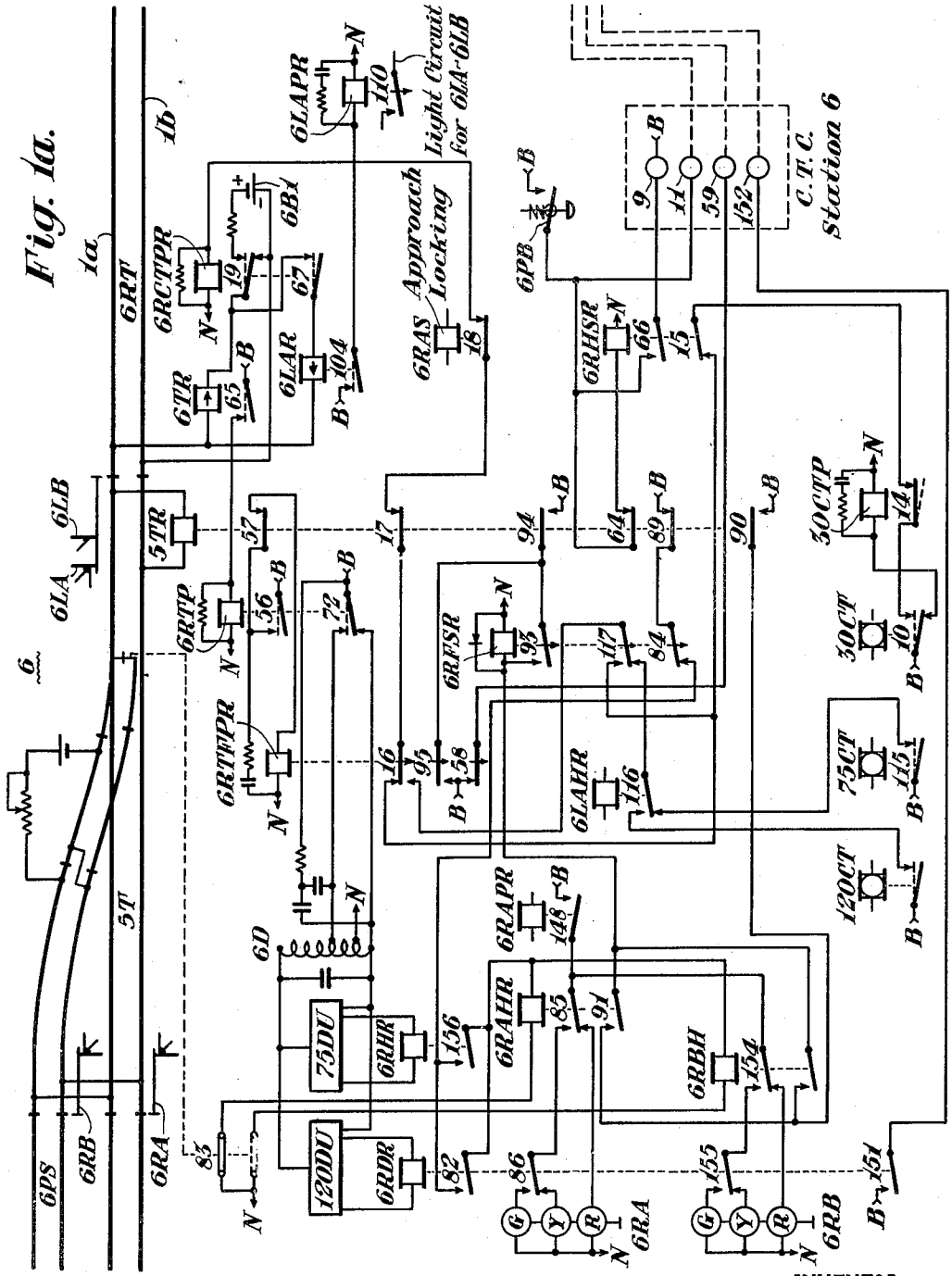
Dec. 27, 1955 C. B. SHIELDS 2,728,851

SINGLE TRACK RAILROAD SIGNAL SYSTEM
USING CODED TRACK CIRCUITS

Filed Aug. 22, 1951 6 Sheets-Sheet 1

Fig. 1a.



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SINGLE TRACK RAILROAD SIGNAL SYSTEM
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Filed Aug. 22, 1951 6 Sheets-Sheet 2

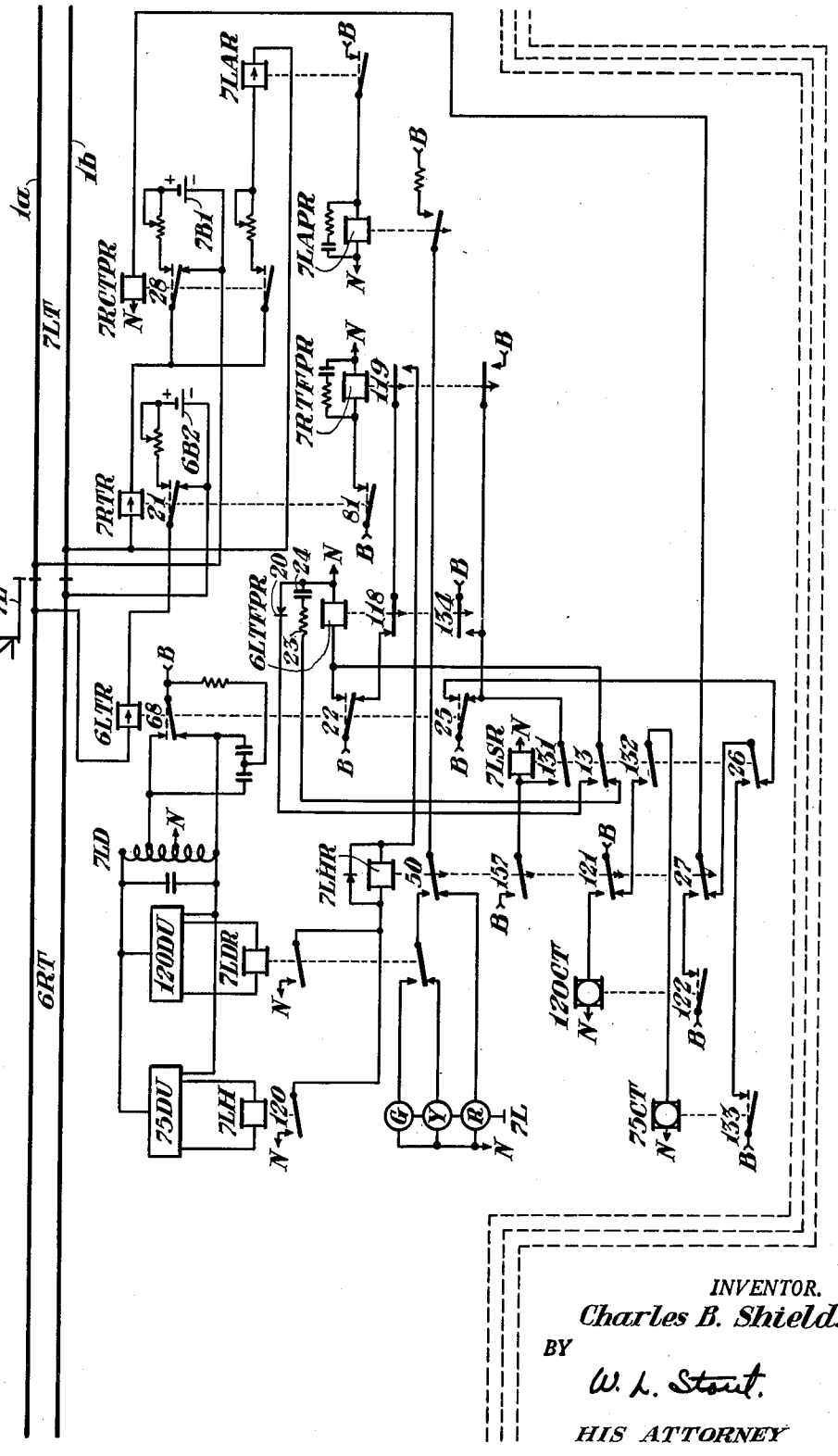


Fig. 1b.

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SINGLE TRACK RAILROAD SIGNAL SYSTEM
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Filed Aug. 22, 1951 6 Sheets-Sheet 3

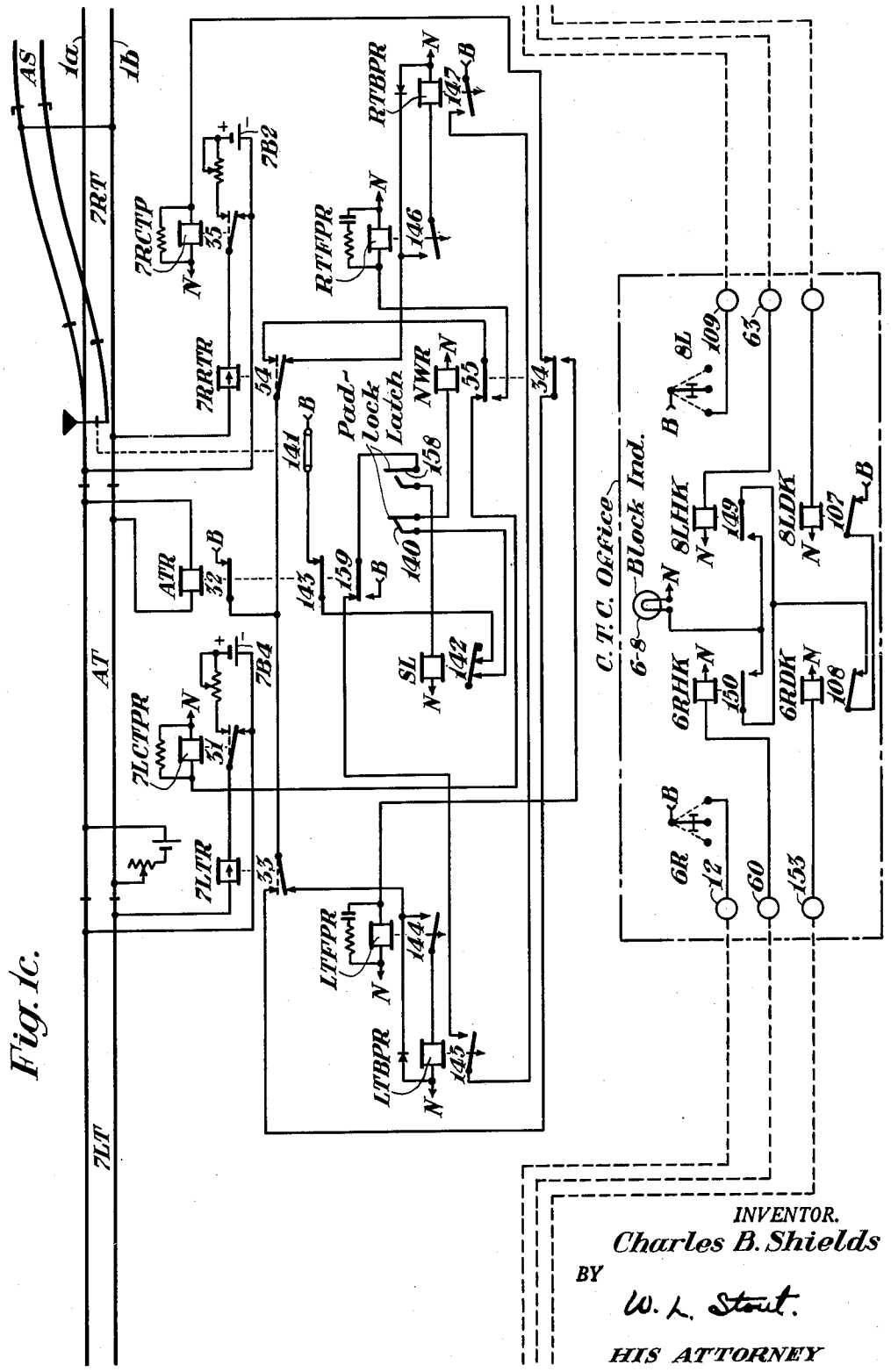


Fig. 1c.

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SINGLE TRACK RAILROAD SIGNAL SYSTEM
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Filed Aug. 22, 1951 6 Sheets-Sheet 4

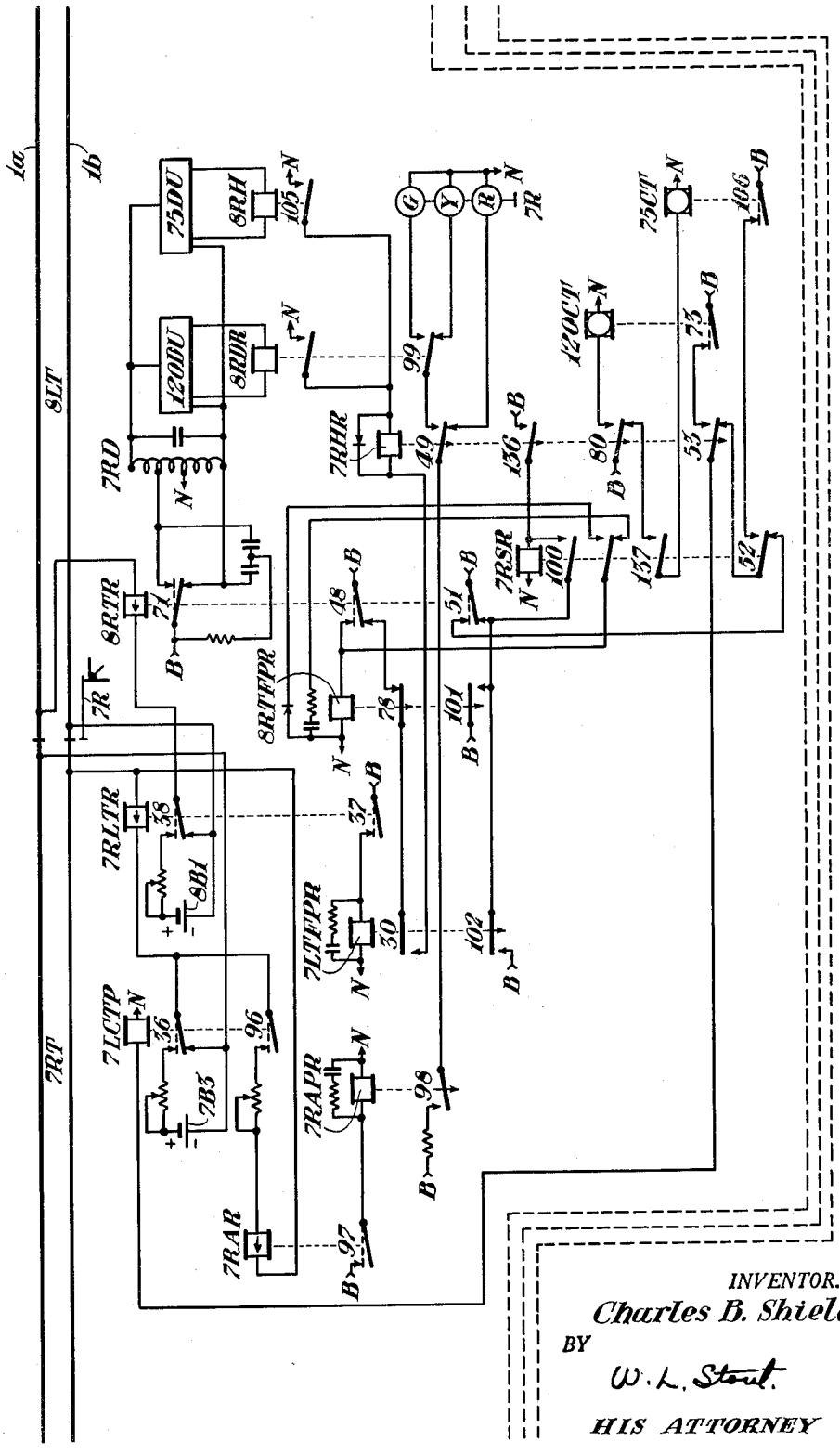


Fig. 1d.

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SINGLE TRACK RAILROAD SIGNAL SYSTEM
USING CODED TRACK CIRCUITS

Filed Aug. 22, 1951 6 Sheets-Sheet 5

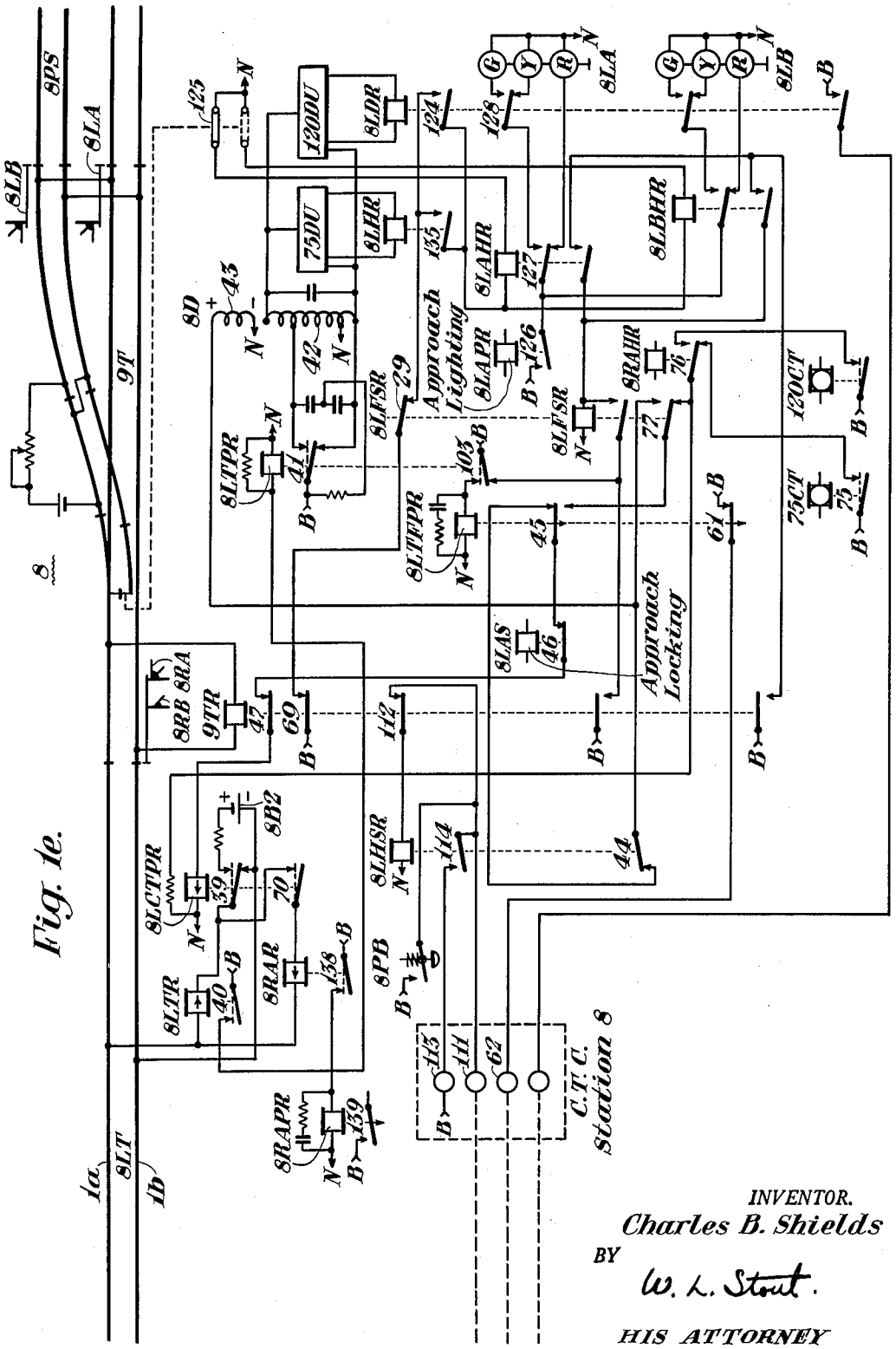


Fig. 1c.

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SINGLE TRACK RAILROAD SIGNAL SYSTEM
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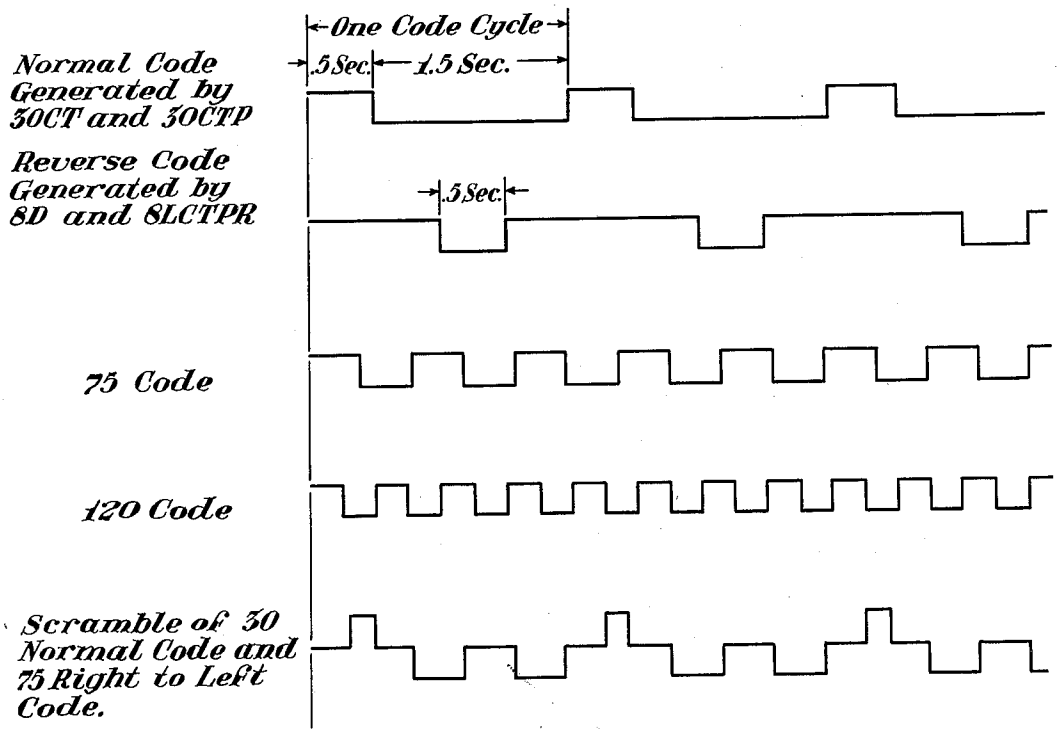


Fig. 2.

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2,728,851

SINGLE TRACK RAILROAD SIGNAL SYSTEM USING CODED TRACK CIRCUITS

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Application August 22, 1951, Serial No. 243,015

11 Claims. (Cl. 246—3)

My invention relates to a single track railroad signal system using coded track circuits. More specifically my invention relates to a two direction signal system of the above character which is subject to remote control.

An object of my invention is the provision of an improved normally energized code signal system for a single track railroad.

A further object of my invention is the provision of a single track two direction signal system incorporating normally energized coded track circuits which permit track circuits of the maximum permissible length.

Another feature of my invention is the provision of a signal system of the type here involved for a stretch of railroad commonly called a block incorporating novel means wherewith a block indicator is controlled when a train occupies the block or an obstruction or other fault occurs in the track anywhere within the block limits.

Again, a feature of my invention is the provision of a single track two direction signal system for a stretch of railroad incorporating improved means for concentrating at the entering end of the stretch all the controls for establishing the direction of traffic.

Still another feature of my invention is the provision of a single track two direction signal system for a stretch of railway incorporating an approach signal having at least three aspects in the approach to each leaving end of the stretch and arranged so that a following move can be made when the track circuit beyond an approach signal is occupied by a train moving in the same direction.

Another feature of my invention is the provision of a novel single track two direction signal system for a block which requires but a single remote control to be sent to the entrance end of the block to clear the signal to permit a train to enter the block.

Another feature of my invention is the provision of a signal system of the type here contemplated incorporating novel means which enable the direction of traffic in the block between two passing sidings to be established under emergency conditions, such as a failure of a line circuit of an associated remote control system.

Another feature of the invention is the provision of a railroad signal system of the type described having means for approach controlling the signals.

A further feature of my invention is the provision of a single track two direction signal system for a stretch of track incorporating novel means for obtaining the unlock of an electrically locked track switch at a track located intermediate the two ends of the stretch.

Other features, objects and advantages of my invention will appear as the specification progresses.

The foregoing objects, features and advantages of my invention I obtain by providing a signal system based on the principle that when a block or stretch of a single track railroad is normal, that is, not occupied by a train, current of a low code rate is sent from, say, the left-hand end of the stretch to the right-hand end, the current being cascaded through the track circuits the whole way through

the block. The code rate of this track circuit current is low and much lower than the code rates used to reflect different traffic conditions. At the right-hand end of the block, a reverse code of the low code rate is generated and is cascaded through the track circuits to the left-hand end of the block. Track occupancy detecting relays, one at each end of the block, are normally energized in response to these pulses of the low code rate and are used to provide an indication that the block is unoccupied. If a control for clearing a signal governing the entrance of a train into this block is sent, say, to the left-hand end, then the normal low code rate current is cut off and the detector relay at the right-hand end of the block is released and cuts off the reverse low code rate current. This operation allows current of either a 75 or 120 code rate to be sent through the track circuits from the right to the left, the code rates of 75 and 120 being used to reflect approach and clear traffic conditions, respectively. It is to be understood that the code rates of 75 and 120 are used by way of illustration and other code rates can be used.

The sending of either the 75 or 120 code current through the track circuits causes the corresponding aspect of the signal at the left-hand end of the block to be displayed. Similarly, if a control is sent to the right-hand end of the block the low reverse code for the track circuits is cut off and current pulses of either the 75 or the 120 code are supplied at the left-hand end and cascaded through the track circuits to clear the entering signal at the right-hand end of the block.

Slow acting detector relays are provided for each junction of the track circuits, one for each direction of traffic, and these relays are retained energized by the low code track circuit current and thus an obstruction or fault occuring in any track circuit will be at once reflected by the release of a corresponding detector relay for the corresponding section. No intermediate wayside signals are provided except an approach signal for each end and hence the direction of traffic can be established by a single control sent to the end of the block at which the train is to enter. These approach signals provide the usual three aspects, clear, approach, and stop and proceed, and a following move is permissible when the track section in advance of an approach signal is occupied by a train moving in the same direction.

To enable a track switch for a spur track at some intermediate point in the block to be electrically locked, I provide a short detector track circuit adjacent this switch and means for repeating the code of the track circuits around this detector track circuit. This detector track circuit is used to provide the usual control of an electric lock for the track switch.

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

Figs. 1*a* to 1*e*, inclusive, of the accompanying drawings when placed end to end with Fig. 1*a* at the left, are a schematic view showing one form of apparatus embodying my invention when applied to a single track railroad extending between two passing sidings and having an electrically locked track switch at an intermediate point. Fig. 2 is a diagrammatic view showing a series of graphs which illustrate the codes of the track circuit current under different conditions of the system.

Referring to the drawings, there is shown a stretch of single track railroad between passing sidings 6PS and 8PS, the two rails being identified by the reference characters 1*a* and 1*b*. This stretch of track is commonly referred to as a block and it will be so designated in the present application, and traffic moving through this block in either direction is under the control of wayside signals, leaving or block signals 6RA and 6RB, entering signals 6LA and

6LB and an approach signal 7L being provided for location 6 at the siding 6PS. Similarly, location 8 at the siding 8PS is provided with block signals 8LA and 8LB, entering signals 8RA and 8RB and an approach signal 7R. These wayside signals may be of any standard type and are illustrated as being color light signals.

This stretch of railway track is formed by the usual insulated rail joints into a series of consecutive track sections which comprise sections 5T, 6RT, 7LT, AT, 7RT, 8LT and 9T. The track sections 5T, AT and 9T are relatively short and the remaining sections are relatively long.

Each of the track sections is provided with a track circuit. The track circuits for the short detector sections 5T, AT and 9T are of the steady energized type and include a battery connected across the rails at one end of the section and a direct current track relay connected across the rails at the other end of the section as will be apparent by an inspection of the drawings. The track circuits for the remaining track sections 6RT, 7LT, 7RT and 8LT are of the direct current coded type. Each of these track circuits includes a battery, a polar bias code following relay and a code transmitting relay at each end of the section. These polar bias relays are of the well known type and it is sufficient for the present application to point out that these relays are provided with an armature that is biased to a released position closing a back contact. The armature is held in this released position when current flows in the winding of the relay in a reverse direction, and the armature is operated to a picked up position closing a front contact when current flows in the relay winding in a normal direction. In the drawings the direction of current flowing in the relay winding required to pick up the relay is indicated by an arrow placed on the relay winding. Each code transmitting relay is provided with a coding contact operable to a first and a second position.

It is to be pointed out that in addition to the track batteries provided, a source of current is also provided at each of the different locations and which source of current is preferably a direct current source, such as a battery, not shown, the positive and negative terminals of this source of power being indicated on the drawings by the reference characters B and N.

Referring to the coded track circuits, the circuits are normally supplied with current of low code rate and which code is cascaded from the left-hand end of the block to the right-hand end where a low rate reverse code is generated and cascaded back to the left-hand end of the block during the off code period of the normal code. To effect this low code track circuit current, a code transmitter or coder 30CT is provided at location 6. The code transmitter 30CT is constantly energized and operates to alternately close front and back contacts 10 at a low code rate which I shall assume as being 30 times per minute or one code cycle each two seconds. It is to be understood that other low codes of this order can be used. The coder 30CT completes at its back contact 10 a simple circuit for a slow releasing code repeater 30CTP, this code repeater being of the relay type which is made slow releasing by any of the well known arrangements. The coder 30CT and the repeater 30CTP by their action control a circuit for a code transmitting or coding relay 6RCTPR, the circuit including terminal B of the power source, front contact 10 of coder 30CT, front contact 14 of repeater 30CTP, back contact 15 of a remote controlled relay 6RHSR, front contact 16 of a block detector relay 6RTFPR, front contact 17 of track relay 5TR, front contact 18 of an approach locking relay 6RAS, winding of relay 6RCTPR and terminal N of the power source, these several control relays here mentioned being more fully referred to later. The code transmitting relay 6RCTPR when operated to close its front contact 19 connects a track battery 6B1 and a polar bias code following relay

6TR in series across the track rails of the associated track section 6RT, and when operated to close its back contact 19 disconnects the track battery 6B1 and connects the relay 6TR directly across the rails of the associated section. For reasons to appear hereinafter, a polar bias approach relay 6LAR is connected in multiple with the track relay 6TR over front contact 67 of the coding relay 6RCTPR. The battery 6B1 is poled for the pulse of current supplied to the rails to be of what I shall call normal polarity and it flows in the relay 6TR in the direction opposite to that indicated by the arrow and relay 6TR does not respond thereto. The approach relay 6LAR is connected for current of normal polarity supplied from battery 6B1 to flow therein in the direction to pick up this relay but the relay is adjusted so that it does not pick up at the magnitude of current ordinarily supplied and the relay is picked up only when the magnitude of the current is increased in a manner to be described later.

As stated hereinbefore, the code rate of the normal track circuit current is 30 pulses per minute or one code pulse every two seconds. The arrangement is such that the on code period of the pulse supplied to the section 6RT is substantially one-half second and the off code period is approximately one and one-half seconds, this normal code being illustrated at the top graph of Fig. 2.

This normal code pulse of track circuit current flows in the rails of section 6RT to the right-hand end of the section and flows in a connection including the winding of a polar bias code following relay 6LTR and back contact 21 of a polar bias code following relay 7RTR for the section next to the right. This pulse of track circuit current of normal polarity flows in the winding of relay 6LTR in the direction indicated by the arrow and that relay is picked up closing front contact 22 to complete a simple circuit for a slow release detector relay 6LTFPR. This relay is provided with slow releasing characteristics by short circuiting paths for its winding, and one of which paths includes a resistor 23, a capacitor 24 and back contact 13 of a relay 7LSR to be referred to later. This path is proportioned so that the relay is retained picked up as long as code pulses of the low code rate are recurrently supplied thereto.

For reasons which will be apparent when the operation of the apparatus is described, the slow release period for relay 6LTFPR is varied by disconnecting the path including resistor 23 and capacitor 24 and substituting a path which includes a rectifier 20. Similarly, other relays of the apparatus are provided with different slow release periods.

The operation of contact member 68 of the code following relay 6LTR causes current to be alternately supplied to two portions of the winding of a decoding transformer 7LD in a manner well understood and to which transformer two decoding units 120DU and 75DU are connected. The decoding units 120DU and 75DU are shown in a conventional manner since they are of a standard form and their specific structure forms no part of my present invention. It is sufficient for the present application to point out that the transformer 7LD and the associated decoding units 75DU and 120DU are tuned such that a relay 7LDR connected to the decoding unit 120DU is effectively energized only when the pulses of current supplied to the transformer 7LD are of a frequency corresponding to operation of the relay 6LTR at the 120 code rate.

Similarly, a relay 7LH connected to the output of the decoding unit 75DU is effectively energized and picked up only when the code pulses supplied to the transformer 7LD are of the 75 code rate. Consequently, operation of the relay 6LTR in response to the low code rate of 30 pulses per minute is ineffective to energize either relay 7LH or 7LDR. It is to be observed that other decoding transformers and associated decoding units which are provided at different places in the apparatus of my inven-

tion operate in the manner just described for the units controlled by the code following relay 6LTR.

The closing of front contact 25 of the code following relay 6LTR completes a circuit for a code transmitting or coding relay 7RCTPR for the next section 7LT, this circuit including the power terminal B, front contact 25 of relay 6LTR, back contacts 26 and 27 of signal control relays 7LSR and 7LHR, respectively, to be referred to later, winding of relay 7RCTPR and terminal N of the power source. Hence the coding relay 7RCTPR is operated in step with the code operation of the code following relay 6LTR, and with this coding relay thus operated there is supplied coded current from a battery 7B1 to the rails of the section 7LT due to the connection across the rails from battery 7B1 over front contact 28 of the relay 7RCTPR and winding of the polar bias code following relay 7RTR. Again, the battery 7B1 is poled for the pulse supplied to the section 7LT to be of normal polarity and the connection for the code following relay 7RTR is such that it does not respond to the code pulses of current of normal polarity.

This pulse of track circuit current flows in the rails of section 7LT and is received at the right-hand end of the section to flow in a connection including code following relay 7LTR and back contact 31 of a code transmitting or coding relay 7LCTPR associated with the section 7LT. This normal code pulse of track circuit current for section 7LT will be substantially that shown in the top graph of Fig. 2. That is, this pulse of track circuit current for the section 7LT is substantially in step with the pulse of track circuit current supplied to the section 6RT.

The relay 7LTR is connected so that it responds to the normal code pulse of track circuit current and the relay operates to control a coding relay 7RCTP and repeat the code in the track section 7RT to the right of the detector section AT providing the track section AT is unoccupied. To this end a circuit is provided that extends from terminal B through front contact 32 of track relay ATR for the section AT, front contact 33 of the code following relay 7LTR, front contact 34 of a relay NWR to be referred to later, and winding of coding relay 7RCTP to terminal N. The coding relay 7RCTP on picking up to close front contact 35, completes a connection for supplying a code pulse from battery 7B2 to the rails of section 7RT, the connection being completed through the winding of polar bias code following relay 7RRTR. The battery 7B2 is poled for the current supplied to the section 7RT to be of normal polarity and the connections of the relay 7RRTR are such that it does not respond to this pulse of normal polarity.

The pulse flows in the rails and is received at the right-hand end of the section 7RT to flow in a connection including the winding of the polar bias code following relay 7RLTR and back contact 36 of a code transmitting or coding relay 7LCTP associated with the section 8LT, the current flowing in the relay 7RLTR in the direction to pick up that relay. With relay 7RLTR picked up closing front contact 37, a simple circuit is completed for energizing a slow releasing detector relay 7LTFPR and that relay is picked up and then retained energized as long as code pulses of this low code rate are received.

When the code following relay 7RLTR is picked up closing its front contact 38, it completes a connection by which current is supplied from battery 8B1 to the rails of section 8LT, the connection including the winding of a polar bias code following relay 8RTR. Again, the battery 8B1 is poled to supply pulses of normal polarity and the connections of relay 8RTR are such that it does not respond to code pulses of energy of normal polarity.

At the right-hand end of the section 8LT, the normal code pulse is received by a connection including the winding of a polar bias code following relay 8LTR and back contact 39 of a code transmitting or coding relay 8LCTPR, the current flowing in the winding of the relay 8LTR in the direction proper to pick up that relay. When the relay 8LTR is picked up closing front contact 40, it completes a simple circuit for a repeater relay 8LTPR and that relay is operated in step with the code following relay 8LTR.

The relay 8LTPR completes at its front contact 103 a simple circuit for a slow release block detector relay 8LTFPR and this detector relay is retained picked up as long as relay 8LTPR is code operated. The repeater relay 8LTPR in operating its contact member 41 causes current pulses to be supplied to the primary winding 42 of a decoding transformer 8D, to which winding there is connected decoding units 75DU and 120DU, but neither of these units responds to the low code rate of the normal track circuit pulses because they are tuned to resonance at frequencies corresponding to current pulses of the 75 and 120 code rates, respectively.

The decoding transformer 8D is also used as a code pulse generating means and is provided with a secondary winding 43, in which voltages are induced in response to the current pulses supplied to winding 42 due to the code operation of the relay 8LTPR, the induced voltage being of, say, normal polarity when the relay 8LTPR is picked up and being of reverse polarity when the relay 8LTPR is released. The winding 43 is included in a circuit extending from the upper terminal of the winding 43 through back contact 44 of a remote controlled relay 8LHSR, front contact 45 of block detector relay 8LTFPR, front contact 46 of an approach locking relay 8LAS, front contact 47 of track relay 9TR for the section 9T, winding of coding relay 8LCTPR and thence to the lower terminal of the winding 43 through the common connection N. The coding relay 8LCTPR is of the polar bias type and it is connected so that it responds to the polarity of the voltage induced in the winding 43 only when the code repeater relay 8LTPR is released.

With the coding relay 8LCTPR picked up closing its front contact 39, a connection is completed by which a pulse of current is supplied from the battery 8B2 to the rails of section 8LT, the connection including the winding of polar bias code following relay 8LTR, which, as pointed out above, is connected to respond to the normal code pulse of track circuit current.

The battery 8B2 is poled for the current supplied therefrom to the section 8LT in response to operation of relay 8LCTPR by the voltage induced in winding 43, to be of the polarity reverse to the normal polarity of the normal code pulses cascaded through the track sections in the manner just described. Thus the relay 8LTR does not pick up in response to the reverse pulse supplied from battery 8B2.

A polar bias approach relay 8RAR and front contact 70 of the coding relay 8LCTPR from a path in multiple with the code following relay 8LTR and the current pulse of reverse polarity supplied from battery 8B2 to the rails in the manner just described flows in the approach relay 8RAR in a direction to pick up that relay but the relay is proportioned so that the magnitude of the portion of the pulse of current flowing therein is insufficient to pick up the relay except under conditions to be explained hereinafter.

Furthermore, the coding relay 8LCTPR is operated by the induced voltage in the winding 43 in such a manner and for a period such that the reverse pulse of track circuit current supplied when the relay is picked up closing front contact 39 is of substantially one-half second or one-fourth of the code cycle of the low code rate of the track circuit current. This reverse code generated at the location 8 is illustrated in the second graph from the top of Fig. 2.

This reverse code pulse flows in the rails of the section 8LT and at the left-hand end of the section it flows in a connection which includes the winding of the polar bias code following relay 8RTR and back contact 38 of relay 7RLTR, the current flowing in the relay 8RTR in the

direction proper to pick up that relay. The picking up of the relay 8RTR closing front contact 43 completes a simple circuit by which current is supplied to a slow releasing detector relay 8RTFPR and that relay is picked up and retained picked up as long as code pulses of the low code rate are received. The relay 8RTFPR is provided with different slow release periods by paths connected across its winding in a manner similar to relay 6LTFPR at the location of signal 7L.

Operation of the contact member 71 of the relay 8RTR completes a connection by which current is supplied to a decoding transformer 7RD to which 75DU and 120DU decoding units are connected by these units do not respond to operation of the relay 8RTR by the low code rate of the current pulses due to the tuning of the units.

The closing of front contact 51 of the code following relay 8RTR completes a circuit for energizing coding relay 7LCTP, the circuit extending from terminal B through front contact 51 of relay 8RTR, back contact 52 of signal control relay 7RSR, back contact 53 of a signal control relay 7RHR, and winding of coding relay 7LCTP to terminal N. This pulse of current causes the coding relay 7LCTP to pick up during the on code period of the reverse code and completes at its front contact 36 a connection by which a pulse of current is supplied from battery 7B3 to the rails of the section 7RT, the connection including the winding of relay 7RLTR. The battery 7B3 is poled to supply current of the reverse polarity to which the relay 7RLTR does not respond.

A polar bias approach relay 7RAR is connected in multiple with the winding of relay 7RLTR through a front contact 96 of the coding relay 7LCTP and the portion of current that flows in the approach relay 7RAR flows in the direction proper to pick up that relay but the magnitude of the current is sufficient to pick up this relay only under certain traffic conditions to be described hereinafter.

This reverse code pulse of current supplied to the section 7RT is received at the left-hand end of the section by the connection including the bias polar code following relay 7RRTR and back contact 35 of the coding relay 7RCTP, the current flowing in the relay 7RRTR in a direction proper to pick up that relay. Code operation of the relay 7RRTR functions to repeat the reverse code in the track circuit of section 7LT through coding relay 7LCTPR, this latter relay being controlled by a circuit that includes terminal B, front contact 32 of relay ATR for the section AT, front contact 54 of the code following relay 7RRTR, front contact 55 of relay NWR, winding of relay 7LCTPR and terminal N. When the coding relay 7LCTPR picks up closing front contact 31, the track battery 7B4 is connected across the rails of section 7LT through the winding of polar bias code following relay 7LTR. The battery 7B4 is poled for the reverse code pulse supplied to the track circuit section of 7LT to be of the reverse polarity to which the relay 7LTR does not respond. This reverse code pulse of current is received at the left-hand end of the section 7LT and flows in the connection including code following relay 7RTR and back contact 28 of the code transmitting relay 7RCTPR and the current flows in the code following relay 7RTR in the direction to pick up the relay. When relay 7RTR is picked up closing its front contact 81 a simple circuit is completed for a slow release detector relay 7RTFPR which is retained picked up as long as the relay 7RTR is operated at code. When the relay 7RTR picks up closing front contact 21 a connection is completed by which current flows from battery 6B2 to the rails of the section 6RT through the winding of the code following relay 6LTR. The battery 6B2 is poled to supply current of the reverse polarity to which the relay 6LTR does not respond.

This reverse code pulse supplied to the right-hand end of the section 6RT is received at the left-hand end of the section and flows through the connection including relay 6TR and back contact 19 of the coding relay 6RCTPR and the current flows in the winding of relay 6TR in the direction proper to pick up the relay. During the on code period of this code pulse when the relay 6TR is picked up closing front contact 65, a simple circuit is completed for energizing a repeater relay 6RTP and that relay is operated to follow the code operation of the relay 6TR.

Operation of the repeater relay 6RTP closing its front contact 56 completes a simple circuit by which current is supplied to a slow release block detector relay 6RTFPR, the connection being completed through front contact 57 of the track relay 5TR as will be apparent by an inspection of the drawing. Thus, the block detector relay 6RTFPR is retained picked up as long as reverse code pulses are received at location 6 to indicate that the block is clear. Furthermore, operation of the relay 6RTP to operate its contact member 72 causes pulses of current to be supplied to a decoding transformer 6D to which two decoding units 75DU and 120DU are connected but these units are tuned to respond to code operation of the relay 6RTP at the 75 and 120 code rates, respectively, and are nonresponsive to the low code rate of the reverse code.

It follows from the above description of the normal track circuits for the block between the passing sidings 6PS and 8PS, that the coder 30CT and its associated repeater function to supply a normal pulse of a low code rate of 30 pulses per minute to the left-hand end of the block. This normal code pulse which has an on code period of approximately one-half second out of every two seconds is of normal polarity and is cascaded from the location 6 at the left-hand end of the block to the location 8 at the right-hand end of the block to operate a block detector relay 8LTFPR and also to cause the decoding transformer 8D and an associated coding relay 8LCTPR to generate a reverse code which had an on code period of approximately one-half second. This reverse code pulse is of reverse polarity and is cascaded through the track circuits back to the location 6 where it is effective to energize block detector relay 6RTFPR, these two detector relays being retained energized as long as pulses of current of the 30 code rate are supplied to the track circuits. Also, the two slow release relays 6LTFPR and 7RTFPR at the location of signal 7L and the two slow release relays 7LTFPR and 8RTFPR at the location of signal 7R are retained energized in response to the coded track circuit current, these relays at these two signal locations serving as directional detector relays as will appear shortly. Also, at the location of the spur track AS the normal and reverse codes are repeated as long as the detector track section AT is unoccupied and the corresponding track relay ATR is picked up.

At the location 6, the block detector relay 6RTFPR when energized closing front contact 58, completes a connection by which power from positive terminal B is connected to a terminal 59 of a field station 6 of an associated centralized traffic control system. In response to energy on terminal 59, an indication is sent from the field station 6 to a central office of such centralized traffic control system causing positive energy to appear at a terminal 69, the relationship being indicated by a dotted line. An indication relay 6RHK is connected to terminal 69 and is energized to indicate at the office the cascading of the reverse code pulses through the track circuits of this stretch of railway track. Similarly, at location 8 the block detector relay 8LTFPR when picked up closing front contact 61 completes a connection by which positive energy is placed on a terminal 62 of field station 8 of the centralized traffic control system and as indicated by a dotted line, an indication is sent from that field station through the centralized traffic control system to the office causing energy to be applied to a terminal 63 of the office and to which terminal an indication relay 8LHK is connected with the result this relay is energized and provides an indication that the normal code pulses are cascaded through the track circuits of the stretch of track. In accordance with the usual custom in such centralized traffic control system, these

two relays 6RHK and 8LHK are used to control an indication light to be referred to shortly, for indicating the condition of the block between the locations 6 and 8.

The centralized traffic control system is shown only conventionally because it can be any one of several known arrangements and the specific type of system used forms no part of my present invention.

I shall next describe the operation of the apparatus to clear a signal to permit a train to move through the block. I shall further consider that the signal 6RA at the left-hand end of the block is to be cleared to permit a train to move from left to right through the block.

To clear the signal 6RA to enable the train to move into the block, a control from the office of the centralized traffic control system is sent to field station 6 through the centralized traffic control system, this control being initiated by placing a lever 6R at the office to the right as viewed in the drawing so that positive energy is applied to a terminal 12. As indicated by a dotted line, energy applied to terminal 12 serves to cause a corresponding control voltage to appear at a terminal 11 of the field station 6 of the centralized traffic control system. With positive energy made to appear at terminal 11, the relay 6RHSR is energized by a pickup circuit that includes terminal 11 and front contact 64 of the track relay 5TR. Then, with the relay 6RHSR picked up, it is retained energized by a stick circuit that includes a terminal 9 of the centralized traffic control system, its own front contact 66, and front contact 64 of track relay 5TR.

With the relay 6RHSR picked up in response to this remote control, the opening of back contact 15 of the relay opens the circuit by which the coding relay 6RCTPR is energized and this relay ceases to be operated at the 30 code rate and the supply of normal code pulses to the track circuit of the section 6RT is discontinued. This discontinuing of the supply of the normal code pulses to the track circuit of section 6RT is reflected through the block and at location 8 the block detector relay 8LTFPR is deenergized and released at the end of its slow release period. The opening of front contact 45 of the detector relay 8LTFPR interrupts the circuit by which the induced voltages from winding 43 of the decoding transformer 8D are supplied to the coding relay 8LTCPR and that relay ceases to be operated with the result the reverse code pulses are no longer supplied to the track circuit for the section 8LT. This discontinuing of the reverse code pulse is reflected through the block and at location 6 the detector relay 6RTFPR is no longer energized and is released at the end of its slow release period. It follows that the directional relays 6LTFPR and 7RTFPR at the location of signal 7L and the directional relays 7LTFPR and 8RTFPR at the location of sign 7R are also deenergized and released when the supply of 30 code track circuit current is cut off.

At location 8 the deenergizing of the relay 8LTFPR due to the discontinuing of the normal 30 code track circuit current causes a circuit to be completed by which coded track circuit current of the 75 or 120 code rate is supplied to the track circuit of section 8LT. At location 8 two code transmitters or coders 75CT and 120CT are provided and are constantly operated. Also, there is provided a traffic controlled relay 8RAHR which is associated with the signal 8RA and controlled by traffic conditions to the right of location 8 by means not shown but which would be in accordance with standard practice. This relay 8RAHR governs a circuit by which either the coder 75CT or 120CT is selected for operating the code transmitting relay 8LCTPR. Assuming that the relay 8RAHR is released and the signal 8RA is at stop, the back contact 76 of relay 8RAHR completes a circuit extending from terminal B through contact 75 of the coder 75CT, back contact 76 of relay 8RAHR, back contact 77 of a signal control relay 8LFSR for signal 8RA, back contact 45 of detector relay 8LTFPR, front contact 46 of approach locking relay 8LAS at location 8, front contact 47 of track relay 9TR and winding of coding relay 8LCTPR to terminal N. Hence the coding relay 8LCTPR is now operated at the 75 code rate and current pulses from battery 8B2 to the track circuit of section 8LT are supplied at the 75 code rate due to the operation of contact 39 of the code transmitting relay. The polarity of the code pulses supplied to the track circuit of section 8LT is of the reverse polarity the same as the reverse code pulses of the 30 code rate. The track circuit current of the 75 code rate is illustrated by the third graph from the top in Fig. 2. It follows that the code following relay 8LTR does not respond but the code following relay 8RTR at the left-hand end of the section 8LT is operated at this 75 code rate. This code operation of relay 8RTR causes the directional relay 8RTFPR to be energized each time the front contact 43 of the relay 8RTR is closed so that the directional relay is picked up and retained energized due to its slow release characteristic. Also, operation of the relay 8RTR at the 75 code rate causes the relay 8RH connected to the 75DU decoding unit to be picked up. Since the directional relay 7LTFPR is now released a circuit is formed for signal control relay 7RHR, the circuit extending from terminal B through back contact 43 of code following relay 8RTR, front contact 78 of relay 8RTFPR, back contact 30 of relay 7LTFPR, winding of relay 7RHR, and front contact 105 of relay 8RH to terminal N. The relay 7RHR is provided with slow release characteristics and it is picked up and remains picked up closing its front contacts in response to the track circuit current of the 75 code rate supplied to the section 8LT. The closing of front contact 49 of the relay 7RHR prepares a circuit for operating the signal 7R this circuit to be described hereinafter. The closing of front contact 80 of the relay 7RHR completes a simple circuit by which a 120CT code transmitter provided at the location of signal 7R is energized and it operates its contact member 73 at the 120 code rate. The coding relay 7LCTP is now provided with a circuit completed through front contact 73 of the 120CT coder and front contact 53 of the signal control relay 7RHR. With the coding relay 7LCTP operated at the 120 code rate, current impulses of the corresponding code rate are supplied from the battery 7B3 to the track circuit of the section 7RT through the connection which includes the winding of the code following relay 7RLTR. These current pulses are of the reverse polarity the same as the reverse current pulses of the 30 code rate supplied from battery 7B3. The code pulses of the 120 code rate are illustrated by the graph fourth from the top of Fig. 2. It follows that relay 7RLTR is not picked up by this track circuit current of the 120 code rate supplied from battery 7B3, but that these track circuit current pulses of the 120 code rate thus supplied to the section 7RT flow in the connection including the code following relay 7RRTR in a direction to operate that relay and that relay is operated at the 120 code to repeat the code in the track circuit for the section 7LT. That is, operation of the relay 7RRTR causes the coding relay 7LCTPR to be operated at a corresponding code due to the circuit previously traced and which includes the front contact 32 of track relay ATR and front contact 54 of relay 7RRTR. Operation of the relay 7LCTPR at the 120 code rate causes a corresponding code rate of current pulses to be supplied from battery 7B4 to the track circuit for section 7LT, the connection including the winding of code following relay 7LTR but which relay does not respond to the polarity of these code pulses because the battery 7B4 is poled to supply current of the reverse polarity. At the left-hand end of the section 7LT, the coded current supplied to that section causes the relay 7RTR to be operated at the 120 code and in turn this relay causes code pulses of the 120 code rate and reverse polarity to be supplied from track battery

6B2 to the track circuit for the section 6RT, the connection including front contact 21 of relay 7RTR and the winding of the relay 6LTR, which latter relay is non-responsive to current of this polarity. Furthermore, the closing of front contact 81 of relay 7RTR completes the circuit for detector relay 7RTFPR and that relay is picked up. The coded current thus supplied to the track circuit of section 6RT causes the relay 6TR to be operated at the corresponding code and in turn the repeater relay 6RTP is correspondingly operated. Operation of the repeater relay 6RTP to operate its contact member 72 supplies current pulses to the decoding transformer 6D at a corresponding code and the coding unit 120DU is effectively energized to cause the relay 6RDR connected with that decoding unit to be energized and picked up. The picking up of the relay 6RDR closing front contact 82 completes a circuit by which a signal control relay 6RAHR is energized and which circuit can be traced from terminal B through front contact 89 of track relay 5TR, back contact 84 of relay 6RFSR, front contact 82 of relay 6RDR, winding of relay 6RAHR, and to terminal N through a contact 83 operated by the track switch of siding 6PS and closed when the switch is set for the main track.

When the relay 6RAHR is picked up closing front contact 85 and the relay 6RDR is energized closing front contact 86, a circuit is completed for the green light G of the signal 6RA and that lamp is illuminated to cause the signal 6RA to display a clear signal indication, the circuit being completed from terminal B through front contact 148 of an approach control relay 6RAPR, front contact 85 of relay, 6RAHR, front contact 86 of relay 6RDR and lamp G of signal 6RA to terminal N. The relay 6RAPR is associated with signals 6RA and 6RB and it is approach controlled in any of the well known arrangements not shown.

In the event a train is to move from the passing siding 6PS instead of from the main track into the block and the track switch is reversed so that the contact 83 occupies the position indicated by dotted lines, the relay 6RBH is selected in response to the energizing of the relay 6RDR and with relay 6RBH picked up closing its front contact 154, a circuit is completed through the front contact 155 of relay 6RDR, for the green light G of signal 6RB and that light is illuminated for the signal 6RB to display a clear indication for the train on the siding to move into the block.

Assuming, however, that the signal 6RA has been cleared for a train to move into the block and the train accepts the signal to enter the section 5T. The shunting of the track relay 5TR opens the front contact 89 of relay 5TR over which the signal relay 6RAHR is controlled and thus the signal 6RA is set to display its stop indication. Subsequent to the release of the track relay 5TR and prior to the release of the signal control relay 6RAHR, a pickup circuit is formed for the stick relay 6RFSR and that relay is picked up, the circuit including back contact 90 of the relay 5TR and front contact 91 of the relay 6RAHR. The relay 6RFSR is then retained energized by a stick circuit including its own front contact 93 and a back contact 94 of the track relay 5TR. The release of track relay 5TR opening its front contact 64 opens the circuit for the remote controlled relay 6RHSR and that relay is released. Furthermore, the opening of front contacts 17 and 57 of the track relay 5TR prevents operation of the code transmitting relay 6RCTPR, and the energization of block detector relay 6RTFPR.

When the train enters the section 6RT and the code following relay 6TR is shunted and it ceases operation with the result that the repeater relay 6RTP ceases to operate and the relay 6RDR is deenergized.

When the train clears the track section 5T and the track relay 5TR is reenergized and picked up, the stick relay 6RFSR is retained energized by a stick circuit which is now completed over a back contact 95 of the block detector relay 6RTFPR. This results in the coding relay 6RCTPR being operated at the low code rate due to a circuit extending from terminal B through front contact 10 of coder 30CT, front contact 14 of repeater 30CTP, back contact 15 of relay 6RHSR, front contact 117 of stick relay 6RFSR, back contact 16 of relay 6RTFPR, front contact 17 of relay 5TR, front contact 18 of relay 6RAS and winding of the coding relay 6RCTPR to terminal N. This means that normal pulses of the 30 code rate are supplied to the rails of section 6RT behind the train.

When a train advances to the right and enters the section 7LT, the code following relay 7RTR is shunted and ceases to operate so that the code pulses of the 120 code rate supplied to the section 6RT are discontinued. Also, the slow release directional relay 7RTFPR is deenergized and releases at the end of its slow release period. This makes no change in the condition of the apparatus at location 6 but the relay 6LTR at the right-hand end of the section 6RT is operated at the low code rate due to the code pulses supplied to the track circuit at the left-hand end of the section 6RT when the train vacates the section 6RT. With the relay 6LTR operated at the low code rate, the code transmitting relay 7RCTPR is operated at the corresponding code rate due to the circuit previously traced. Thus there are supplied to the rails of the section 7LT behind the train normal current pulses of the low code rate from the battery 7B1. Also the detector relay 6LTFPR is picked up in response to operation of relay 6LTR.

When the train enters the section AT at the track AS to shunt track relay ATR, that relay is released to open its front contact 32 and disconnect the circuit by which the coding relay 7LCTPR is being operated so that code pulses of the 120 code rate supplied to the right-hand end of section 7LT are discontinued. With the train advancing to vacate the section 7LT the code following relay 7LTR is operated in response to the normal code pulses supplied to the left-hand end of section 7LT and that relay is operated at the low code rate. This operation of the code following relay 7LTR causes the coding relay 7RCTP to be correspondingly operated and code pulses from battery 7B2 are supplied to the rails of the section 7RT when the train advances to the right to vacate the section AT. Thus normal code pulses of the low 30 code rate are supplied to the section 7RT behind the train.

As soon as the head end of the train advances into the section 7RT, the track relay 7RRTR is shunted and the circuit for the coding relay 7LCTPR is opened at front contact 54 of relay 7RRTR and the repeating of the 120 code in the section 7LT continues to be discontinued. It follows that there is no change in the condition of the apparatus at location 6 as the train passes into the section 7RT.

As the train moves to the right and advances to a given distance, say, a distance of the order of 4000 feet from signal 7R, the magnitude of the code pulses supplied to the section 7RT due to the operation of the code transmitting relay 7LCTP is increased because of the shunting of the impedance of the track rails by the train and the portion of the energy supplied to the winding of the approach relay 7RAR becomes large enough to effectively energize this relay and it begins to be operated at the 120 code rate. This operation of the approach relay 7RAR to recurrently close its front contact 97 permits energy to be supplied to the slow release relay 7RAPR and that relay is picked up and retained picked up from one code pulse to the next. With the relay 7RAPR picked up closing front contact 98, the circuit is completed for illuminating the lamps of the signal 7R, this circuit extending from terminal B through front contact 98 of relay 7RAPR, front contact 49 of relay 7RHR, back contact 99 of relay 8RDR, the yellow light Y of signal 7R and terminal N. Consequently, the signal 7R is

now illuminated to display an approach indication to the train moving to the right.

When this train has passed signal 7R into the section 8LT, the code following relay 8RTR is shunted and it ceases to be operated by the code pulses supplied to the section 8LT at location 8. The relay 8RTR not following code, the detector relay 8RTFPR is deenergized and releases to open its front contact 78 at the end of its slow release period. This causes the relay 7RHR to be released and the circuit for the red lamp R for the signal 7R is completed at back contact 49 of relay 7RHR, and that lamp is illuminated causing signal 7R to display a stop and proceed indication.

When the relay 7RHR was first energized to operate the signal 7R, the closing of front contact 136 of relay 7RHR completed a pickup circuit for stick relay 7RSR and this stick relay 7RSR is retained energized and in the picked up position subsequent to the train entering the section 8LT to deenergize the relay 7RHR due to a stick circuit being completed through its own front contact 100 and three multiple paths including back contact 101 of relay 8RTFPR, back contact 102 of relay 7LTFPR and back contact 51 of the code following relay 8RTR. It follows that the stick relay 7RSR remains picked up while the train occupies the section 8LT.

With the train vacating the section 7RT the code following relay 7RLTR is operated at the normal low code rate due to the code pulses supplied to the section 7RT at the left-hand end and this operation of the code following relay 7RLTR causes current pulses of the 30 code rate to be supplied to the section 8LT behind the train.

The energizing of the stick relay 7RSR in the manner previously explained completes a circuit for operating the code transmitter or coder 75CT at signal 7R, this circuit including terminal B, back contact 80 of relay 7RHR, front contact 137 of relay 7RSR, the winding of the coder and terminal N. Also, a circuit is completed for the relay 7LCTP for operating this relay at the 75 code rate, the circuit being completed from terminal B through contact 106 of coder 75CT, front contact 52 of stick relay 7RSR, back contact 53 of relay 7RHR and winding of relay 7LCTP to terminal N. Hence at this time code pulses of the 75 code rate are supplied from battery 7B3 to the right-hand end of the track section 7RT. The code pulses of the 75 code rate thus supplied to section 7RT are of the reverse polarity and are cascaded past the section AT in the manner previously explained for the reverse code pulses of the 30 code rate and also at the location of signal 7L the 75 code pulses are repeated into the section 6RT in the same manner as the reverse low code pulses were cascaded past this point. At location 6, the 75 code pulses received from the track circuit of section 6RT cause the relay 6TR to be operated at the corresponding code rate. Prior to this time, the coding relay 6RCTPR has been operating at the 30 code rate for feeding track circuit pulses from the left to the right. Thus in the sections 6RT, 7LT and 7RT current of the 30 code is being supplied from left to right and current of the 75 code is being supplied from right to left. This action results in a scramble of the two codes and causes the track circuit current to have a graph similar to that illustrated by the fifth graph from the top of Fig. 2. Due to this scramble of the track circuit current, the detector relay 7LTFPR at signal location 7R and the block detector relay 6RTFPR at location 6 become energized and are retained picked up due to their slow release characteristics. The relay 6RTFPR on picking up to open its back contact 95 opens the stick circuit for the stick relay 6RFSR and that relay is released causing the circuit for the coding relay 6RCTPR to be transferred from the path through back contact 16 of relay 6RTFTR and front contact 117 of relay 6RFSR to the path including back contact 15 of relay 6RHSR and front contact 16 of relay 6RTFPR, and the coding relay 6RCTPR continues to be operated at the 30 code rate. This condition for the track circuit between location 6 and the location of signal 7R continues as long as the train remains in the section 8LT.

Under this condition described above, it is possible to operate signal 6RA or 6RB to permit a following train to enter the block. This is done by a control being sent through the centralized traffic control system to apply energy to terminal 11 and cause relay 6RHSR to be picked up in the manner explained for the first train. With the relay 6RHSR picked up opening back contact 15, the circuit for operating the coding relay 6RCTPR is opened and the supply of code pulses of the 30 code rate to the track circuit of section 6RT is discontinued. Since the relay 6RHR connected to the decoding unit 75DU at location 6 is energized in response to the current of the 75 code rate received from the track circuit of section 6RT, the relay 6RAHR or 6RBHR is energized over front contact 155 of relay 6RHR according to the position of the track switch, and the signal 6RA or 6RB is controlled to display a yellow light for an approach signal indication to permit a train to enter the block. This circuit for the signal 6RA, for example, can be traced from terminal B over front contact 143 of approach relay 6RAPR, front contact 35 of relay 6RAHR, back contact 86 of relay 6RDR and the lamp Y of signal 6RA to terminal N.

Assuming, however, that with the first train in the section 8LT no following move is made, then no change takes place in the track circuits until the train in section 8LT has proceeded out of the block. As the head end of the train in the section 8LT advances to a distance of the order of 4000 feet of signal 8RA, the magnitude of the track circuit pulses increases to a value where the energy supplied to the approach relay 8RAR is effective to energize that relay and cause it to be operated in step with the code pulses with the result that a slow release relay 8RAPR which is controlled over front contact 138 of relay 8RAR is picked up closing its front contact 139. The closing of front contact 139 of approach relay 8RAPR completes a circuit not shown for the lamps of the signals 8RA and 8RB in the same manner that the approach relay 7RAPR controls the lamp circuits for the signal 7R. The lamp circuits for the signals 8RA and 8RB are not illustrated in the drawing in order to simplify the drawing, these circuits being in accordance with standard practice and forming no part of the present invention. It will be recalled that at the outset it was assumed that the signals 8RA and 8RB normally display a stop indication, thus the red lamp of these circuits would be illuminated as the train approached the location 8. I shall further assume that a control is sent through the centralized traffic control system and that traffic conditions to the right of location 8 are such that the signal 8RA is operated to either its approach or clear indication to permit the train moving from left to right to advance to the right past the signal. When the train advances past the signal 8RA to enter the section 9T and shunt the track relay 9TR, the shunting of that relay will cause the signal to be operated to its stop position in the usual manner.

It will be recalled that while the train occupied section 8LT code pulses of the 30 code rate were supplied to the track circuits from location 6 and impulses of the 75 code rate were supplied from location of signal 7R through the track circuits to the location 6.

After the rear end of the train has vacated section 8LT and it still occupies section 9T, the circuit by which the coding relay 8LCTPR is operated by the 75CT coder is opened at front contact 47 of relay 9TR. Since normal code pulses of 30 code are supplied to section 8LT the code following relay 8LTR and its repeater 8LTPR are operated and the block detector relay 8LTFPR is picked up.

When the train vacates the section 9T and relay 9TR is reenergized and closes its front contact 47, the coding relay 8LCTP responds to the reverse code voltages in-

duced in winding 43 due to operation of relay 8LTPR in response to the normal pulses of the 30 code. At the signal location 7R both directional relays 8RTFPR and 7LTFPR are now energized so that the stick relay 7RSR is deenergized to open front contact 52 over which the 75 code pulses are being supplied to coding relay 7LCTP and in turn to the track circuits to the left of signal 7R and the reverse 30 code pulses again generated at location 8 are cascaded through the track circuits. It follows from the foregoing that quickly after the train vacates the block the track circuits are restored to their normal condition under which the low code rate of 30 pulses per minute is used.

During the entire time the train moving from left to right was in the block, either the block detector relay 8LTFPR at location 8 or the block detector relay 6RTFPR at location 6 or both were released causing one of the indicating relays 8LHK or 6RHK or both at the office of the centralized traffic control system to be deenergized so that the circuit for the block indication light 6—8 is completed and the lamp illuminated, indicating that there is a train in the block. This lamp circuit can be traced from terminal B over back contact 107 of office relay 8LDK, back contact 108 of office relay 6RDK, either back contact 149 of relay 8LHK or back contact 150 of relay 6RHK and lamp 6—8 to terminal N. When the signal 6RA is cleared to permit the train to move into the block, the relay 6RDR at location 6 is picked up closing front contact 151, and energy is applied to terminal 152 of the field station at location 6 and the centralized traffic control system so operates that energy is applied to terminal 153 at the office and relay 6RDK at the office is energized and picked up opening back contact 108 and causing the block lamp 6—8 to remain dark because otherwise the circuit for the lamp 6—8 would be completed due to the block detector relay 8LTFPR being released at this time and the office indicator relay 8LHK deenergized. That is, the block light 6—8 is dark until the train moves past signal 6RA and enters the block.

The operation of the apparatus for controlling signal 8LA or 8LB to permit a train to enter the block from the right is substantially the same as the operation by which the signal 6RA is controlled to permit a train to move into the block from the left and the operation of the apparatus for clearing the signal 8LA or 8LB need be described only as required to point out the manner in which the operation differs from the operation when the signal 6RA is controlled. When the lever 8L at the office of the centralized traffic control system is moved to the left to complete a circuit by which energy is supplied to terminal 109 of the centralized traffic control equipment and positive energy is made to appear at terminal 111 of the field station 8, the remote controlled relay 8LHSR is energized and picked up providing the track relay 9TR is picked up closing its front contact 112. The relay 8LHSR is provided with a stick circuit by which it is supplied with energy from terminal 113 through its own front contact 114, and front contact 112 of track relay 9TR after the control from the office is completed. The relay 8LHSR on picking up opening back contact 44 opens the circuit by which code pulses of the 30 code rate generated at winding 43 are supplied to coding relay 8LCTPR and the reverse low code pulses are no longer supplied to the track circuit of section 8LT. This causes the block detector relay 6RTFPR at location 6 to become deenergized and released. This in turn causes the normal pulses of the 30 code rate to be discontinued due to the opening of the circuit for the coding relay 6RCTPR at front contact 16 of relay 6RTFPR. The coding relay 6RCTPR is now operated at the 75 code rate due to a circuit which can be traced from terminal B through contact 115 of coder 75CT at location 6, back contact 116 of a relay 6LAHR, which is governed by traffic conditions to the left of location 6 in the usual manner by circuits not shown to control the signals 6LA and 6LB, and which signals are assumed as being set at stop, back contact 117 of stick relay 6RFSR, back contact 16 of detector relay 6RTFPR, front contact 17 of track relay 5TR, front contact 18 of approach locking relay 6RAS and winding of the coding relay 6RCTPR to terminal N. With track circuit current of the 75 code rate and of normal polarity supplied from battery 6B1 to the track circuit of section 6RT due to operation of relay 6RCTPR, the relay 6LTR at the right-hand end of section 6RT is operated at the 75 code rate and the detector relay 6RTFPR is picked up. Also, the relay 7LH at location of signal 7L is energized and picked up through the decoding unit 75DU provided at this location due to operation of relay 6LTR. Hence the signal control relay 7LHR is energized and picked up by a circuit extending from terminal B through back contact 22 of relay 6LTR, front contact 118 of relay 6LTFPR, back contact 119 of relay 7RTFPR, winding of relay 7LHR and front contact 120 of relay 7LH to terminal N.

The relay 7LHR is slow releasing and remains picked up closing front contact 50 to prepare a circuit by which the G or Y lamp of signal 7L can be approach controlled in a manner to be pointed out shortly. The relay 7LHR on picking up closing front contact 121 completes a simple circuit for operating a coder 120CT at the location of signal 7L and this coder then operates its contact 122 at the 120 code rate causing the coding relay 7RCTPR to be energized and operated at the corresponding code rate due to a circuit completed through front contact 27 of relay 7LHR. This results in code pulses of 120 code rate being supplied from battery 7B1 to the section 7LT, the pulses being of normal polarity. Code pulses of the 120 code rate are cascaded through the track circuits to the location 8 in the same manner explained for current pulses of the 30 code. The code following relay 8LTR and its repeater relay 8LTPR at location 8 are operated at the corresponding 120 code with the result the control relay 8LDR is energized through the decoding unit 120DU. This in turn selects the circuit for signal control relay 8LAHR, the circuit including terminal B, front contact 69 of track relay 9TR, contact 29 of relay 8LFSR, front contact 124 of relay 8LDR, winding of relay 8LAHR, contact 125 operated by the switch of passing siding 3PS and closed when the switch is set at its normal position and terminal N. With relay 8LAHR selected, then a signal circuit is completed from terminal B through front contact 126 of an approach lighting relay 8LAPR, front contact 127 of relay 8LAHR, front contact 128 of relay 8LDR, and green lamp G of signal 8LA to terminal N, and this signal is displayed to permit the train to enter the block.

The operation of the apparatus for the train as it moves through the block from right to left up to and beyond the signal 7L is similar to that described for a train moving through the block from left to right and this operation of the apparatus will be apparent from an inspection of the drawings taken in connection with the description of the operation of the apparatus for the train moving from left to right.

However, when the train moves past signal 8LA through section 9T and clears section 9T to permit track relay 9TR to be reenergized, the stick relay 8LFSR is retained picked up by its stick circuit completed at back contact 103 of code repeater relay 8LTPR. This results in the coding relay 8LCTPR not being operated and no coded current is supplied to the rails of section 8LT behind the train. Thus there is provided no coded track circuit current behind the train moving to the left until IT occupies the section 6RT. When the train moving to the left is entirely within the section 6RT, the coding relay 7RCTPR for section 7LT will be operated at the 75 code rate causing current of the 75 code to be supplied from battery 7B1 to the section 7LT. This is so because

as the train moving to the left enters section 6RT the stick relay 7LSR which is picked up over front contact 157 of signal control relay 7LHR is retained energized over its stick circuit including back contact 25 of relay 6LTR and its own front contact 131 so that the circuit for operating the 75CT coder at this location is completed over back contact 121 of relay 7LHR and front contact 132 of the stick relay 7LSR. Hence the coding relay 7RCTPR is operated at the 75 code rate due to the circuit completed at front contact 133 of the coder, front contact 26 of stick relay 7LSR, back contact 27 of relay 7LHR and winding of coding relay 7RCTPR to terminal N.

When the first code pulse of the 75 code rate thus supplied to the section 7LT is cascaded through the track circuits and applied to the relay 8LTR at location 8, the relay 8LTR and in turn the repeater relay 8LTPR are picked up causing the block detector relay 8LTFPR to be energized and picked up. This results in the stick relay 8LFSR being deenergized and released due to the opening of its stick circuit. At the first off period of the 75 code current supplied at signal 7L and the repeater relay 8LTPR at location 8 is released, the voltage induced in the secondary winding 43 of the transformer 8D is of the polarity to pick up the coding relay 8LTCPR and cause a reverse code pulse to be supplied to the section 8LT from battery 8B2. This reverse code pulse will be cascaded through the track circuits to the location of signal 7L. These two pulses, one fed from signals 7L to the location 8 and the other fed from location 8 to signal 7L will be of the same code rate but the on time of relay 8LCTPR may be greater than the off time of relay 7RCTPR. There will be, however, some overlapping of the pulses, and the detector relays will be picked up and the circuits will continue to operate while the train is in the section 6RT.

With the code following relay 7RTR operated, then code pulses will be supplied to the rails of section 6RT behind the train, the pulses being of the reverse code polarity.

When the train in section 6RT advances to a reasonable distance from the signal 6LA, the magnitude of the track circuit pulses supplied at the left-hand end of section 6RT increases to a value great enough to cause the approach relay 6LAR to be operated and in turn cause the approach control relay 6LAPR to be energized, the circuit being completed over front contact 104 of the approach relay 6LAR. The picking up of relay 6LAPR closing front contact 110 completes the lamp circuits for the signals 6LA and 6LB but which circuits are not shown in order to simplify the drawings because they would be of standard arrangement and form no part of my present invention. These lamp circuits and the control thereof by relay 6LAPR would be similar to that by which the approach relay 7RAPR governs the circuits of the lamps of signal 7R.

If it is desired to operate signal 8LA or 8LB to permit a following move through the block while the train occupies the section 6RT, a control is sent through the centralized traffic control system to location 8 to energize the relay 8LHSR and that relay is picked up opening back contact 44 to open the circuit by which the coding relay 8LCTPR is operated at this time by voltage induced in winding 43 and the supply of pulses to the section 8LT from battery 8B2 ceases. Since at this time the relay 8LTR and its repeater relay 8LTPR are operated by the pulses of the 75 code rate supplied from the location of signal 7L, the relay 8LHR is energized and picked up through the decoding unit 75DU. The closing of front contact 135 of relay 8LHR completes a circuit for signal control relay 8LAHR or 8LAPR according to the position of contact 125 operated by the track switch. Assuming that the relay 8LAHR is selected, a signal circuit is completed from terminal B through front contact 126 of relay 8LAPR, front contact 127 of relay 8LAHR, back contact 128 of relay 8LDR and the lamp Y of the signal 8LA to terminal N, with the result that the signal 8LA displays an approach indication for a train to move into the block while the first train occupies the section 6RT.

I shall assume, however, that a control for a following move is not sent and also that the signal 6LA or 6LB is operated in the usual manner to permit the train in section 6RT to move to the left out of the block and through the section 5T. The reverse code pulses being received from the right-hand end of the block will cause the relay 6TR and its repeater 6RTP to be operated at this code rate. This operation of the repeater 6RTP causes the detector relay 6RTFPR to be picked up closing its front contact 16 and to thereby complete the circuit for operating coding relay 6RCTPR at the 30 code rate and cause a normal pulse of 30 code rate to be supplied to the track circuit for the section 6RT.

This normal code pulse operates the code following relay 6LTR at the right-hand end of section 6RT and causes the detector relay 6LTFPR to be picked up to open at its back contact 134 the third path of the stick circuit for relay 7LSR and that relay is released. With relay 7LSR released the circuit of the coder 75CT and the circuit for operating the coding relay 7RCTPR are opened and the supply of code pulses of the 75 code rate to the section 7LT is discontinued. The coding relay 7RCTPR is now operated by its original circuit including front contact 25 of relay 6LTR, and thus is operated at the normal 30 code rate. It follows that this normal code pulse is cascaded to location 8 where it causes relay 8LTR to be operated. This operation of relay 8LTR causes a corresponding operation of the repeater relay 8LTPR which in turn operates to generate a reverse code pulse of the 30 code rate in the manner previously explained. Consequently, the track circuits are now restored to their normal condition.

I shall next describe the operation of the apparatus by which the switch for the track AS is unlocked to permit a train to move into the block for the track AS. At the start a trainman first obtains permission from the operator over a telephone circuit in the usual order of operation. With permission obtained, the trainman operates the usual padlock latch for the switch which operates a contact 140 to open that contact and operate a second contact 158 to close that contact. The opening of contact 140 which is interposed in a circuit for relay NWR causes this relay to be deenergized and released, the circuit extending from terminal B over contact 141 operated by the track switch and closed only when the switch is set at its normal position, front contact 143 of track relay ATR, a contact 142 of the electric lock SL for the switch, padlock contact 140, and winding of relay NWR to terminal N. The release of relay NWR opens its front contacts 34 and 35 and thereby opens the connection by which the normal and reverse 30 code pulses are cascaded between sections 7LT and 7RT with the result the detector relay 6RTFPR at location 6 and detector relay 8LTFPR at location 8 are deenergized and released causing the supply of low rate code pulses to the track circuits to be discontinued and track circuit pulses of the 75 code rate to be sent from each end of the block toward the location of the track AS. With relay 7LTR operated at the 75 code rate, a relay LTFPR is energized by a connection completed from terminal B over front contact 32 of track relay ATR, front contact 33 of relay 7LTR, back contact 34 of relay NWR and winding of relay LTFPR to terminal N. Then during the off code period and relay 7LTR is released, a circuit is formed from terminal B over front contact 32 of relay ATR, back contact 33 of relay 7LTR, front contact 144 of relay LTFPR and winding of relay LTBPR and this latter relay is energized and picked up closing its front contact 145. Similarly, the operation of the relay 7RRTR completes a circuit for repeater relays RTFPR and RTBPR, the circuit for relay RTFPR including terminal B, front contact 32 of relay

ATR, front contact 54 of relay 7RRTR, back contact 55 of relay NWR, and winding of relay RTFPR. The circuit for the relay RTBPR includes front contact 32 of relay ATR, back contact 54 of relay 7RRTR, front contact 146 of relay RTFPR and the winding of relay RTBPR. With both relays LTBPR and RTBPR picked up closing their front contacts 145 and 147, respectively, a circuit is completed for the electric lock SL and which circuit includes terminal B, front contact 147 of relay RTBPR, front contact 145 of relay LTBPR, front contact 159 of track relay ATR, padlock contact 158 which is now closed, winding of the electric lock SL and terminal N. With the electric lock SL thus energized, the trainman can operate the track switch and permit the train to move from track AS onto the main track of the block. It is to be noted that if signal 6RA at location 6 or signal 8LA at location 8 has been cleared to permit a train to enter the block, then code from only one end of the block would be supplied to the track circuits with the result that one or the other of the relays 7LTR or 7RRTR at the location of the track AS would not be operated and the electric lock SL would not be energized.

It is to be pointed out that in the event a remote control cannot be sent from the office of the centralized traffic control system to station 6 for energizing the relay 6RHSR and thereby control signal 6RA or 6RB to permit a train to enter the block, the relay 6RHSR can be energized by means of a manually operable key or push button 6PB. In this emergency a trainman would obtain permission and momentarily close the key 6PB and thereby complete a simple pickup circuit for relay 6RHSR after which the relay would be retained energized by its stick circuit. It follows that with relay 6RHSR picked up the apparatus functions in the same manner as previously described to clear signal 6RA or 6RB to permit a train to enter the block, the apparatus restoring to its normal condition when the train has moved through the block. Similarly, a push button 8PB at location 8 enables emergency operation of the apparatus to be effected to permit a train to move through the block from right to left.

Although I have herein shown and described but one form of single track railroad signal system using coded track circuits embodying my invention, it is to be 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 a single track two direction signal system using coded track circuit currents of selected code rates of a relatively high order to reflect different traffic conditions, the combination comprising, a track block formed with a plurality of track sections, a low rate coder means at a selected end of the block having a code cycle of a relatively low code frequency as compared with traffic reflecting code frequencies and provided with contact means which is closed a relatively short selected portion of each code cycle; track circuit means for each said section and including a battery, a polar code following relay and a coding contact at each end of the section; each said coding contact operable to a first and a second position, each said code following relay connected across the rails of its section over the first position of the associated coding contact and connected in series with the associated battery across the rails over the second position of the associated coding contact, the two batteries of each section being poled reverse to each other, the two polar code following relays of each section poled to respond only to the polarity of the current supplied by the battery at the opposite end of the section, circuit means at each junction of said sections including contacts of the code following relays at that junction for each code following relay to operate the coding contact of the adjacent section, other circuit means including said low rate coder contact means when closed to control the coding contact for the end of the track section at said selected end of the block and thereby cascade a low rate code pulse through the track circuits to the opposite end of the block, said pulse being of normal polarity, code generating means including a battery and a transformer controlled by the code following relay at said opposite end of the block to generate a voltage in the transformer in response to said code pulse of said normal polarity, means including a polar relay connected to said transformer responsive to said generated voltage and operable to operate said coding contact at said opposite end of the block for a different selected portion of said code cycle and thereby cascade a low rate code pulse of reverse polarity through the track circuits to said selected end of the block, and a detector relay controlled by the code following relay at said selected end of the block to detect the cascading of said normal and reverse code pulse through the track circuits.

2. In a single track two direction signal system using coded track circuit currents of selected code rates of a relatively high order to reflect different traffic conditions, the combination comprising, a track block formed with a plurality of track sections, a low rate code transmitter at a selected end of the block having a code cycle of a relatively low code frequency as compared with traffic reflecting code frequencies and associated with contact means which is closed a relatively short selected portion of each code cycle; track circuit means for each said section and including a battery, a polar code following relay and a coding contact at each end of the section; each said coding contact operable to a first and a second position, each said code following relay connected across the rails of its section over the first position of the associated coding contact and connected in series with the associated battery across the rails over the second position of the associated coding contact, the two batteries of each section being poled reverse to each other, the two polar code following relays of each section poled to respond only to the polarity of the current supplied by the battery at the opposite end of the section, circuit means at each junction of said sections including contacts of the code following relays at that junction for each code following relay to operate the coding contact of the adjacent section, other circuit means including said low rate code transmitter contact means when closed to control the coding contact for the end of the track section at said selected end of the block and thereby cascade a low rate code pulse through the track circuits to the opposite end of the block, said pulse being of normal polarity, code generating means including a battery and a transformer controlled by the code following relay at said opposite end of the block to generate a voltage in the transformer in response to said code pulse of said normal polarity, means including a polar relay connected to said transformer responsive to said generated voltage and operable to operate said coding contact at said opposite end of the block for a different selected portion of said code cycle and thereby cascade a low rate code pulse of reverse polarity through the track circuits to said selected end of the block, two detector relays one controlled by the code following relay at each end of the block, and a block indicator controlled by said two detector relays.

3. In a single track two direction signal system using coded track circuit currents of selected code rates of a relatively high order to reflect different traffic conditions, the combination comprising, a track block formed with a plurality of track sections, a low rate code transmitter at a selected end of the block having a code cycle of a relatively low code frequency as compared with traffic reflecting code frequencies and associated with contact means closed for a selected portion of each code cycle equal to approximately one-fourth of the code cycle;

track circuit means for each said section and including a battery, a polar code following relay and a coding contact at each end of the section; each said coding contact operable to a first and a second position, each said code following relay connected across the rails of its section over the first position of the associated coding contact and connected in series with the associated battery across the rails over the second position of the associated coding contact, the two batteries of each section being poled reverse to each other, the two polar code following relays of each section poled to respond only to the polarity of the current supplied by the battery at the opposite end of the section, circuit means at each junction of said sections including contacts of the code following relays at that junction for each code following relay to operate the coding contact of the adjacent section, other circuit means including said low rate code transmitter contact means when closed to control the coding contact for the end of the track section at said selected end of the block and thereby cascade a low rate code pulse through the track circuits to the opposite end of the block, said pulse being of normal polarity, code generating means including a battery and a transformer controlled by the code following relay at said opposite end of the block to generate a voltage in the transformer in response to said code pulse of said normal polarity, means including a polar relay connected to said transformer responsive to said generated voltage and operable to operate said coding contact at said opposite end of the block for a different selected one-fourth portion of said code cycle and thereby cascade a low rate code pulse of reverse polarity through the track circuits to said selected end of the block, slow release detector relays one controlled by each code following relay, and means controlled by each said detector relay for governing the supply of said code pulses to the track circuits.

4. In a single track two direction signal system using coded track circuit currents of selected code rates of a relatively high order to reflect different traffic conditions, the combination comprising, a track block formed with a plurality of track sections, a low rate code transmitter at a selected end of the block having a code cycle of a relatively low code frequency as compared with traffic reflecting code frequencies and associated with contact means which is closed for a selected portion of each code cycle equal to approximately one-fourth of the code cycle; track circuit means for each said section and including a battery, a polar code following relay and a coding contact at each end of the section; each said coding contact operable to a first and a second position, each said code following relay connected across the rails of its section over the first position of the associated coding contact and connected in series with the associated battery across the rails over the second position of the associated coding contact, the two batteries of each section being poled reverse to each other, the two polar code following relays of each section poled to respond only to the polarity of the current supplied by the battery at the opposite end of the section, circuit means at each junction of said sections including contacts of the code following relays at that junction for each code following relay to control the coding contact of the adjacent section, other circuit means including said low rate code transmitter contact means when closed to control the coding contact for the end of the track section at said selected end of the block and thereby cascade a low rate code pulse through the track circuits to the opposite end of the block, said pulse being of normal polarity, code generating means including a battery and a transformer controlled by the code following relay at said opposite end of the block to generate a voltage in the transformer in response to said code pulse of said normal polarity, means including a polar relay connected to said transformer responsive to said generated voltage and operable to operate said coding contact at said opposite end of the block for a different selected one-fourth portion of said code cycle and thereby cascade a low rate code pulse of reverse polarity through the track circuits to said selected end of the block, two slow release detector relays each controlled by the code following relay at each end of the block, coder means at each end of the block operable to supply code pulses of the 75 or 120 code rate, and circuit means at each end of the block including a back contact of the detector relay at the same end of the block to connect the said coder means at the same end of the block to said track circuits.

5. In a single track two direction signal system using coded track circuit currents of selected code rates of a relatively high order to reflect different traffic conditions, the combination comprising, a track block formed with a plurality of track sections, a low rate code transmitter at a selected end of the block having a code cycle of a relatively low code frequency as compared with traffic reflecting codes and associated with contact means which is closed for a selected portion of each code cycle equal to approximately one-fourth of the code cycle; track circuit means for each said section and including a battery, a polar code following relay and a coding contact at each end of the section; each said coding contact operable to a first and a second position, each said code following relay connected across the rails of its section over the first position of the associated coding contact and connected in series with the associated battery across the rails over the second position of the associated coding contact, the two batteries of each section being poled reverse to each other, the two polar code following relays of each section poled to respond only to the polarity of the current supplied by the battery at the opposite end of the section, circuit means at each junction of said sections including contacts of the code following relays at that junction for each code following relay to control the coding contact of the adjacent section, other circuit means including said low rate code transmitter contact means when closed to control the coding contact for the end of the track section at said selected end of the block and thereby cascade a low rate code pulse through the track circuits to the opposite end of the block said pulse being of normal polarity, code generating means including a battery and a transformer controlled by the code following relay at said opposite end of the block to generate a voltage in the transformer in response to said code pulse of said normal polarity, means including a polar relay connected to said transformer responsive to said generated voltage and operable to operate said coding contact at said opposite end of the block for a different selected one-fourth portion of said code cycle, and thereby cascade a low rate code pulse of reverse polarity through the track circuits to said selected end of the block, a remote controlled relay at each end of said block, and means at each end of the block including a contact of the remote controlled relay at the same end of the block operable automatically in accordance with traffic conditions at the entrance to said selected end of the block to control the supply of said low code rate pulses to the track circuits at the corresponding end of the block.

6. In a single track two direction signal system using coded track circuit currents of selected code rates of a relatively high order to reflect different traffic conditions, the combination comprising, a track block formed with a plurality of track sections, a low rate code transmitter at a selected end of the block having a code cycle of a relatively low code frequency as compared with traffic reflecting codes and associated with contact means which is closed for a selected portion of each code cycle equal to approximately one-fourth of the code cycle; track circuit means for each said section and including a battery, a polar code following relay and a coding contact at each end of the section, each said coding contact operable to a first and a second position, each said code following relay connected across the rails of

its section over the first position of the associated coding contact and connected in series with the associated battery across the rails over the second position of the associated coding contact, the two batteries of each section being poled reverse to each other, the two polar code following relays of each section poled to respond only to the polarity of the current supplied by the battery at the opposite end of the section, circuit means at each junction of said sections including contacts of the code following relays at that junction for each code following relay to control the coding contact of the adjacent section, other circuit means including said low rate code transmitter contact means when closed to control the coding contact for the end of the track section at said selected end of the block and thereby cascade a low rate code pulse through the track circuits to the opposite end of the block said pulse being of normal polarity, code generating means including a battery and a transformer controlled by the code following relay at said opposite end of the block to generate a voltage in the transformer in response to said code pulse of said normal polarity, means including a polar relay connected to said transformer responsive to said generated voltage and operable to operate said coding contact at said opposite end of the block for a different selected one-fourth portion of said code cycle, and thereby cascade a low rate code pulse of reverse polarity through the track circuits to said selected end of the block, a remote controlled relay at each end of said block, means at each end of the block including a contact of the remote controlled relay at the same end of the block operable automatically in accordance with traffic conditions at the entrance to said selected end of the block to control the supply of said low code rate pulses to the track circuits at the corresponding end of the block, an emergency manually operable key at each of the blocks, and means at each end of the block including the corresponding key for selective operation to supercede automatic control of the corresponding remote controlled relay.

7. In a single track two direction signal system using coded track circuit currents of selected code rates of a relatively high order to reflect different traffic conditions, the combination comprising, a track block formed with a plurality of track sections, a code transmitter at a selected end of said block having a code cycle of a relatively low code frequency as compared to traffic reflecting code rates, said code transmitter associated with contact means which is closed a selected portion of each code cycle equal to approximately less than one-half the code cycle, track circuit means connected across the rails at each end of said sections; each said track circuit means including a polar code following relay, a track battery and a coding contact; the two track batteries of each section being poled reverse to each other, and the two polar relays of each section being poled for each relay to respond only to the polarity of the current supplied by the battery at the opposite end of the section, at each junction of said sections the two polar relays of the track circuit means at the junction being operable for each relay to control the coding contact of the adjacent section, means including said contact means of said code transmitter at said selected end of the block to operate the coding contact of the track circuit means at said selected end of the block whereby code pulses of said low code rate are cascaded through the track sections from the selected end to the opposite end of the block, said code pulses being of normal polarity; code generating means including a battery, a transformer and a contact of the polar relay of the track circuit means at said opposite end of the block to generate a voltage in a winding of said transformer in response to said normal code pulse, means including a polar relay connected to said transformer winding to operate the coding contact of the track circuit means at said opposite end of the block in response to said generated voltages whereby code pulses of reverse polarity are cascaded through the track sections to said selected end of the block to operate the polar code following relay at said selected end of the block, and a block indicator controlled by said polar code following relay at said selected end of the block.

8. In a single track two direction signal system using coded track circuit currents of code rates of a relatively high order to reflect different traffic conditions, the combination comprising, a track block formed with a plurality of track sections; a track circuit for each track section having connections across the rails at each end of the section and provided with a current source, a code following relay and a coding relay at each end of the section; said track circuits being interconnected at each junction of said sections and poled to cascade a current pulse of normal polarity from left to right through the sections and to cascade a current pulse of reverse polarity from right to left through the sections, a code transmitter at the left-hand end of the block having a code cycle of a relatively low frequency as compared to the frequencies of traffic reflecting codes and associated with contact means closed a selected portion of each said code cycle equal to substantially less than one-half the code cycle, means including said code transmitter contact means connected to the track circuit coding relay at said left-hand end of the block to thereby cascade low code normal polarity pulses through the track circuits, code generating means including a current source at said right-hand end of the block controlled by the track circuit code following relay at the right-hand end of the block, said code generating means operable to create a voltage pulse in response to each said normal current pulse, said generating means connected to the track circuit coding relay at the right-hand end of the block to thereby cascade low code rate reverse polarity pulses through the track circuits, a slow release detector relay controlled by the track circuit code following relay at the left-hand end of the block, and a block indicator controlled by said detector relay.

9. In a single track two direction signal system using coded track circuit currents of code rates of a relatively high order to reflect different traffic conditions, a combination of elements for supplying to the track a plurality of traffic codes and a code of relatively low frequency with respect to the traffic codes, the combination comprising, a track block formed with a plurality of track sections; a track circuit for each track section having connections across the rails at each end of the section and provided with a current source, a code following relay and a coding relay at each end of the section; said track circuits being interconnected at each junction of said sections and poled to cascade a current pulse of normal polarity from left to right through the sections and to cascade a current pulse of reverse polarity from right to left through the sections, a code transmitter at the left-hand end of the block having a code cycle of a relatively low frequency as compared to the frequencies of traffic reflecting codes and associated with contact means closed a selected portion of each said code cycle, means including said code transmitter contact means connected to the track circuit coding relay at said left-hand end of the block to thereby cascade low code normal polarity pulses through the track circuits, code generating means including a current source at said right-hand end of the block controlled by the track circuit code following relay at the right-hand end of the block said code generating means operable to create a voltage pulse in response to each said normal current pulse, said generating means connected to the track circuit coding relay at the right-hand end of the block to thereby cascade low code rate reverse polarity pulses through the track circuits, detector relays one at each end of the block and each detector relay controlled by the track circuit code following relay at the same

end of the block, two remote controlled relays one at each end of the block, coder means at each end of the block operable to supply traffic reflecting code pulses, means at each end of the block including a contact of the remote controlled relay at the same end of the block to discontinue operation of the corresponding track circuit coding relay, and means at each end of the block including a back contact of the corresponding detector relay to connect the said coder means to the track circuit coding relay at that end of the block.

10. In a single track two direction signal system, the combination comprising, a track block formed with a plurality of track sections, coding means at a selected end of said block operable to divide time into recurrent cycles of a selected time interval and having a contact which is operated to one position for a selected portion of each cycle, means including a current source and said contact connected across the rails at said selected end of the block to supply a current pulse during said selected portion of each cycle, said current source poled for said pulse to be of a normal polarity, a first means including a polar relay and a current source at each junction of said track sections having connections to the rails of each of the adjoining sections and poled to cascade said normal current pulse from the section toward said selected end to the section away from said selected end; code generating means including a polar relay, a transformer, a coding relay and a current source at the nonselected end of said block; said code generating means connected to the rails adjacent said nonselected end and operable to supply to the rails another current pulse in response to said normal pulse received at said nonselected end, said generating means poled for said another pulse to be of reverse polarity, said another pulse being of a duration equal to a second selected portion of said cycle the sum of said selected portion and said second selected portion being no more than one-half of each cycle, a second means including a polar relay and a current source at each junction of said sections and having connection to the rails of the adjoining sections and poled to cascade said another pulse from the section away from said selected end of the block to the section toward the selected end, another polar relay connected to the rails adjacent said selected end and poled to respond to current pulses of reverse polarity, and a slow release block indication relay controlled by said another polar relay.

11. A system for supplying to a track a code of relatively low frequency during non-occupancy of the track, the system comprising in combination, a track section, track circuit means for said section and including a coding relay, a bias polar code following relay and a battery for each end of the section, each said code following relay in series with the battery for the same end of the section connected across the section rails over a front contact of the coding relay for the same end of the section and connected across the rails exclusive of the battery over a back contact of the coding relay, said batteries poled reverse to each other, each said bias polar code following relay poled to respond to current of the polarity supplied by the battery for the opposite end of the section, coder means including a driven code transmitter for a selected end of the section and operable to divide time into recurrent cycles and having a contact means closed for only a selected portion of each cycle, circuit means including a current source and said contact means connected to the coding relay for said selected end of the section to pick up that relay for said selected portion of each said cycle, a code generating means for the nonselected end of the section and including a direct current source and a transformer having a primary and a secondary winding, means including a front contact of the code following relay for said nonselected end of the section to connect said direct current source to said primary winding to induce voltages in said secondary winding, the induced voltage being of reverse polarity when said direct current source is disconnected from said primary winding, circuit means having connections to said secondary winding and to the coding relay for said nonselected end of the section, and said coding relay for said nonselected end being a bias polar relay and poled to respond only to said voltage of reverse polarity.

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