release. When the train passes the intermediate signal 9W and enters section 8ART, however, the master code will be shunted so that the code responsive apparatus responding to the master code will be deenergized. Clearing of section 10 LT and the detector section BT by the train will re-introduce master code of the 75 code rate into section 10LT in the usual manner for a following westbound train. The apparatus for applying code to permit a following move is well known and is not shown in detail at location I. It is shown more complete at location F, however, and it will be obvious that when the train passes out of section 8RT, having picked up the directional stick relay 8WSR in the usual manner, 75 code will be applied to section 8RT because of the 75 code energization of relay 8ECTM over the front contact 93 of relay 8WSR, back point of contact 27 of relay 8WHR, and back points of contacts 28 and 29 of relay 8EFB.

The receipt of 75 code at location K will cause the deenergization of relay 10LSR in the usual manner so that feed back code will be applied to track section 10LT as hereinbefore described.

Nothing significant will happen as the train passes over the sections 6ART and 6RT (except that the master code will be shunted) until the train vacates the stretch completely. The westbound traffic direction relay 8LFSR will remain energized during occupancy, over its stick circuit which includes contacts 71 and 72 of relays WFB and 8LFSR, as pointed out before, so that the traffic direction will be retained until the train passes completely out of sections 6RT and 5T. Thereupon, the apparatus may be restored by the operator to its normally deenergized condition in which it is illustrated. This can be done by coding the signal 10L to stop, if clear, so that feed back code will be cascaded from location K to location D for energizing relay WFB at the latter location. Thereupon, the operator may send out a code for releasing the traffic relay 8LFSR. Release of this relay will discontinue the supply of master code at location D so that all of the coded track circuits of the stretch will become deenergized.

This system is arranged so that operation of the coded track circuit apparatus may be discontinued when their operation is not required. However, it is not essential that operation of the coded track circuit equipment be discontinued and if desired, after a train has passed through the stretch in either direction, the coded track circuit apparatus may be permitted to continue to operate with the entering head block signal held at stop so that master code energy is transmitted in one direction over the stretch and feedback energy is transmitted in the opposite direction over the stretch. While the deenergized condition is referred to as the normal condition it is obvious that the condition in which the coded track circuit apparatus is operating and the head block signal is at stop may also be considered to be the normal condition, and during such times coded energy is normally supplied in both directions over the rails of the track stretch.

Should the operator now desire to establish traffic in the eastbound direction, he will move lever 8 to the R position so as to transmit a code to the field station at location K to pick up the eastbound traffic direction relay 8RFSR and thereby initiate a cycle of operation which re-

sults in establishing the eastbound traffic direction over the stretch in a manner identical with that already described for westbound traffic. It will be clear, however, that relay 8RFSR may not be energized in an attempt to establish the eastbound traffic direction even though the lever is moved to the R position, if either or both relays 8LFR or 10LSR are energized as will be the case when the westbound traffic direction is effective in the stretch. Energization of relay 8LFR indicates that master code is being received at the westbound entrance end, whereas energization of relay 10LSR (which corresponds with relay 6RSR at the other end) indicates that the westbound train has accepted the entrance signal.

Referring now more particularly to the control of the electric switch locks for the manually operated track switches W1 and W2 at locations H and J, these switch locks are so controlled as to permit a train to enter the main track from the siding provided that the stretch is then unoccupied, or if occupied, the train is moving away from the switch and is beyond the next signal location. In order to permit a train from the siding to enter the main track when the stretch is already occupied, I provide a short track circuit AT and BT ahead of each switch lock for the release of the lock when the main track is occupied. When a train on the siding at location H, for example, is to enter the main track, an unlock of the electric switch lock AW may be secured provided that the stretch is either unoccupied or that a train is occupying a portion of the stretch between the switch W1 and the exit end such that master code can be supplied to the track section between the train and the switch location. Assuming westbound traffic, if the stretch is unoccupied, then master code will be effective in section 8RT for operating relay 8AWHR. Also, feed back code will be effective in section 8ART for operating relay 8AWFB. The same will also be true if a westbound train on the main track has completely vacated section 8RT because 75 master code will then be effective in this section so that if the operator codes signal 10L to stop, feed back code will be effective in section 8ART. Accordingly, relays 8AWHR and 8AWFB will again both be energized. Since relays 8AWFB and 8AWHR are both picked up, as previously explained, an operating circuit for electric switch lock AW will be completed over the front contacts 76 and 77 of these relays, and wires 78, 79, 80 and 81. A similar circuit for energizing the switch lock AW can be traced over front contacts 94 and 95 of relays 8AEFB and 8AEHR when traffic conditions are eastbound instead of westbound. Relay ATWM repeats the deenergized position of the switch lock (contact 83), the energized position of the track relay ATR for the short releasing track section AT (contact 84), and the manual time element release TER (contact 85). The operation of this apparatus which is associated with the electric switch lock AW as well as the operation of the switch lock BW at the signal location and its associated apparatus will be clear without further description.

The apparatus described above provides complete automatic control of the electric switch locks whereby all that is necessary to permit a train to leave a siding switch is to have the operator set up traffic in the direction in which it is desired to have the train proceed. In case the operator desires to have the siding train follow a train on the main track, then no action on the part of the operator is required to accomplish this result because an unlock will be automatically obtained. It will be apparent that the above means of control is not limited to the control of an electric switch lock, but is broadly useful for controlling any traffic governing device at a location intermediate the two ends of the stretch. Accordingly, although the short detector section AT is desirable in the case of control of a track switch, this detector section may be dispensed with and the sections 8RT and 8ART made to adjoin, in other applications of this means of control.

In Fig. 2, I have shown an alternative type of control for the switch lock AW at location H. This control is quite similar to that already described but includes a code controlled relay CCR under the control of the operator at the C. T. C. control office. By transmitting a suitable code, the operator can pick up relay CCR to close the front contact 86 whereby, if both the normal polarity master code and reverse polarity feed back code (as reflected by the energization of the westbound relay pair 8AWHR and 8AWFB or the eastbound relay pair 8AEHR and 8AEFB) are received at the switch lock location, the energizing circuit for the lock AW will be completed so as to permit an unlock of the switch.

From the foregoing it will be apparent that I have provided a safe, efficient and flexible normally deenergized system of signaling for a stretch of single track, two-direction railway, without requiring any control line wires except for the C. T. C. line circuit. By cascading the master code from the exit end to the entrance end and by cascading a feed back code in the reverse direction, I check unoccupancy of the stretch, establish traffic in a given direction, and permit the entrance signal to be cleared for passage of traffic in that direction. I am also able to retain the established traffic direction by means of the track circuits themselves without requiring inter-controls on the C. T. C. machine since clearing of the entrance signal or occupancy by a train cuts off the feed back code. This is an important advantage because in the case of locking obtained by inter-controls on the C. T. C. machine the unavoidable time lags between codes may permit interference with the established direction. By polarizing the master and feed back codes I render the system selective for the two directions and safe, and I also provide for automatic as well as manual operation of electric switch locks in a safe, simple and reliable manner.

Although I have herein shown and described only two forms of apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination with a stretch of track over which traffic may move in either direction, an eastbound and a westbound traffic direction control relay, means for selectively energizing said eastbound or said westbound direction control relay, means effective when said eastbound direction control relay is energized for transmitting rail current impulses of a master code from the eastbound exit end to the eastbound entrance end of the stretch, a code detecting relay adjacent said entrance end responsive to said master code and effective when energized for establish-

ing eastbound traffic, an eastbound directional stick relay adjacent said entrance end which becomes energized when an eastbound train enters said stretch, and means controlled by said code detecting relay and said directional stick relay when either relay is energized for preventing energization of said westbound traffic direction control relay to thereby prevent a reversal of said established traffic direction.

2. In combination, a section of railway track through which traffic may move in either direction between the first and the second end of the section, means effective when master code energy is received at the first end of the section to permit a first signal to be cleared to authorize traffic to enter said section at the first end thereof, means effective when master code energy is received at the first end of said section provided said first signal is at stop to supply impulses of feed-back energy to the section rails at the first end thereof, means effective when master code energy is received at the second end of the section to permit a second signal to be cleared to authorize traffic to enter said section at the second end thereof, means effective when master code energy is received at the second end of said section provided said second signal is at stop to supply impulses of feed-back energy to the section rails at the second end thereof, a first and a second directional relay each having contacts which normally occupy a first position, means operative when a train enters said section at the first end thereof for moving the contacts of said first directional relay to their second position and for maintaining them in their second position as long as said section is occupied, means operative when a train enters said section at the second end thereof for moving the contacts of said second directional relay to their second position and for maintaining them in their second position as long as said section is occupied, manually controlled means for supplying master code energy to the section rails at the first end thereof provided master code energy is not being received at the first end thereof and the contacts of said first directional relay are in their first position, means effective only when feed-back energy is being received over the section rails at the first end thereof for discontinuing the supply of master code energy to the section rails at the first end thereof, manually controlled means for supplying master code energy to the section rails at the second end thereof provided master code energy is not being received over the section rails at the second end thereof and the contacts of said second directional relay are in their first position, and means effective only when feed-back energy is being received over the section rails at the second end thereof for discontinuing the supply of master code energy to the section rails at the second end thereof.

3. In a coded track circuit signaling system for governing train movement over a stretch of track including an outlying switch, a switch lock for said switch, code responsive means responsive to the transmission of code pulses in both directions toward said switch for governing the release of said switch lock, means normally acting while the stretch is not occupied by a train for transmitting such code pulses in both directions toward said switch, and means responsive to the presence of a train adjacent the switch for independently governing the release of said switch lock, whereby the switch is locked by the approach of a train in either direction but may be released for a train to enter the switch when that train is adjacent the switch.

4. In a coded track circuit signaling system for a stretch of single track between the ends of passing sidings divided into a number of track sections, coding means for the respective track sections manually controlled from a distant control office for at times transmitting signal clearing code pulses in one direction over the track rails of the respective track sections and inverse code pulses in the opposite direction over the track rails of a plurality of said track sections in accordance with the direction of traffic manually established, means responsive to the presence of a train in one of said plurality of track sections for stopping transmission of said inverse code pulses in the adjoining track section ahead of such train, occupancy indicating means in said control office, and code responsive means for each end of said stretch energized by the inverse code pulses received at that end for governing said indicating means.

5. In a coded track circuit signaling system for single track railroads, a stretch of single track divided into track sections and having an outlying switch associated with one of said track sections, insulated joints in said one track section adjacent the facing point side of said switch, a code following track relay connected across the track rails of said track section on each side of said insulated joints, means normally acting while the stretch is not occupied for transmitting code pulses in both directions over the track rails of said track section, a switch lock for said switch, means effective only if both of said track relays are energized by code pulses transmitted in each direction toward said switch for governing the release of said switch lock, and release means responsive to the presence of a train adjacent said switch for independently governing the release of said switch lock.

6. In a coded track circuit signaling system for a stretch of track divided into track sections and having signals at intervals governing train movement in opposite directions into and through said stretch, an outlying switch associated with one of said track sections, insulated joints in said one track section adjacent the facing point side of said switch, a switch lock for said switch, means normally acting while the stretch is not occupied for transmitting code pulses over the track rails of said track section in both directions, means responsive to the reception of code pulses in both directions on opposite sides of said insulated joints for governing the release of said switch lock, and means effective only if a train shunts the track rails adjacent said insulated joints for independently governing the release of said switch lock, whereby the switch is locked by the approach of a train in either direction until that train comes within a predetermined distance of the switch.

7. In a coded track circuit signaling system for railroads, a stretch of track having a track section including an outlying track switch, code transmitting means normally acting to transmit code pulses over said track stretch in each direction toward said switch, means responsive to the entrance of a train into said stretch at either end for stopping transmission of code pulses in the corresponding direction in said track stretch toward said switch, code responsive means adjacent said switch responsive to the transmission of code pulses in both directions toward said switch, a switch lock for said switch, a lock relay

for governing the release of said switch lock, manually operable means for energizing said lock relay only if code pulses are being received by said code responsive means in both directions over said track stretch, and means effective while said lock relay is energized for preventing transmission of code pulses in either direction past said switch.

8. In a coded track circuit signaling system for single track railroads, a stretch of single track divided into track sections and having signals governing train movement into and through said stretch, one of said track sections including an outlying track switch, code transmitting and receiving means associated with each end of each track section and normally acting to provide code pulses at intervals in both directions of each track section, said means acting in response to the entrance of a train into said stretch at either end to stop transmission of code pulses in each track section toward the other end, a manually operable switch lock for said outlying switch, a lock relay acting when deenergized to prevent operation of said switch lock, code responsive means adjacent said switch responsive to transmission of code pulses in both directions toward said switch for governing the energization of said lock relay, and means effective while said lock relay is energized or said switch lock is in its unlocked position for preventing transmission of code pulses over the track rails of said track stretch past said switch in either direction.

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