March 3, 1953 I. F. CADMAN ET AL 2,630,523

CENTRALIZED TRAFFIC CONTROL SYSTEM OF THE CODED REVERSIBLE TRACK CIRCUIT TYPE

Filed July 28, 1949 7 Sheets-Sheet 1

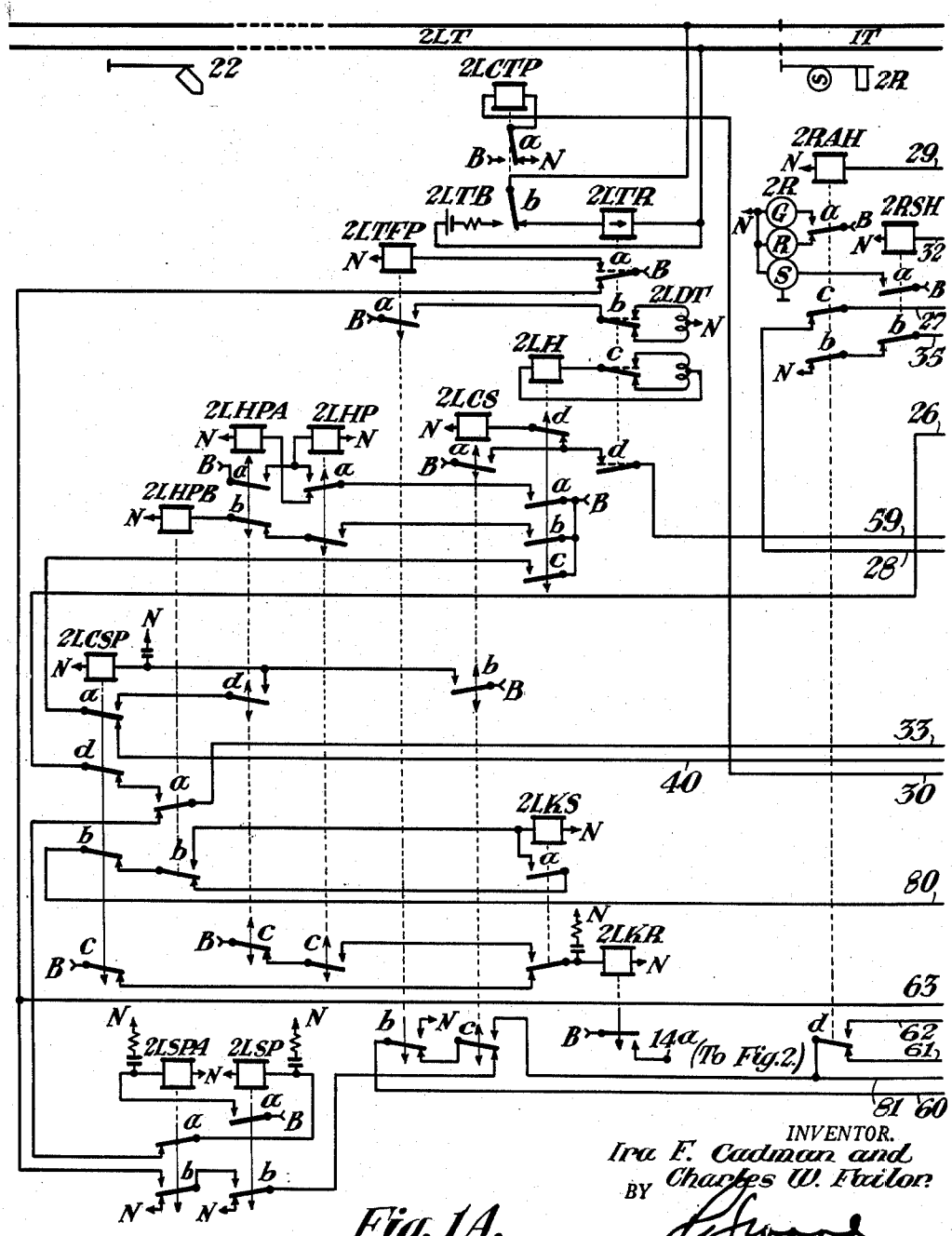



Fig. 1A.

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Filed July 28, 1949 7 Sheets-Sheet 2

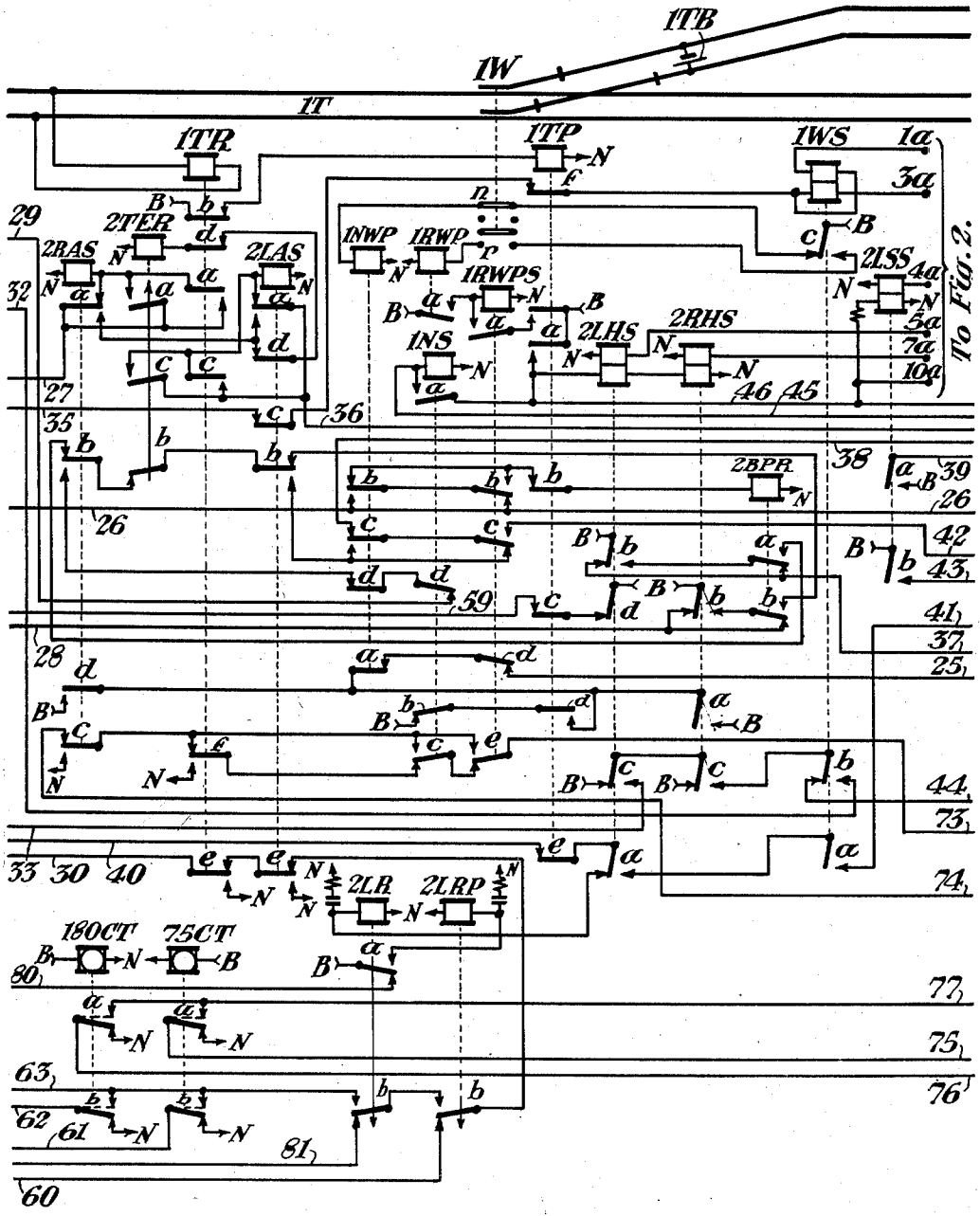



Fig. 1B.

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Filed July 28, 1949 7 Sheets-Sheet 3

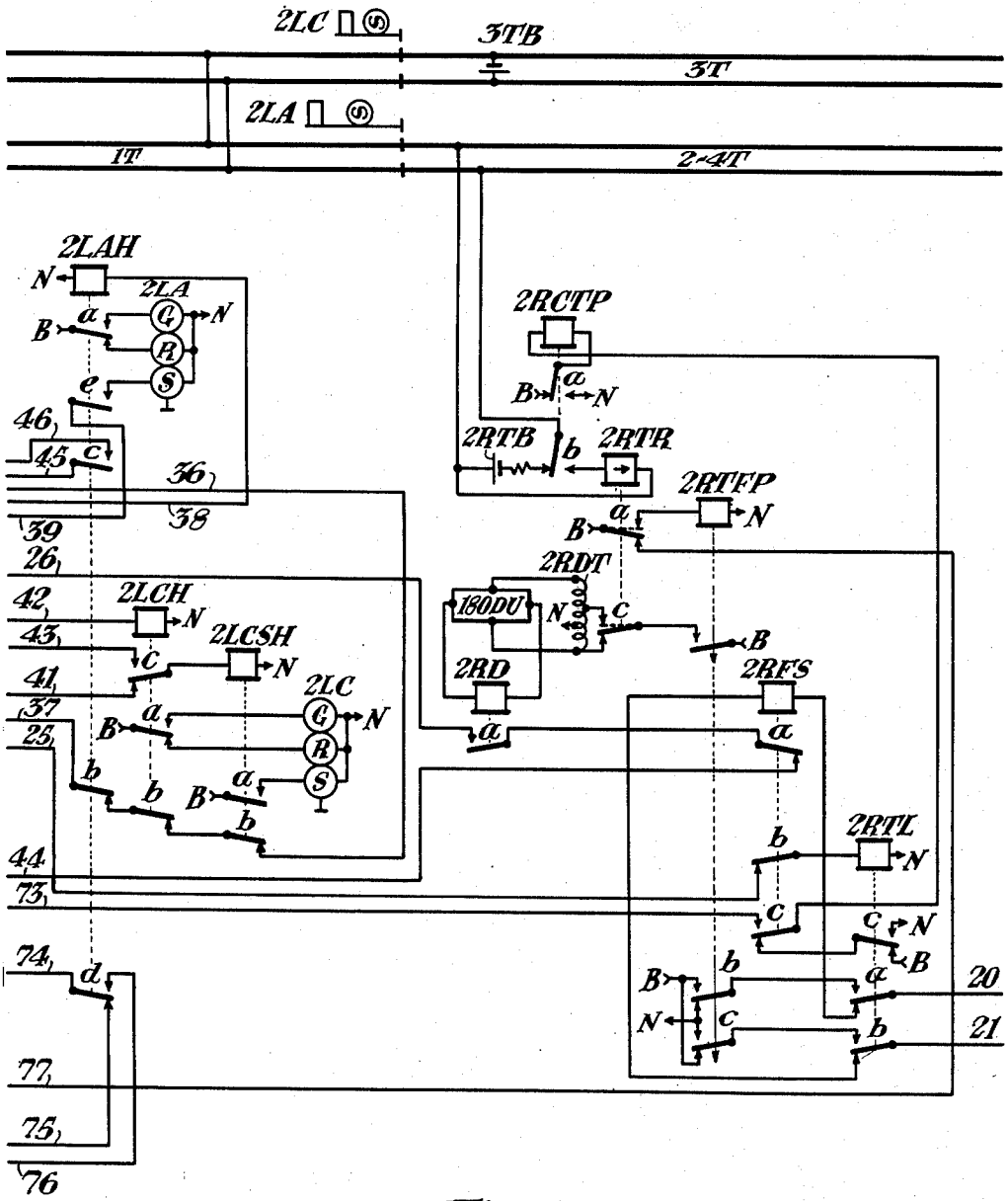



Fig. 1C.

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CENTRALIZED TRAFFIC CONTROL SYSTEM OF THE CODED REVERSIBLE TRACK CIRCUIT TYPE

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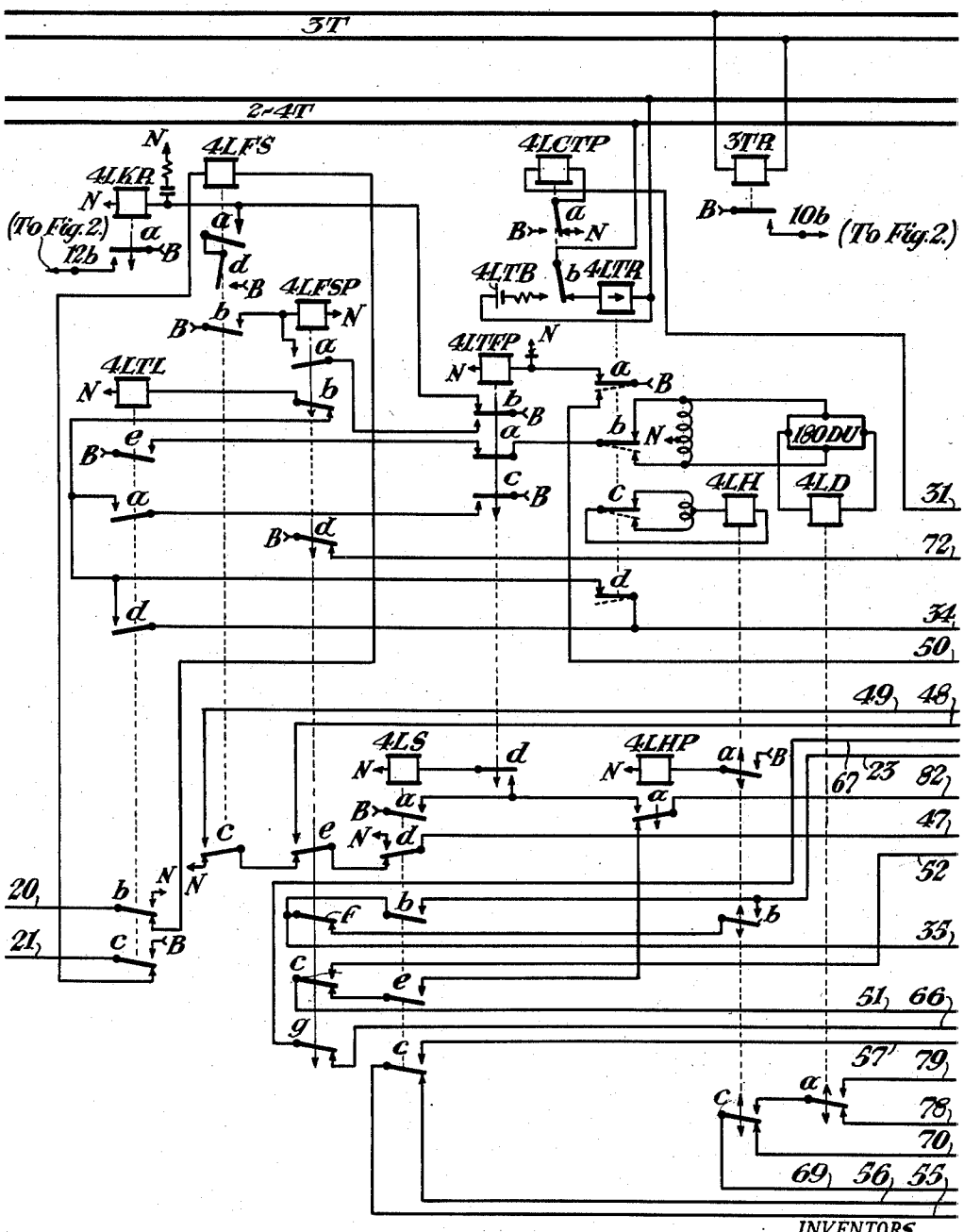



Fig. 1D.

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CENTRALIZED TRAFFIC CONTROL SYSTEM OF THE CODED REVERSIBLE TRACK CIRCUIT TYPE

Filed July 28, 1949 7 Sheets-Sheet 5

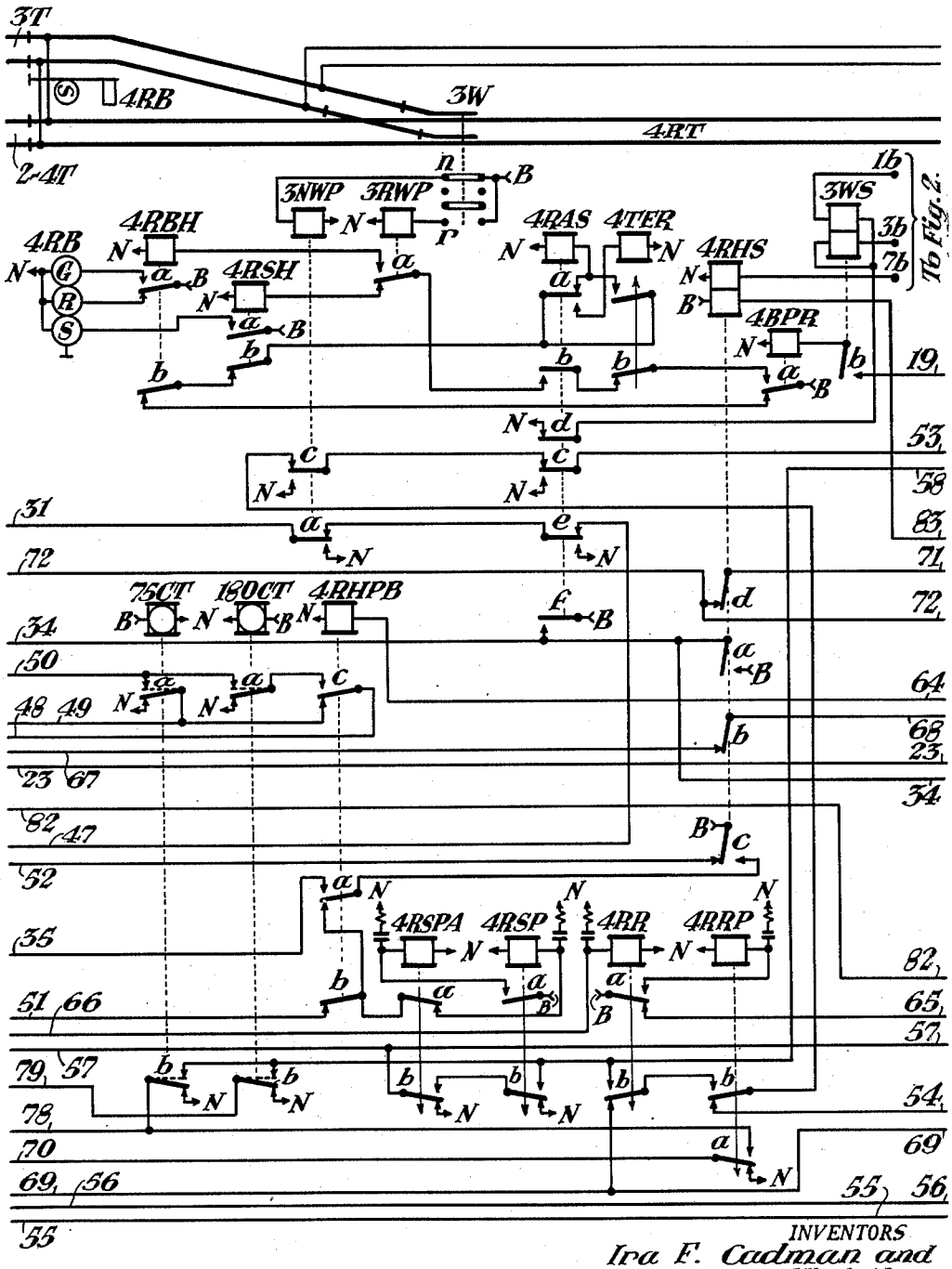



Fig. 1E.

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CENTRALIZED TRAFFIC CONTROL SYSTEM OF THE CODED REVERSIBLE TRACK CIRCUIT TYPE

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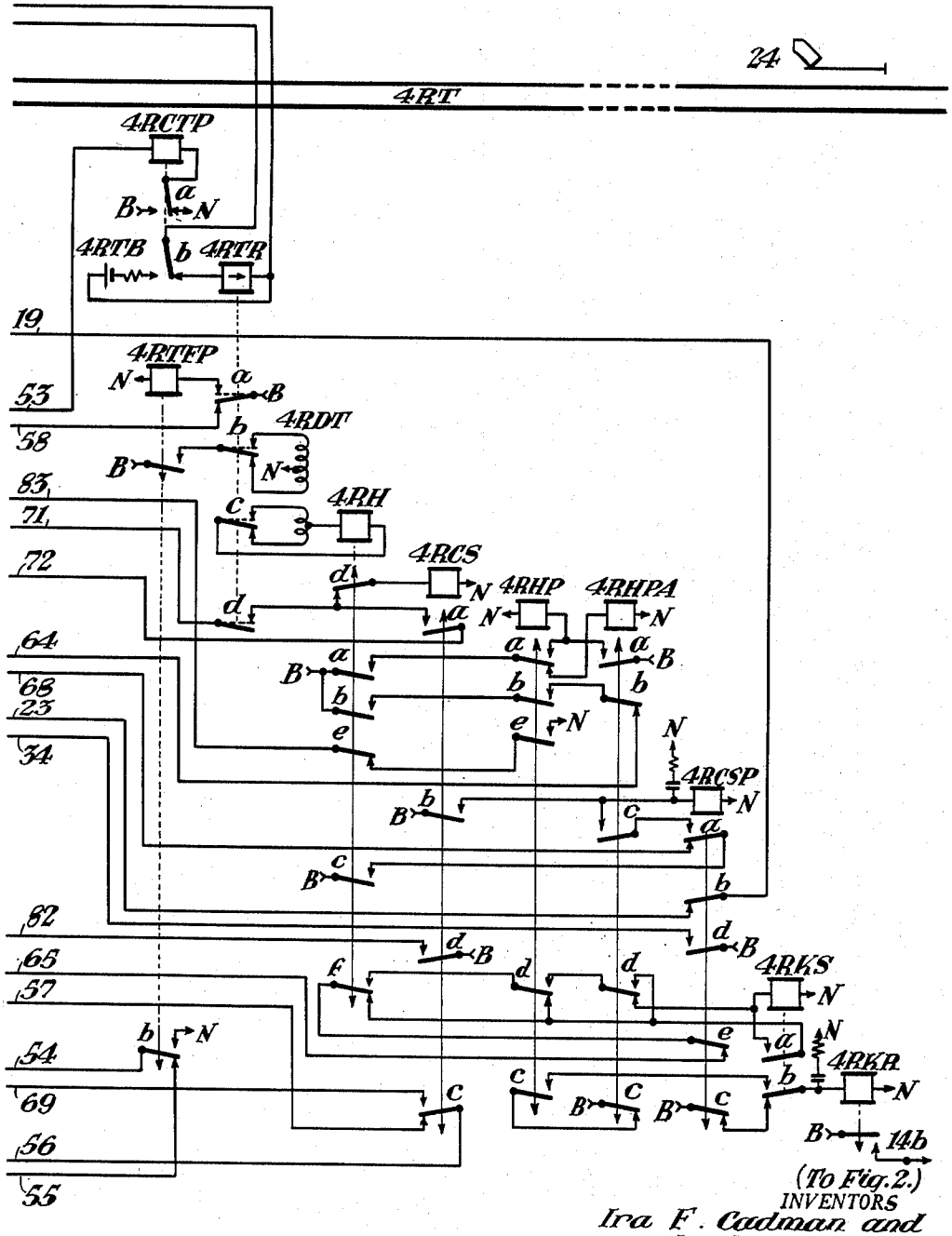



Fig. 1F.

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CENTRALIZED TRAFFIC CONTROL SYSTEM OF THE CODED REVERSIBLE TRACK CIRCUIT TYPE

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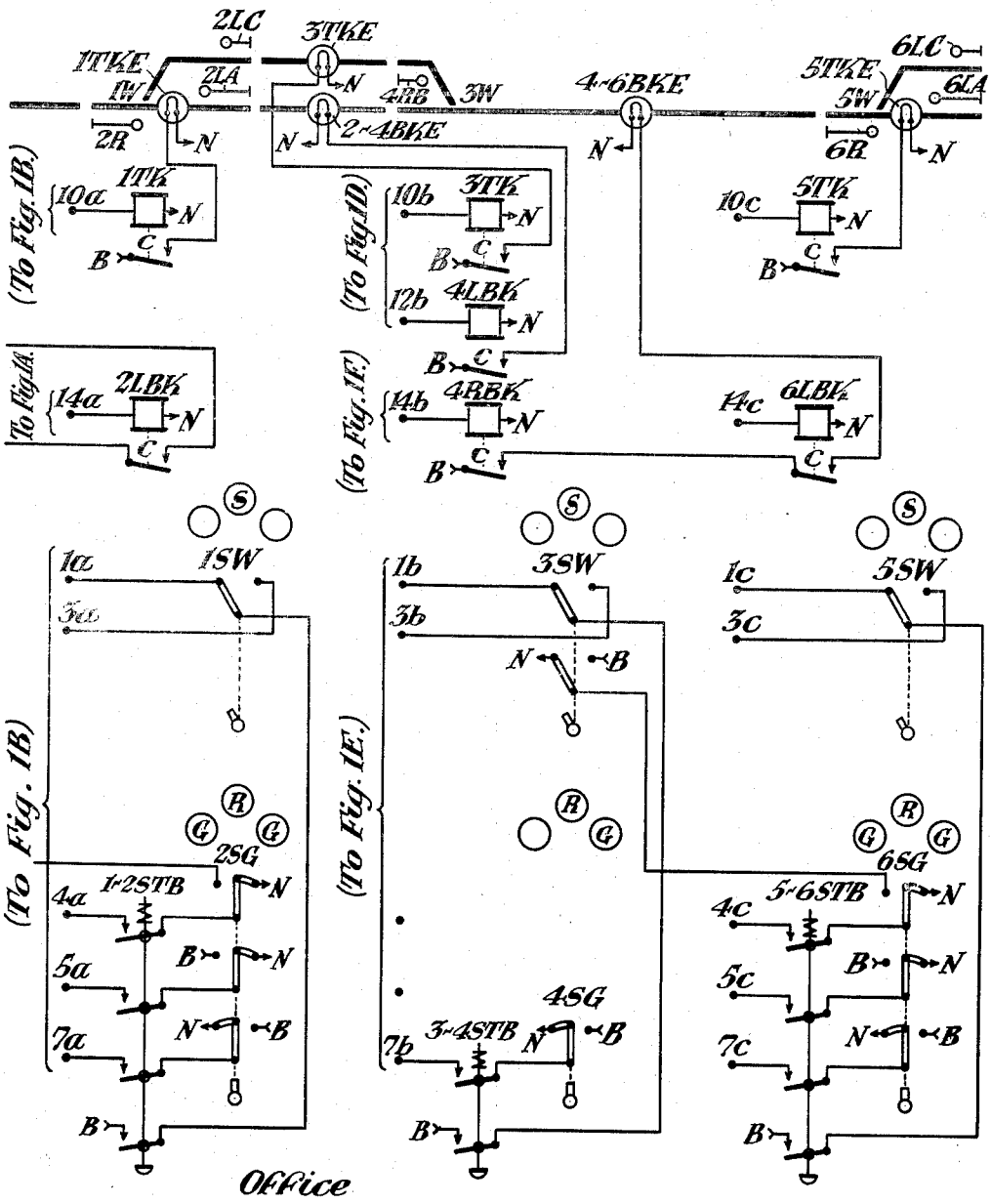



Fig. 2.

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Patented Mar. 3, 1953

2,630,523

# UNITED STATES PATENT OFFICE

2,630,523

## CENTRALIZED TRAFFIC CONTROL SYSTEM OF THE CODED REVERSIBLE TRACK CIRCUIT TYPE

Ira F. Cadman, Wilkinsburg, and Charles W. Failor, Forest Hills, Pa., assignors to Westinghouse Air Brake Company, a corporation of Pennsylvania

Application July 28, 1949, Serial No. 107,354

15 Claims. (Cl. 246—3)

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Our invention relates to centralized traffic control systems for single track railroads, of the type employing coded track circuits for the protection of main line train movements. The principal object of our invention is to provide a system giving an adequate measure of protection with fewer signals than are required by the conventional systems, in order to render the system economically suitable for use on single track railroads of relatively light traffic.

In the centralized traffic control systems now widely used on single track railroads, it is the practice to provide passing tracks at intervals of several miles, with the track switch at each end included in a short detector track section over which train movements are governed by a group of four block signals which are interlocked with the track switch by approach locking relays and are manually controllable in accordance with the positions of switch and signal levers at a central office by a suitable remote control system. This arrangement is shown, for example, in Letters Patent of the United States No. 2,229,249, issued January 21, 1941, to L. V. Lewis, for Remote Control Systems. Continuous track circuits are provided for all main track, for the control of these signals in accordance with traffic conditions to form a block signaling system in which the blocks for the protection of opposing train movements extend from siding to siding or from one end to the other of the same siding.

In the system of our invention as disclosed herein, the manually controllable block signals are arranged in accordance with a novel plan which differs from that outlined above in that a detector track section defining the end of a block and three block signals are provided at one end only of each siding (the left-hand or west end of the siding, as disclosed herein), while the fourth signal is located at the opposite end of the siding, its purpose being to govern eastbound train movements out of the side track over the track switch at that end. In accordance with this plan, the blocks correspond in length to two successive blocks of the conventional systems, that is to say, they extend from the signals at one end of a siding to the opposing signals at the corresponding end of the next siding to the right or left, respectively, and train movements into each block are governed not only by the signals at its opposite ends, but also by a signal by which a train is enabled to enter the block at an intermediate point. Hand throw track switches are provided at the ends of the passing tracks and their operation is authorized when an illuminated letter "S" is displayed by a remotely controlled indicator, one of which is provided

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for each block signal. The signals are of the two position color light type and no intermediate signals are used other than a conventional distant signal in approach to each block signal which governs high speed train movements.

The control of the block signals and of the associated "S" indicators in accordance with traffic conditions is effected by the provision of separate reversible coded track circuit systems for the single track stretch and for the main track in the siding area.

The coded track circuit system for the single track stretch is of the normally deenergized type, and is so arranged that it may be set into operation for either direction of traffic movement, by the transmission of a special actuating code over the track rails from the entrance end, by the operation of the control relay for the signal at that end, and the system returns automatically to its normally deenergized condition when the block is vacated by a train. This system corresponds generally to that disclosed in a prior application for Letters Patent of the United States, Serial No. 19,366, filed April 6, 1948, by C. E. Staples, for Normally Deenergized Coded Track Circuit Signaling Systems, which in turn is an improvement upon the system shown in the Staples United States Reissue Patent No. Re. 22,931, dated November 4, 1937.

The coded track circuit system for the main track stretch in the siding area is of the type in which the track rails are normally energized by steady current to detect when the block is unoccupied.

The energization of this last-mentioned coded track circuit system as required for either direction operation is controlled in a novel manner, which constitutes one of the features of our invention, embodied in the provision of a reversible line circuit system extending the length of the siding over which a traffic relay at either end may be controlled from the opposite end, to energize or deenergize the system as required.

Another feature of our invention resides in the provisions hereinafter described by which both track circuit systems may be energized by the operation of the remotely controlled signal control relay for any of the signals so as to effect the clearing of the corresponding signal. In accordance with this feature of the invention the two track circuit systems are energized at times in tandem by coded current supplied at either end of the block for controlling the signal at the opposite end of the block, or are energized in parallel by coded currents supplied at both ends of the block for controlling the signal which gives access to the block at an intermediate point.

A further feature of our invention resides in the provision of directionally controlled means for enabling the signal at the east end of the siding to be cleared for an eastbound train as soon as a westbound train has passed its location and vacated the single track portion of the block.

Another feature of our invention resides in the provisions by which the signal located at an intermediate point in the block is fully interlocked with those at the ends of the blocks and by which the latter are interlocked with each other by their control of the track circuit systems, this feature providing adequate time locking protection against the clearing of any one of these signals for a suitable interval following the manual return of a conflicting signal to stop.

Other features and characteristics of the system of our invention will be pointed out in the detailed description which follows.

In the accompanying drawings Figs. 1A to 1F, inclusive, when arranged side by side with Fig. 1A at the left, show the track plan and the circuits for one complete set of the wayside apparatus for the centralized traffic control system of our invention, in which Figs. 1A, 1B and 1C show the apparatus located adjacent the track switch 1W at the end of a block, while Figs. 1D, 1E and 1F show the apparatus at the intermediate point at which the track switch 3W and signal 4RB are located. The apparatus located at the right-hand end of this block is not shown for the reason that this is identical to that shown in Figs. 1A, 1B and 1C and may be represented by these views by placing them at the right of Fig. 1F.

Fig. 2 shows in simplified form the apparatus at the control office for the wayside circuits of Figs. 1A to 1F, together with a miniature track diagram of the tracks of a complete block.

In the description which follows the functions of the various elements of the system will first be defined, the general mode of operation of the system will then be briefly described, and finally, the circuits will be traced in detail in connection with the operations involving the movement of trains through the block.

Similar reference characters refer to similar parts in each of the views, and similar relays at different locations are identified in the drawings by different numerical prefixes which correspond to the number of the switch or signal with which they are associated. It is to be understood that when in the course of the description a relay is identified only by a letter combination such as RHS, for example, the description applies to each of the relays 2RHS, 4RHS, etc., shown on the drawings.

To simplify the drawings, the local sources of current for energizing the various circuits are not shown. Each such source is identified by its terminal designations, the positive and negative terminals being designated B and N, respectively. Certain of the local sources also have a center or middle terminal C.

The remote control system employed in connection with our invention is substantially similar to that described in the hereinbefore-mentioned Lewis patent, and consideration of its detailed mode of operation is not needed further than to note that it provides a plurality of intermittently available control and indication channels between the office and stations at the ends of the sidings.

For simplicity, the various channels which are established by code action are represented herein by the equivalent direct wire connections.



The apparatus of our invention will be described in connection with the traffic block shown in the track diagram of Fig. 2, which has an entering signal 2R and a leave-siding signal 4RB for governing eastbound traffic movements into the block and two opposing entering signals 6LA and 6LC for governing westbound traffic movements into the block. It will be understood that the block system includes a plurality of successive blocks each arranged like the one shown. These signals are controlled from three successive field stations of the remote control system, comprising one at the location of switch 1W for the control of signal 2R and of the opposing entering signals 2LA and 2LB for the next block at the left, one at the location of switch 3W for the control of signal 4RB, and one at the location of switch 5W for the control of signals 6LA and 6LB and of the entering signal 6R for the next block at the right.

In Fig. 2 there are shown three panels of the office control machine each arranged as in the Lewis patent to include a switch lever SW, a signal lever SG and control code starting button STB and connected over the channel wires *1a*—*1a*, *1b*—*1b* etc., with the three successive field stations at the locations of switches 1W, 3W and 5W, respectively. As already mentioned, the apparatus at the location of switch 5W is not shown because it is identical with that at switch 1W. These circuits function in a manner analogous to the code action described in the Lewis patent, that is to say, in response to the pressing of a starting button STB, impulses are transmitted which cause switch and signal control relays such as the relays WS, LHS, RHS and LSS at a selected station to assume positions determined by the positions of the corresponding switch levers SW and SG at the office. As shown herein the switch and signal control relays are of the polar stick type arranged to operate their contacts to the left when terminal B is applied to the left-hand terminal of the relay winding (or when terminal N is applied to the right-hand terminal) and to operate their contacts to the right when these connections are interchanged, the relay remaining in its last operated position when deenergized.

The indication channels for the control of the lamps of the track diagram are also represented schematically herein by direct wire connections, while those for controlling the lamps which indicate switch and signal conditions are not shown, since their operation is conventional.

It will be apparent that although the system of our invention employs hand throw switches, the manipulation is essentially the same, as far as the operator is concerned, as that of the conventional centralized traffic control system employing power operated switches.

Referring now to the wayside apparatus as shown in Figs. 1A to 1F, it will be seen that the detector track section 1T and the siding section 3T are each provided with a conventional track circuit having a track battery TB at one end and a track relay TR at the other end, while each remaining section is equipped with a reversible coded track circuit having a polar stick transmitter relay LCTP or RCTP and a code following track relay LTR or RTR at each end. Relay 2RCTP normally has its contacts in the left-hand position, as shown, so that steady current is supplied from the adjacent track battery

2RTB to the rails of section 2–4T. Relays 2LCTP, 4LCTP and 4RCTP have their contacts normally in the right-hand position, as shown, in which they connect the associated track relay across the rails of the section.

Each code following track relay LTR or RTR is of the biased polar type so connected as to be responsive to current of the polarity supplied by the track battery RTB or LTB at the opposite end of the section but to be non-responsive to current from the adjacent track battery. Relays 4LTR and 4RTR, for example, are non-responsive to current from battery 4LTB or 4RTB. even though the insulated joints between sections 2–4T and 4RT are broken down.

Figs. 1E, 1F, 1A and 1B, arranged in the order given, show the coded track circuit apparatus for the opposite ends of the single track stretch which comprises the major portion of the block. Usually this portion will have a length of from five to ten miles and will include a series of cascade connected track sections comprising cut sections and at least two intermediate signal locations for repeating the track circuit currents and for the control of the distant signals 22 and 24. Consideration of these elements is not needed for an understanding of our invention and to simplify the description it will be assumed that sections 4RT and 2LT are adjoining portions of the same track section.

The normally deenergized coded track circuit system is set into operation by picking up a traffic relay at the exit end of the block, such as the stick relay 4RCS, Fig. 1F, or 2LCS, Fig. 1A, designated the code sending relay, by the transmission of an actuating code impulse over the rails from the opposite end of the stretch. Each code sending relay, when energized, by closing its front control *b*, picks up a slow release repeater relay 4RCSP or 2LCSP which controls various circuits as required at the exit end of the block and by closing its front contact *c* connects the winding of the associated transmitter relay 4RCTP or 2LCTP to the contacts of a continuously operating code transmitter 75CT or 180CT, of the pendulum type, so that the transmitter relay is operated periodically at the rate of 75 or 180 times per minute to supply coded signaling current of the corresponding code frequency to the rails of the stretch.

In response to the coded signaling current received over the rails of section 4RT or 2LT, the code following track relay 4RTR or 2LTR energizes a slow release track repeater relay 4RTFP or 2LTFP which completes a circuit over contact *b* of the track relay for supplying impulses of alternately opposite polarity to the primary winding of a decoding transformer DT, inducing impulses in its secondary winding which are rectified by the track relay contact *c* and supplied to a code detector relay 4RH or 2LH, which is of the slow pick-up, slow release type and does not assume its energized position until at least three successive impulses of coded signaling current have been received.

Each cycle of the "actuating code" by which the system is set into operation comprises an "on" period of about six seconds' duration followed by an "off" period of equal duration. This code is generated by the cyclic operation of a pair of interconnected slow release actuating code relays 4RSP and 4RSPA, Fig. 1E, which are set into operation by reversing the signal control relay 2RHS, Fig. 1B, or 4RHS, Fig. 1E, or by operation of the similar relays 2LSP and 2LSPA, Fig. 1A, which are set into operation by reversing the signal control relay 2LHS, Fig. 1B. The transmission of the actuating code relays is stopped by the energization of the associated code detector relay 4RH or 2LH during an "off" period in the actuating code. Normally this occurs during the first "off" period and the actuating code then consists of but a single pulse of six seconds' duration.

The operation of the normally deenergized coded track circuit is discontinued when the stretch is vacated and the signal control relay by which the system was set into operation has been restored to its normal, or left-hand position, by the transmission of a restoring code over the rails of the stretch.

The restoring code is generated by the cyclic operation of a pair of slow release restoring code relays 4RR and 4RRP, Fig. 1E, or 2LR and 2LRP, Fig. 1B. Each cycle of the restoring code comprises a steady "on" period of six seconds' duration followed by a succession of 75 code pulses for six seconds terminating with an "off" period of six seconds' duration. This code is transmitted from the entrance end of the stretch, and the effect of the initial steady current pulse is to override the coded signaling current being received from the opposite direction and to stop its further transmission due to the fact that the operation of the transmitter relay contacts from left to right to initiate an "off" period in the signaling code enables the associated track relay to be picked up by current received over the rails, and the latter by opening its contact *a*, disconnects terminal B from the circuits for operating the transmitter relay from right to left. The succeeding period of 75 code transmission then momentarily picks up the code detector relay LH or RH and thereby releases the energized code sending relay, which prevents re-initiation of the signaling code during the "off" period of the restoring code and thereby prevents further operation of the restoring code relays.

To prevent improper signal operation by the relay LH or RH under the conditions discussed above, the signal circuits are not governed directly by relay 4LH or 2RH but by a code detector repeating relay 4LHPB or 2RHPB which is controlled by two interposed slow pick-up slow release repeating relays 4LHP and 4LHPA or 2RHP and 2RHPA, so that it does not pick up until coded signaling current has been received continuously for a period of about 20 seconds.

In addition to the foregoing, the apparatus at each end of the single track stretch includes a stick relay such as relay 2RKS or 4LKS and a slow release relay such as relay 2RKR or 4LKR. The relays RKR and LKR at the opposite ends of the stretch jointly govern the transmission of indications of block occupancy to the office over the code indication channels 14, the operation being such that when the system is set up for eastbound traffic, for example, the code sending relay LCSP at the right-hand end of the single track stretch is energized and the associated stick relay LKS is released. Under this condition the relay LKR at the right-hand end of the stretch is released and supplies energy to the indication channel 14c, as will be readily apparent from consideration of the circuits for the corresponding relay 2LKR of Fig. 1A, and consequently the block indication relay 6LBK, Fig. 2, is picked up to prepare a circuit for lamp 4–6BKE. At the left-hand end of the single track stretch, relays 4RKS and 4RKR, Fig. 1F, are picked up by the code detector repeater relay 4RHP. The circuit

for lamp 4–6BKE is completed by relay 4RBK when relay 4RKR, Fig. 1F, is released due to the occupancy of the stretch. When the system is set up for westbound traffic, relay 4RKR is released by relay 4RCSP to hold relay 4RBK energized, and relay 6LBK picks up to light lamp 4–6BKE when a train enters the stretch.

The coded track circuit system for section 2–4T, shown in Figs. 1C–1D, is arranged to be set into operation by energizing a traffic relay 2RFS or 4LFS over a reversible line circuit which includes the line wires 20 and 21 which extend from one end of the siding to the other. This line circuit is energized at the entrance end of the block by the operation of a traffic locking relay 2RTL governed by the signal control relay 2RHS or by a similar relay 4LTL governed by relay 4RHS or 4RCSP.

The transmitter relays 2RCTP and 4LCTP for section 2–4T, likewise the code following track relays 2RTR and 4LTR and their slow release repeating relays 2RTFP and 4LTFP and the code detector relay 4LH all function in the manner described for the similarly designated elements of the system for the single track stretch. The system for section 2–4 however includes two additional decoding relays 2RD and 4LD which are controlled through resonant decoding units 180DU of a well-known type and are selectively responsive to coded signaling currents of the 180 code frequency only.

The block indication lamp 2–4BKE for this section is controlled by the indication relay 4LBK controlled over the remote control system channel 12*b* by a slow release relay 4LKR. Normally, and also when the system is set up for westbound traffic, if section 2–4T is not occupied, relay 4LKR is held energized by relay 4LTFP. When eastbound traffic is set up, if section 2–4T is not occupied, relay 2RTFP is energized and reverses the polarity of the current supplied to relay 4LFS, to hold relay 4LKR energized.

The indication lamps 1TKE, 3TKE and 5TKE on the track diagram of Fig. 2 are controlled by the indication relays TK governed over the remote control system channels 10*a*, 10*b* and 10*c*, by their respective track relays.

The coded track circuit system for section 2–4T also includes two directional stick relays 4LS and 1NS, which become energized when a westbound train enters section 2–4T and section 1T, respectively.

The local interlocking circuits for the signals are to a large extent conventional. These include normal and reverse switch indication relays NWP and RWP which reflect the position and locked condition of the track switches, and in the case of switch 1W, are energized only when the switch control relay 1WS occupies a corresponding position, a stick repeater relay 1RWPS for relay 1RWP, block repeating relays BPR controlled jointly by the signal control and code detector relays, approach locking stick relays RAS and LAS which are released by the relay BPR when a signal is to be cleared and are picked up only when the signal has been restored to stop by the passage of a train or by the operation of a time element device 2TER, the signal relays 2RAH, 2LAH, 2LCH and 4RBH for controlling the lamps G and R of the color light signals, and the relays 2RSH, 2LSS, 2LCSH and 4RSH for controlling the "S" indicators associated with the signals.

It is to be understood that in practice the system of our invention will include a number of features which have been omitted in order to simplify the drawings, but which nevertheless determine the form and arrangement of the circuits as shown herein to some extent.

For example, the system is arranged to employ a minimum amount of energy so that primary batteries can be used in territory remote from commercial power sources and includes the conventional means for lighting the signal lamps automatically upon the approach of trains. It is also the practice to employ "light-out" relays with windings in series with the signal lamps for governing the transmission of signal indications to the office and for controlling the coded current supplied to the distant signals.

Furthermore the system is so arranged that it is suitable for use with a coded cab signaling system of the type shown for example in Letters Patent of the United States No. 1,986,679, issued January 1, 1935, to L. V. Lewis, for Railway Traffic Controlling Apparatus, in which alternating current in the track rails is interrupted at the rate of 75 or 180 times per minute to govern vehicle carried apparatus for the control of the aspects of a cab signal reflecting traffic conditions ahead of the vehicle. The code frequencies of the track circuit currents employed in our system are the same as those required for cab signaling purposes under each of the different conditions of operation. It follows that alternating currents to which the vehicle carried receivers are responsive may be superimposed upon the current supplied by the track batteries LTB and RTB and that this current will be properly coded by the operation of the relays LCTP and RCTP, as required for cab signaling purposes. Coded alternating currents may be superimposed upon the non-coded main line sections, such as 1T, in a conventional manner as will be readily understood.

Finally, the apparatus of our invention is arranged in such a manner that automatic clearing of the signals by the approaching trains may be provided for under emergency conditions when the remote control system is disabled, as disclosed, for example, in a co-pending application for Letters Patent of the United States, Serial No. 41,112, filed July 28, 1948, by Harry C. Van Tassel, for Centralized Traffic Control Systems.

The system of our invention may also be readily adapted to the control of electric switch locks such as are required in centralized traffic control systems for the protection of outlying track switches leading to industrial sidings or the like, but the circuits have not been shown herein in order to simplify the disclosure. Circuits for this purpose suitable for use in connection with the system of our invention are disclosed in a co-pending application for Letters Patent of the United States, Serial No. 14,244, filed March 11, 1948, by C. W. Failor and C. B. Shields.

The mode of operation of the system of our invention, briefly described, is as follows:

(1) To clear signal 2R for an eastbound train movement over the main track:

The operator moves the signal lever 2SG to the right, and presses the remote control system starting button 1–2STB, thereby operating the signal control relay 2RHS, Fig. 1B, to its right-hand or reverse position. The traffic locking relay 2RTL, Fig. 1C, is thereby energized over contacts *a* of relays 2RHS and 1NWP, contact *d* of relay 1RWPS, wire 25, and contact *b* of relay

2RFS, and the traffic relay 4LFS, Fig. 1D, is energized in the normal direction, its polar contact *d* remaining open, over back contacts *b* and *c* of relay 2RTFP, front contacts *a* and *b* of relay 2RTL, line wire 20 and 21, and back contacts *b* and *c* of relay 4LTL, and energizes its repeater relay 4LFSP. Relay 2RTL operates the transmitter relay 2RCTP to the right to disconnect battery 2RTB from the rails of section 2–4T, which releases the track relay 4LTR and its repeater relay 4LTFP, and at the same time, relay 4LFS by closing its front contact *c* in a circuit hereinafter traced in detail causes relay 4LCTP to supply 75 code pulses from battery 4LTB to the rails of this section to operate the track relay 2RTR and pick up relay 2RTFP. The closing of front contact *c* of relay 4LFSP sets the actuating code relays 4RSP and 4RSPA, Fig. 1E, into operation, and these relays, by completing circuits hereinafter traced in detail, cause the transmitter relay 4RCTP to supply an actuating code impulse to the rails at the left-hand end of section 4RT, to operate the track relay at the right-hand end of the single track stretch, adjacent signal 6R. This track relay, not shown, corresponds to relay 2LTR at the similar location at the right-hand end of section 2LT, in Fig. 1A, and its operation by the actuating code impulse energizes its repeating relay corresponding to relay 2LTFP and also energizes the code sending relay and its repeater corresponding to relays 2LCS and 2LCSP. Upon the termination of the actuating code impulse the track relay and its repeater at the right-hand end of the stretch release, but the associated code sending relay is held energized over its stick circuit and causes the associated transmitter relay corresponding to relay 2LCTP to supply 75 code to the rails of the single track stretch at its right-hand end. The transmission of an actuating code impulse by relay 4RCTP thus has the result that the coded track circuit system for the single track stretch including section 4RT is set into operation by the code sending relay corresponding to relay 2LCS, at its right-hand end, and in Fig. 1F, relays 4RTFP, 4RH, 4RHPA and 4RHP will pick up, due to the reception of coded signaling current over the rails of section 4RT by the track relay 4RTR.

The operation of relays 4RTR and 4RTFP prevents the transmission of a second actuating code impulse by relay 4RCTP, and when relay 4RHP picks up, relay 4RHPA releases, energizing relay 4RHPB, Fig. 1E, which by opening its back contact *b*, prevents further operation of the actuating code relays 4RSP and 4RSPA, and by the operation of its contact *c* changes the frequency of the coded signaling current supplied to the rails of section 2–4T by relay 4LCTP from 75 to 180 code, with the result that the code detector relay 2RD picks up in Fig. 1C and by closing its contact *a*, energizes the block repeater relay 2BPR over wire 26 and contacts *b* of relays 1NWP and 1TP. Since relay 2RHS is now reversed, the opening of back contact *b* of relay 2BPR opens the stick circuit including wires 27 and 28, for the approach locking relay 2RAS, which relay releases and completes at its back contact *b* the circuit for the signal relay 2RAH including wire 29 and front contact *d* of the normal indication relay 1NWP, so that relay 2RAH becomes energized to extinguish the stop indication lamp R and to light the proceed indication lamp G, of signal 2R.

It will be seen that the two coded track circuit systems are now energized in tandem, in accordance with a feature of our invention, as a result of the energization of the line wires 20 and 21. Our invention also includes means for restoring the coded track circuit system for the rear section to its inactive condition as soon as that section is vacated by a train moving through the block, as hereinafter described. The circuits for the transmitter relay 2LCTP of Fig. 1A are similar to those for the relay LCTP at the location of signals 6LA and 6LC in Fig. 2, and it will be seen that relay 2LCTP is controlled over wire 30 and front contacts *e* of the detector section track relay 1TR and the approach locking relay 2LAS for signals 2LA and 2LC. From Fig. 1D it will be seen that the transmitter relay 4LCTP is controlled over a wire 31, a front contact *a* of the normal indication relay 3NWP for switch 3W and a front contact *e* of the approach locking relay 4RAS for signal 4RB. The transmitter relay 4RCTP, Fig. 1F, is controlled over wire 53 and front contacts *c* of relays 3NWP and 4RAS, while the transmitter relay 2RCTP, Fig. 1C, is controlled over wire 73 and front contact *c* of the approach locking relay 2RAS for signal 2RA. It follows that the opposing or conflicting signals are fully interlocked by their control of the coded track circuit systems in accordance with a feature of our invention, as will be pointed out hereinafter in detail.

(2) To authorize an eastbound train to enter the siding over switch 1W reversed:

The operator first reverses the switch lever 1SW and then moves the signal lever 2SG to the right and presses the starting button 1–2STB, with the result that relays 1WS and 2RHS, Fig. 1B, are both operated to the right. Relay 1NWP is released by the reversal of relay 1WS, and its contact *a* opens the circuit for relay 2RTL over wire 25 so that the coded track circuit system is not set into operation in this case. Relay 2RSH is energized over the reverse contact *c* of relay 2RHS, the reverse contact *b* of relay 1WS and wire 32, and completes the circuit for lighting the S indicator along with lamp R of signal 2R to authorize this train movement.

(3) To clear signal 6LA for a westbound train movement over the main track:

The operator moves the signal lever 6SG to the left and presses button 5–6STB, thereby operating the corresponding signal control relay to reverse. The signal control relay for signal 6LA is not shown, since its operation is similar to that of the corresponding relay 2LHS, Fig. 1B, for signal 2LA, and as shown for relay 2LHS, the closing of the reverse contact *c* of this relay completes a circuit over wire 33 for the actuating code relay 2LSP, Fig. 1A, which energizes its repeater relay 2LSPA, and the closing of the front contacts *b* of these relays causes the associated transmitter relay 2LCTP to supply an actuating code impulse to the rails of section 2LT at its right-hand end. The reversal of the signal control relay for signal 6LA thus results in the transmission of an actuating code impulse from the right-hand end of the stretch, the reception of which over the rails of section 4RT operates the track relay 4RTR and thereby causes the energization of its repeater relay 4RTFP and of the code sending relay 4RCS, Fig. 1F, and its repeater 4RCSP. Relay 4RCS prepares a circuit over its front contact *c* for the transmitter relay 4RCTP, but this relay does not begin to supply coded signaling current to the rails of section 4RT until the code detector

relay 4LH for section 2–4T picks up. Relay 4RCSP, by closing its contact *d*, energizes the traffic locking relay 4LTL, Fig. 1D, over wire 34, contact *d* of the normally energized track relay 4LTR, and back contact *b* of relay 4LFSP, and relay 4LTL then energizes the traffic relay 2RFS, Fig. 1C, over the line wires 20 and 21. Relay 2RFS by closing its front contact *c* sets the transmitter relay 2RCTP into operation at the 75 code rate to supply coded signaling current to the rails of section 2–4T in place of steady current. The energization of the code detector relay 4LH in response to the operation of the track relay 4LTR by this current causes relay 4RCTP to supply coded signaling current to the rails of section 4RT at the left-hand end of the single track stretch as soon as the actuating code impulse being supplied from the right-hand end of the single track stretch is terminated. The operation by this coded current of the track relay at the right-hand end of the stretch, adjacent signal 6R, serves to prevent further transmission of actuating code impulses and to energize the code detector relay LH for signal 6LA by operations similar to those of Example (1). The two coded track circuit systems are now energized in tandem as in Example (1) but in the opposite direction. Since the local circuits for the signal 6LA which is to be cleared and not shown, those for the similarly controlled signal 2LA will be described. It will be seen from Fig. 1A that the code detector relay 2LH, when energized, picks up the repeating relays 2LHPA and 2LHP, and then relay 2LHPA releases to pick up relay 2LHPB, front contact *a* of which completes a circuit over wires 26 and 33 to energize the block repeating relay 2BPR.

Since relay 2LHS is now reversed, the opening of back contact *a* of relay 2BPR opens the stick circuit including wires 36 and 37 for the approach locking relay 2LAS, the release of which completes a circuit over wire 38 for the signal relay 2LAH so that this relay becomes energized to extinguish lamp R and to light lamp G of signal 2LA (or of signal 6LA, in the case of the similar apparatus at the right-hand end of the block having signal 2R at its left-hand end).

(4) To clear signal 6LA for a westbound train and to authorize that train to enter the siding over switch 3W:

The operator reverses the switch lever 3SW, moves lever 6SG to the left and then presses button 5–6STB, with the result that the control relays for signal 6LA corresponding to 2LSS and 2LHS for signal 2LA are operated to reverse. The resulting operations are the same as in Example (3) except that when the signal relay for signal 6LA which corresponds to relay 2LAH is energized to light the signal lamp G, lamp S is lighted over the circuit including wire 39 and contact *a* of the associated relay corresponding to relay 2LSS. The lighting of lamps G and S of signal 6LA authorizes the train to proceed to the location of switch 3W and enter the side track over that switch.

(5) To clear signal 6LC for a westbound train movement over the main track:

The operator reverses the switch lever 5SW, moves lever 6SG to the left and then presses button 5–6STB, with the result that the control relays at the location of signal 6LC corresponding to 1WS and 2LHS are operated to reverse. The resulting operations are the same as in Example (3) up to the point where the block repeating relay BPR becomes energized. Considering again the circuits for signal 2LC which are similar to those for signal 6LC, it will be seen that in this case relay 2BPR does not pick up when relay 2LHPB becomes energized because its circuit is open at the front contact *b* of relay 1NWP, which relay has been released by the reversal of the switch control relay 1WS, but that when the code detector relay 2LH picks up, a circuit is completed over wires 41 and 40 for the signal relay 2LCSH, which relay picks up and lights the lamp S below lamp R of signal 2LC to authorize the train crew to operate switch 1W to reverse. When this operation is completed, the reverse indication relay 1RWP and its repeater 1RWPS pick up to complete a circuit for relay 2BPR over back contact *b* of relay 1NWP and front contact *b* of relay 1RWPS, and relay 2BPR then picks up and energizes relay 2LCH over wire 42, to light lamp G of signal 2LC. Relay 2LCSH is released by the opening of back contact *c* of relay 2LCH and lamp S is extinguished.

The lighting of lamp G of the corresponding signal 6LC, with lamp S dark, authorizes the train to proceed over the main track to the location of signal 2LA.

(6) To clear signal 6LC for a westbound train and to authorize that train to enter the siding over switch 3W:

The operator reverses the switch levers 3SW and 5SW, moves lever 6SG to the left and presses button 5–6STB with the result that the control relays at the location of signal 6LC corresponding to relays 1WS, 2LSS and 2LHS are operated to reverse. The resulting operations are the same as those considered with reference to signal 2LC in Example 5 except that when relay 2LCH picks up to light the signal lamp G, the lamp S remains lighted, since relay 2LCSH is now energized over wire 43 and the reverse contact *b* of the control relay 2LSS. The lighting of lamp S along with lamp G of signal 6LC authorizes the westbound train to proceed and to enter the next siding over switch 3W reversed.

(7) To clear signal 4RB to authorize an eastbound train to enter the block over switch 3W:

The operator reverses the switch lever 3SW, moves the signal lever 4SG to the right and presses button 3–4STB, with the result that the control relays 3WS and 4RHS are operated to reverse.

The traffic locking relay 4LTL, Fig. 1D, picks up over wire 34 and contact *a* of relay 4RHS to set up the coded track circuit system for section 2–4T for westbound traffic as in Example (3) above, and the actuating code relays 4RSP and 4RSPA, Fig. 1E, are set into operation by the closing of the reverse contact *c* of relay 4RHS to set up the coded track circuit system for the single track stretch for eastbound traffic as in Example (1) above. That is, relay 2RCTP is set into operation to supply coded current to the rails of section 2–4T at its left-hand end to operate the track relay 4LTR at the location of signal 4RB, and at the opposite end of the single track stretch the transmitter relay corresponding to relay 2LCTP is set into operation to supply coded current to the rails of the stretch, including section 4RT, to operate the track relay 4RTR. It will be evident that the operation of the track relays 4LTR and 4RTR by coded current indicates that the entire block is vacant and that the approach locking relays at the ends of the block are energized. Upon this condition both of the code detector relays 4LH and 4RH and the repeater relays 4RHP and 4RHPB at the

location of switch 3W will become energized to complete a circuit for the block repeating relay 4BPR which may be traced from terminal N through its winding over reverse contact *b* of relay 3WS to wire 19, back contact *b* of relay 4RCSP, wire 23, front contact *b* of relay 4LH, back contact *f* of relay 4LFSP, wire 35, front contact *a* of relay 4RHPB to terminal B at the reverse contact *c* of relay 4RHS. Relay 4BPR will then become energized to release the approach locking relay 4RAS and energize the signal relay 4RSH to light lamp S of signal 4RB, and thereby authorize the train crew to operate switch 3W to reverse. When this operation is completed, the reverse switch indication relay 3RWP picks up and energizes the signal relay 4RBH to light lamp G and to extinguish lamps R and S of signal 4RB, thereby authorizing the train in section 3T to enter the main track over switch 3W.

Signal 4RB may also be cleared when the westbound train discussed in Example 3 or 5 above has passed switch 3W and vacated section 4RT, due to the provision of the directional stick relay 4LS, Fig. 1D, which relay picks up to close its contact *b* which bridges the contact of relay 4LH in the circuit for relay 4BPR when the westbound train enters section 2–4T, as hereinafter described.

The step by step operation of the system will now be explained, in connection with the movement of trains through the stretch, and those circuits the operation of which is not obvious from the drawings will be traced in detail.

By reference to Figs. 1A, 1B and 1C it will be seen that the apparatus at the location of switch 1W constitutes a relay interlocking system in which the signals are governed manually by the remote control system and automatically by traffic conditions as reflected by the code detector relays 2LH and 2RD and by the track relay 1TR or its repeater 1TP in a manner which conforms to the accepted practice for systems of this character. Each signal in its stop position governs an approach locking relay 2LAS or 2RAS which must be energized to enable an opposing or conflicting signal to be cleared or to enable the switch control relay 1WS to be operated, and must be released to enable the associated signal to be cleared. Relay 2RAS, for example, is normally energized over a stick circuit from terminal N which includes its winding and front contact *a*, wire 27, back contact *c* of the signal relay 2RAH, wire 28, and extends to terminal B at the contacts *b* of relays 2RHS and 2BPR. Relay 2RAS has a pick-up circuit including back contact *a* of relay 1TR by which the relay is picked up automatically when a train enters the stretch and a second pick-up circuit including a front contact *a* of a time element relay 2TER which closes at the end of a predetermined delay period of from two to six minutes, following the manual return of signal 2RA to stop. The circuit for relay 2LAS is similar, except that it includes wire 36, back contacts *b* of relays 2LAH, 2LCH and 2LCSH and wire 37, and extends to terminal B over the normal contact *b* of relay 2LHS or over back contact *a* of relay 2BPR and the reverse contact *b* of relay 2LHS. The switch control relay 1WS is operable only when the signals are at stop, its circuit extending to terminal N over contact *f* of relay 1TP, contact *c* of relay 2LAS, wire 35 and back contacts *b* of relays 2RAH and 2RSH. The circuit for the block repeating relay 2BPR extends from terminal N through its winding over contacts *b* of relays 1TP, 1NWP and 1RWPS to wire 26, from which point one branch extends over back contact *d* of relay 2LCSP, Fig. 1A, front contact *a* of relay 2LHPB to wire 33, to terminal B over the reverse contact *c* of relay 2LHS and the normal contact *c* of relay 2RHS, and another branch extends from wire 26 over contact *a* of relay 2RD, Fig. 1C, back contact *a* of relay 2RFS, wire 44, normal contact *b* of relay 1WS to terminal B over the reverse contact *c* of relay 2RHS and the normal contact *c* of relay 2LHS. The circuit for the signal relay 2RAH extends from terminal N through its winding to wire 29 and thence over contacts *d* of relays 1NS and 1NWP, contacts *b* of relays 2RAS, 2TER, 2LAS, 2BPR and 2RHS to terminal B. The circuits for the signal relays 2LAH and 2LCH extend over wires 38 and 42 to contacts *c* of relays 1NWP and 1RWPS, respectively, and thence over contacts *b* of relays 2LAS, 2TER and 2RAS, contact *a* of relay 2BPR to terminal B at contact *b* of relay 2LHS. Relays 1NWP and 1RWP are normal and reverse indication relays for switch 1W, and are controlled in a conventional manner and indicate the position and locked condition of switch 1W and also indicate its correspondence with the position of its control relay 1WS. Relay 1RWSP is controlled in an obvious manner and serves to prevent a change in the indicated route in the event switch 1W has been reversed and is restored to normal before section 1T is vacated. Relay 1RWPS when energized provides a circuit over its front contact *e* for the transmitter relay 2RCTP which is independent of the track relay 1TR. This enables signal 4RB, 6LA or 6LB to be cleared even though section 1T is occupied by a train which is entering or leaving the siding at its left-hand end. Relay 1NS is a directional stick relay which is picked up over wires 45 and 46 by relay 2LAH and its front contact *c* provides another circuit for the transmitter relay 2RCTP which is independent of the track relay 1TR, the purpose of which is to enable signal 4RB, 6LA or 6LB to be cleared when section 1T is occupied by a westbound main line train.

It will be readily apparent from Fig. 1B that when a train enters section 1T, relays 1TR and 1TP release. Contact *a* of relay 1TP completes circuits for energizing the signal control relays 2RHS, 2LHS and 2LSS in the normal direction and to energize the track indication relay 1TK at the office over channel 10*a*, to indicate the occupancy of section 1T by lighting lamp 1TKE in the track diagram. Relay 2BPR and the energized signal relay will release, and the corresponding approach locking relay 2RAS or 2LAS will pick up over contact *a* or *c* of relay 1TR.

In considering the operation of the coded track circuit systems, it is to be noted that the transmitter relays RCTP and LCTP are of the stick polar type arranged so that their contacts remain in the last operated position when deenergized, and that each such relay is shown deenergized with one terminal of its winding connected to terminal B or N over its own contact *a* and the other terminal connected over a circuit network to the same terminal B or N. Each such relay is arranged to operate its contacts to the right or left and to open its own circuit, following the connection of its circuit network to terminal N or B, respectively. Relay 2RCTP, Fig. 1C, for example, is operated to the right over back contact *c* of relay 2RFS when relay 2RTL picks up, and to the left when relay 2RTL releases.

Referring now to the operations involved in clearing signal 2R as described in Example (1) above, it has been pointed out that relay 2RCTP assumes its right-hand position when relay 2RTL picks up as the result of the reversal of relay 2RHS, and disconnects battery 2RTB from the rails of section 2–4T, thereby releasing relays 4LTR and 4LTFP, Fig. 1D. Relay 4LFS is energized by relay 2RTL over wires 20 and 21 and initiates the operation of relay 4LCTP to supply coded signaling current of 75 impulses per minute from battery 4LTB to the rails of section 2–4T, by completing a circuit for relay 4LCTP over wire 31, front contact *a* of relay 3NWP, front contact *e* of relay 4RAS, wire 47, back contact *d* of relay 4LS, back contact *e* of relay 4LFSP, front contact *c* of relay 4LFS, wire 49, to contact *a* of the code transmitter relay 75CT, which when picked up connects the circuit over wire 50 to terminal B at back contact *a* of relay 4RTR. Relay 4LFSP picks up and shifts the portion of the circuit from wires 47 to 49 to include its front contact *e*, wire 48 and back contact *c* of relay 4RHPB in place of contact *c* of relay 4LFS. Contact *a* of the code transmitter 75CT connects the circuit alternately to terminal B over wire 50 and back contact *a* of relay 4LTR, or to terminal N. Relay 2RTR responds to the code received over the rails of section 2–4T and energizes relay 2RTFP, which reverses the polarity of the current supplied over line wires 20 and 21. Relay 4LFS closes its reverse contact *d*, completing a circuit over its contact *a* to hold relay 4LKR energized after relay 4LTFP releases.

As mentioned in connection with Example (1) above, and as hereinafter described in detail, the code detector relay 4RH for the single track stretch also becomes energized. When this occurs, the repeater relay 4RHBP picks up and its contact *c* shifts the circuit for relay 4LCTP to include contact *a* of the code transmitter 180CT so that 180 code replaces 75 code in the rails of section 2–4T. Relay 2RD picks up in response to the 180 code and causes signal 2R to clear in the manner hereinbefore described.

Relays 2RTL, 4LFS and 4LFSP are held energized when signal 2R is cleared, and following its return to stop, until relay 2RAS picks up and section 1T is vacated, for the reason that wire 25 is connected to terminal B not only at contact *a* of relay 2RHS but also at back contacts *d* of relays 2RAS and 1TP.

When the eastbound train enters section 1T signal 2R is put to stop and lamp 1TKE in the operator's track diagram becomes lighted as has just been explained, and when the train enters section 2–4T the code operation of relay 2RTR ceases and relay 2RTFP releases. Current of normal polarity is again supplied to relay 4LFS and its contact *d* opens, releasing relay 4LKR and energizing relay 4LBK, Fig. 2, over channel 12*b* to light the block indication lamp 2–4BKE.

The release of relay 2RTL when section 1T is vacated operates relay 2RCTP to the left, causing steady current to be supplied from battery 2RTB to the rails of section 2–4T behind the train. Relay 4LFSP is held energized over back contact *b* of relay 4LTFP until section 2–4T is vacated, whereupon relays 4LTR and 4LTFP pick up during an interval between the code pulses being supplied by relay 4LCTP. The operation of relay 4LCTP is terminated by the opening of back contact *a* of relay 4LTR, and its further operation is prevented due to the release of relay 4LFSP when relay 4LTFP picks up.

Relay 4LKR is picked up over contact *b* of relay 4LTFP and releases the indication relay 4LBK at the office, to extinguish the block indication lamp 2–4BKE.

It will be seen, therefore, that the coded track circuit system for section 2–4T is restored automatically to its normal condition as soon as this section is vacated by an eastbound train. As will hereinafter be pointed out, the two coded track circuit systems are also arranged to be energized in tandem for westbound traffic and in that case also the rear section is restored to normal as soon as it is vacated, these arrangements constituting one of the features of our invention.

Considering now the coded track circuit system for the single track stretch and its mode of operation as required for the clearing of signal 2R as described above, it has already been pointed out that the actuating code relays 4RSP and 4RSPA of Fig. 1E are set into operation when relay 4LFSP is picked up by the reversal of the signal control relay 2RHS. The circuit for relay 4RSP in this case extends over back contact *a* of relay 4RSPA, back contact *b* of relay 4RHPB, wire 51, front contact *c* of relay 4LFSP, wire 52 to terminal B over the normal contact *c* of relay 4RHS. When relay 4RSP picks up it energizes relay 4RSPA and thereby opens its own circuit, so that these relays operate periodically, at a rate of about five times per second, until the circuit for relay 4RSP is opened by relay 4RHPB due to the reception of coded signaling current. When relays 4RSP and 4RSPA are both picked up, the transmitter relay 4RCTP is operated to the left and supplies an actuating code impulse from battery 4RTB to the rails of section 4RT. The circuit for relay 4RCTP in this case extends from its winding over wire 53, front contacts *c* of relays 4RAS and 3NWP, back contact *b* of relay 4RRP, wire 54, back contact *b* of relay 4RTFP, wire 55, back contact *c* of relay 4LS, wire 56, back contact *c* of relay 4RCS, wire 57, front contacts *b* of relays 4RSPA and 4RSP, wire 58, and back contact *a* of relay 4RTR to terminal B. The actuating code relay 4RSP releases after six seconds and its contact *b* connects terminal N in place of terminal *b* to the circuit for relay 4RCTP to operate it to the right to terminate the actuating code impulse. If this impulse results in setting the system into operation as explained below, coded signaling current will be received over the rails of section 4RT to pick up relays 4RTR and 4RTFP and relay 4RCTP will be maintained in its right-hand position by the connection over wires 53 and 54 to terminal N at front contact *b* of relay 4RTFP.

This actuating code impulse sets the system into operation by energizing a code sending relay at the right-hand end of the single track block extending to the location of signal 6R. The circuits for this relay are not shown because they are similar to those for the code sending relay 2LCS of Fig. 1A. By reference to Fig. 1A it will be seen that when an actuating code impulse, is received over the rails of section 2LT, relays 2LTR and 2LTFP will pick up and then the code sending relay 2LCS will pick up over the circuit including contacts *d* of relays 2LH and 2LTR, wire 59, contact *c* of relay 1TP and the normal contact *d* of relay 2LHS.

When the actuating code impulse is terminated, relays 2LTR and 2LTFP release to complete circuits for the transmitter relay 2LCTP over wire 30, front contacts *e* of relays 1TR and 2LAS, back contact *b* of relay 2LRP, wire 60, back contact *b* of relay 2LTFP, front contact *c* of

relay 2LCS, contact *d* of relay 2RAH and over wire 61 or 62 to contact *b* of the code transmitter 75 CT or 180 CT and thence alternately to terminal B at back contact *a* of relay 2LTR over wire 63, or to terminal N.

Coded signaling current is thus supplied from battery 2LTB to the rails of section 2LT at the 75 code rate when signal 2R is at stop and at the 180 code rate when signal 2R is clear. These codes control the distant signal 22 in a conventional manner to cause it to indicate caution or proceed, respectively.

The code detector relay at the left-hand end of each single track stretch such as the relay 4RH, Fig. 1F, is responsive to the code operation of the associated track relay at either of these frequencies, but when cab signaling is used, it is necessary to supply 180 code to the sections in the rear of signal 22 in order to provide a proceed cab signal indication when signal 22 indicates caution or proceed, as will be readily understood.

When relay 2LCS picks up as just described it completes a stick circuit at its contact *a* by which it is held energized until a restoring code impulse is received over the rails of section 2LT. Relay 2LCS energizes its repeating relay 2LCSP, which releases relay 2LKR and thereby energizes the block indication relay 2LBK, Fig. 2, over channel 14*a*.

At the right-hand end of the block shown in Fig. 2, relay 6LBK is energized in this manner to enable lamp 4–6BKE to be lighted by the operation of relay 4RBK, when the single track stretch is occupied by an eastbound train.

Referring now to Fig. 1F, relay 4RTR is operated periodically by the coded signaling current received over the rails of section 4RT from the right-hand end of the block, following the termination of the actuating code impulse, and relays 4RFTP, 4RH, 4RHPA and 4RHP pick up over obvious circuits and then relay 4RHPA releases. Relay 4RHPB in Fig. 1E picks up over wire 64 and contacts *b* of relays 4RHPA, 4RHP and 4RH, and relay 4RKS picks up over contacts *d* of relays 4RHPA and 4RHP, contact *f* of relay 4RH, contact *e* of relay 4RCSP, wire 65, and back contact *a* of relay 4RR.

When the eastbound train above referred to enters section 4RT, relay 4RTR ceases to operate and relays 4RTFP, 4RH, 4RHP and 4RHPB release, but relay 4RKS is held energized over its own front contact *a* and back contact *f* of relay 4RH. Relay 4RKR has been placed under the control of relays 4RHP and 4RHPA by the operation of relay 4RKS and now releases due to the opening of contact *c* of relay 4RHP so that relay 4RBK at the office becomes energized over channel 14*b* to light lamp 4–6BKE to indicate the occupancy of the single track stretch.

Assuming now that the eastbound train has entered the detector section at the exit end of the block, the code transmitter ceases to supply coded signaling current to the rails because its circuit which is similar to that of relay 2LCTP, Fig. 1A, will be connected over wire 30 to terminal N at the back contact *e* of the track relay corresponding to relay 1TR, which relay will also release its repeater relay corresponding to relay 1TP, and the latter will close its back contact *a* to energize the office indication relay 5TK over channel 16*c* to light lamp 5TKE.

When the eastbound train vacates the block, lamp 5TKE is extinguished and the transmitter relay corresponding to relay 2LCTP at the exit end of the block is set into operation at the 75 code rate so that, in Fig. 1F, relay 4RH becomes re-energized, and closes a circuit for the restoring relay 4RR, Fig. 1E, over wire 66, back contact *g* of relay 4LFSP, wire 67, contact *b* of relay 4RHS, wire 68, back contact *a* of relay 4RCSP and contact *c* of relay 4RH.

Relay 4RR picks up, energizing relay 4RRP and opening the circuit over wire 65, for relay 4RKS, which releases, and energizes relay 4RKR, and relay 4RKR then releases the office indication relay 4RBK and lamp 4–6BKE becomes dark.

When relay 4RRP picks up, the transmitter relay 4RCTP is operated to the left during an off period of the received code, to supply current from battery 4RTB to the rails of section 4RT. The circuit for relay 4RCTP now extends over wire 53, front contacts *c* of relays 4RAS and 3NWP, front contacts *b* of relays 4RRP and 4RR, wire 58 and back contact *a* of relay 4RTR to terminal B.

Relay 4RTR remains released due to the opening of the reverse contact *b* of relay 4RCTP, so that relays 4RTFP, 4RH and 4RR release, and relay 4RRP is deenergized. The closing of the back contact *b* of relay 4RR causes 75 code pulses to be supplied to relay 4RCTP over wire 69, back contact *c* of relay 4LH, wire 70, front contact *a* of relay 4RRP and contact *b* of the code transmitter relay 75CT, causing relay 4RCTP to supply 75 code to the rails of section 4RT for the duration of the release period of relay 4RRP. When relay 4RRP releases, relay 4RCTP is operated to the right over the circuit including wires 53, 54, 55, 56 and 57 and extending to terminal N at back contact *b* of relay 4RSPA.

Assuming that this restoring code, comprising a period of steady energy followed by a series of 75 code impulses, is received at the right-hand end of the block by the apparatus of Fig. 1A, it will be seen that the steady current received during an off interval in the code being supplied by relay 2LCTP will pick up relay 2LTR to disconnect terminal B from the circuit for relay 2LCTP, and relay 2LTFP picks up to connect terminal N to relay 2LCTP over wires 30 and 60 and front contact *b* of relay 2LTFP, holding relay 2LCTP in its right-hand position and enabling relay 2LTR to respond to the 75 code portion of the restoring code so that relay 2LH will pick up and release the code sending relay 2LCS. Relay 2LCSP releases after a delay period following the release of relay 2LCS and re-energizes relay 2LKR, thereby releasing the block indication relay 2LBK.

Relay 6LBK is released in this manner to open its contact *c* in the circuit for lamp 4–6BKE.

Relay 2LTFP releases when the code operation of relay 2LTR ceases, and the circuit for relay 2LCTP then extends over wires 30 and 60 to terminal N at back contact *b* of relay 2LSPA. This completes the restoration of the coded track circuit system for the single track stretch to the normally deenergized condition as shown in the drawings.

Referring now to the operations involved in the clearing of signal 2LA or 2LC, corresponding to those for clearing signal 6LA or 6LC for a westbound train as discussed in Examples (3) to (6) above, it will be seen from Figs. 1A and 1B that in each case, the reversal of relay 2LHS supplies energy over its reverse contact *c*, wire 33 and back contact *a* of relay 2LHPB to set the actuating code relays 2LSP and 2LSPA into operation, and relay 2LCTP is operated to the left to supply

an actuating code impulse from battery 2LTB to the rails of section 2LT, over the circuit including its winding, wire 30, front contacts *e* of relays 1TR and 2LAS, back contact *b* of relay 2LRP, wire 60, back contact *b* of relay 2LTFP, back contact *c* of relay 2LCS, front contacts *b* of the actuating code relays 2LSP and 2LSPA and extending to terminal B at back contact *a* of relay 2LTR. These actuating code relays function in a manner similar to that already described in connection with relays 4RSP and 4RSPA.

Assuming that this actuating impulse is received over the rails of section 4RT, Fig. 1F, relays 4RTR and 4RTFP will pick up to energize the code sending relay 4RCS over the circuit including contacts *d* of relays 4RH and 4RTR, wire 71, contact *d* of relay 4RHS, Fig. 1E, wire 72 and back contact *d* of relay 4LFSP, Fig. 1D, and relay 4RCS will pick up to complete the stick circuit including its own contact *a*, wire 72 and contact *d* of relay 4LFSP. Relay 4RCTP is not set into operation at this time, but its circuit is extended over wire 53, front contacts *c* of relays 4RAS and 3NWP, back contact *b* of relay 4RRP, wire 54, back contact *b* of relay 4RTFP, wire 55, back contact *c* of relay 4LS, wire 56, front contact *c* of relay 4RCS, wire 69, back contact *c* of relay 4LH, wire 70 and back contact *a* of relay 4RRP to terminal N. Relay 4RCS energizes relay 4RCSP, which releases relay 4RKR and thereby energizes the indication relay 4RBK over channel 14*b* to render the block indication lamp 4–6BKE responsive to the operation of relay 6LBK.

The energization of relay 4RCSP also sets the coded track circuit system for section 2–4T into operation as required for westbound traffic, by energizing relay 4LTL, Fig. 1D, over the circuit including back contact *b* of relay 4LFSP, front contact *d* of relay 4LTR, wire 34 and contact *d* of relay 4RCSP. By closing its contacts *d* and *a*, relay 4LTL prepares stick circuits by which it is held energized by relay 4RCSP until section 2–4T is occupied and by relay 4LTFP until section 2–4T is vacated.

Relay 4LTL energizes the traffic relay 2RFS over the line wires 20 and 21 and thereby sets the transmitter relay 2RCTP into operation by completing a circuit which may be traced from its winding over front contact *c* of relay 2RFS, wire 73, back contact *e* of relay 1RWPS, back contact *c* of relay 1NS, front contact *f* of relay 1TR, front contact *c* of relay 2RAS, wire 74, contact *d* of relay 2LAH, wire 75 or 76, contact *a* of the code transmitter 75CT or 180CT and thence alternately over wire 77 to terminal B at back contact *a* of relay 2RTR or to terminal N.

Relay 2RCTP therefore supplies 75 or 180 code to the rails of section 2–4T in place of the steady current which it normally supplies thereto, and in response to the code, relay 4LTR energizes relays 4LH and 4LHP, and when signal 2LA indicates proceed, also energizes relay 4LD.

The circuit for relay 4RCTP now extends over wires 53, 54, 55 and 56 to front contact *c* of relay 4RCS, as traced above, and thence over wire 69, front contact *c* of relay 4LH, contact *a* of relay 4LD, wire 78 or 79 to contact *b* of the code transmitter 75CT or 180CT and alternately over wire 58 to terminal B or to terminal N. It follows that the 75 or 180 code impulses received over the rails of section 2–4T are repeated over the rails of section 4RT to cause the distant signal 24 to indicate caution or proceed and to energize the code detector relay corresponding to relay 2LH, for signals 6LA and 6LB at the entrance end of the block, enabling 6LA or 6LB to be cleared in the manner already described for signals 2LA and 2LC.

Referring again to Fig. 1A, it will be seen that when the code detector relay 2LH picks up, the repeating relays 2LHPA and 2LHP pick up, and then relay 2LHPA releases and relay 2LHPB picks up and closes at its front contact *b* a circuit for relay 2LKS over back contact *b* of relay 2LCSP, wire 80, and back contact *a* of relay 2LR. Relay 2LKS picks up and prepares a stick circuit at its contact *a* over which it is held energized following the release of relay 2LHPB, and its contact *b* transfers the control of relay 2LKR from contact *c* of relay 2LCSP to contacts *c* of relays 2LHP and 2LHPA.

Assuming now that a westbound train governed by signal 6LA or 6LB enters the block, the signal will be restored to stop when the train enters the detector track section including switch 5W, the signal control relays will be restored to normal, and the approach locking relay LAS will be re-energized in a manner similar to that described above in connection with the occupancy of section 1T by an eastbound train. Lamp 4–6BKE will become lighted, due to the operation of relay 6LBK over channel 14*c* following the release of an indicating relay similar to 2LKR.

In the event the westbound train enters the siding over switch 3W as in Examples (4) and (6) above, section 2–4T remains unoccupied and when the train vacates section 4RT and relay 3NWP becomes energized due to the restoration of switch 3W to its normal position, the transmitter relay 4RCTP will again repeat the coded signaling current received from section 2–4T into the rails of section 4RT.

At the entrance end of the block, as shown in Figs. 1A and 1B, relays 2LTR, 2LTFP and 2LH operate and since relay 2LHS is now in its normal position, the restoring code relay 2LR picks up over the normal contact *a* of relay 2LHS, contact *e* of relay 1TP, wire 40, back contact *a* of relay 2LCSP and contact *c* of relay 2LH. Relay 2LR disconnects terminal B from wire 60 and thereby releases relay 2LKS, and relay 2LKR becomes energized and the block indication lamp extinguished to indicate that the single track stretch is no longer occupied.

Relay 2LRP is picked up by relay 2LR and completes a circuit for operating relay 2LCTP to the left during an off period of the code being received, to supply a restoring code impulse of current from battery 2LTB to the rails of section 2LT. The circuit for relay 2LCTP now extends over wire 30, front contacts *e* of relays 1TR and 2LAS, front contacts *b* of relays 2LRP and 2LR, wire 63 and back contact *a* of relay 2LTR to terminal B. Relay 2LTR remains released, and relays 2LTFP, 2LH and 2LR release. The release of relay 2LR deenergizes relay 2LRP, and during its release period 75 code pulses are supplied to relay 2LCTP over back contact *b* of relay 2LR, wire 81, back contact *d* of relay 2RAH, and wire 61, contact *b* of the code transmitter relay 75CT and thence alternately to terminal B over wire 63 or to terminal N. When relay 2LRP releases, relay 2LCTP is held in its right-hand position over the connection to terminal N over wire 60, back contact *b* of relay 2LTFP, back contact *c* of relay 2LCS and back contact *b* of relay 2LSPA.

Assuming that this restoring code is received over the rails of section 4RT at the left-hand

end of the single track stretch, the steady current portion of the restoring code impulse will pick up relay 4RTR and stop the code operation of relay 4RCTP, and relay 4RTFP picks up to hold relay 4RCTP in its right-hand position while relay 4RTR is responding to the 75 code portion of the restoring code impulse, by connecting terminal N to wire 54 over its front contact *b*, to enable relay 4RH to be picked up by the 75 code to release relay 4RCS.

When the restoring code impulse terminates, relays 4RTFP and 4RH release and relay 4RCSP also releases, due to the release of relays 4RCS and 4RH. Relay 4RCTP is connected to terminal N over wires 53, 54, 55, 56 and 57, and back contact *b* of relay 4RSPA and remains in its right-hand position. The coded track circuit system for the single track stretch is now in its normally deenergized condition, as shown in the drawings.

The coded track circuit system for section 2–4T continues in operation until relay 4RCSP releases. The opening of contact *d* of that relay disconnects terminal B from wire 34 and releases relay 4LTL, which disconnects terminals B and N from the line wires 20 and 21 causing relay 2RFS to release to hold relay 2RCTP in its left-hand position in which current is supplied steadily to the rails of section 2–4T, as shown.

In the example just described it was assumed that the westbound train left the block via switch 3W and did not occupy section 2–4T. In case the westbound train remains on the main track and occupies section 2–4T as in Example (3) or (5) above, the code operation of relay 4LTR ceases when the train enters section 2–4T and relays 4LTFP, 4LKR and 4LH release. Relay 4LH deenergizes the slow release repeater relay 4LHP and during its release period the directional stick relay 4LS, Fig. 1D, picks up over back contact *d* of relay 4LTFP, front contact *a* of relay 4LHP, wire 82 and front contact *d* of relay 4RCS.

The code operation of relay 4RCTP stopped when relay 4LH released, and its circuit now extends over wires 53, 54 and 55, front contact *c* of relay 4LS, wire 57 to terminal N at back contact *b* of relay 4RSPA.

When relay 4LS picks up, the actuating code relay 4RSP is energized over back contact *a* of relay 4RSPA, back contact *b* of relay 4RHPB, wire 51, back contact *c* of relay 4LFSP, front contact *e* of relay 4LS, back contact *a* of relay 4LHP, wire 82 and contact *d* of relay 4RCS, and relay 4RSP energizes relay 4RSPA which extends the circuit for relay 4RCTP from wire 57 over front contacts *b* of relays 4RSP and 4RSPA to terminal B at wire 58, causing relay 4RCTP to supply an actuating code to the rails of section 4RT.

As soon as the single track stretch is vacated by the westbound train this actuating code will be received at the right-hand end of the stretch with the same result as when supplied for the purpose of setting up the system for eastbound traffic as already described in connection with Example (1). The code sending relay corresponding to relay 2LCS at the right-hand end of the stretch picks up and causes the associated transmitter relay 2LCTP to supply coded signaling current to the rails at that end, this being the entrance end in the example now being considered. This coded signaling current received from the right over the rails of section 4RT during the off period of the actuating code cycle causes relay 4RH to become energized, thereby releasing relay 4RCS and preventing further operation of the actuating code relays 4RSP and 4RSPA. Relay 4RCSP also releases, following the release of relays 4RSP and 4LHPA, and the restoring code relay 4RR is energized over wires 66, 67 and 68, by relay 4RH to cause a restoring code impulse to be supplied to the rails of section 4RT for releasing the code sending relay LCS at the right-hand end of the block and thereby deenergizing the coded track circuit system for the single track stretch in the same manner as when the stretch is vacated by an eastbound train as described above in connection with Example (1).

The block indication lamp 4–6BKE becomes dark, since relays 4RBK and 6LBK are released during the operations just described, but until section 2–4T is vacated, lamp 2–4BKE remains lighted and relay 4LTL is held energized following the release of relay 4RCTP over its own front contact *a* and back contact *c* of relay 4LTFP.

When the westbound train of Example (3) or (5) passes signal 2LA at the exit end of the block under consideration, the directional stick relay 1NS is picked up over the circuit including wires 45 and 46 and contact *c* of the signal relay 4LAH, and relay 1NS is held energized by relay 1TP until section 1T is vacated.

Relay 1NS maintains relay 2RCTP in operation while section 1T is occupied by the westbound train, its front contact *c* removing contact *f* of relay 1TR from the circuit for relay 2RCTP. It follows that as soon as the westbound train vacates section 2–4T, 75 code will again be supplied to relay 4LTR, energizing relays 4LTFP and 4LKR and releasing relays 4LTL and 2RFS, and the closing of back contact *c* of relay 2RFS stops the code operation of relay 2RCTP with its contacts in their left-hand position as shown.

It will be seen from the foregoing that the coded track circuit systems are set up for operation in tandem for westbound traffic as well as for eastbound traffic, by entrance end control, and that the system for the rear section in each case is restored automatically to normal as soon as it is vacated by the train.

Example (7) will now be considered in detail, with the assumption that relays 3WS and 4RHS have been reversed by the operator, to clear signal 4RB.

The closing of the reverse contact *c* of relay 4RHS energizes the actuating code relay 4RSP over back contacts *a* of relays 4RSPA and 4RHPB to cause an actuating code impulse to be supplied to the rails of section 4RT as in the preceding Examples (1), (3) and (5) to set up the coded track circuit system for the single track stretch as required for eastbound traffic, relay 4RHPB becoming energized.

The closing of the reverse contact *a* of relay 4RHS energizes relay 4LTL over wire 34 and sets up the coded track circuit system for section 2–4 as required for westbound traffic, as in Examples (3), (4), (5) and (6) already described, relay 4LH becoming energized. If the system for section 2–4T is already set up and is occupied by a westbound train, relay 4LS is picked up and the operation of relay 4LH is not needed in order to enable signal 4RB to be cleared.

It will be evident that the time when it is proper to issue the control for signal 4RB to admit an eastbound train to the portion of the block in the rear of a westbound train will be indicated to the operator by the fact that lamp 4–6BKE will become dark when the westbound train vacates the single track stretch as ex-

plained in connection with Examples (3) and (5). It will also be evident that this information could not be given if the block indicator remained lighted until the entire block is vacated, as is the conventional practice in centralized traffic control systems for single track railroads.

When relays 4RHPB and 4LH are both picked up, indicating that signals 4R, 6LA and 6LB are at stop with their approach locking relays energized and that the block is not occupied, or when 4RHPB and 4LS are both picked up, indicating that a westbound train is in the block but has vacated the single track stretch, with signals 6LA and 6LB held at stop, the block repeating relay 4BPR becomes energized over the reverse contact *b* of relay 3WS, wire 19, back contact *b* of relay 4RCSP, wire 23, contact *b* of relay 4LS or contact *b* of relay 4LH and contact *f* of relay 4LFSP, wire 35, front contact *a* of relay 4RHPB and the reverse contact *c* of relay 4RHS. Relay 4BPR when energized releases the approach locking relay 4RAS and energizes relay 4RSH over back contact *a* of relay 3RWP, back contacts *b* of relays 4RAS and 4TER and front contact *a* of relay 4BPR, lighting the lamp S of signal 4RB.

This authorizes the operation of switch 3W to reverse by the train crew, and when this operation is completed, relay 3RWP picks up, energizing relay 4RBH in place of relay 4RSH, thereby extinguishing lamps S and R and lighting lamp G of signal 4RB to authorize the train in section 3T to enter the block.

When the train enters section 4RT, the code detecting relays 4RH and 4RHP release successively and restore relay 4RHS to normal by the momentary closing of a circuit which extends from terminal B through its winding over wire 83 and contacts *e* of relays 4RH and 4RHP to terminal N. Relay 4BPR is released by relay 4RHPB or 4RHS and releases relay 4RBH. Relay 4TER is supplied with energy over back contact *a* of relay 4RAS, and when energized for a suitable delay period, which may be made relatively short for the reason that trains in section 3T approaching signal 4RB are operated at slow speed, energizes relay 4RAS and then releases.

Relay 4LTL is maintained picked up over back contact *f* of relay 4RAS until that relay becomes energized, and also over back contact *c* of relay 4LTFP until stretch 2–4T is vacated. When relay 4LTL releases, relay 2RFS releases and restores the coded track circuit system for section 2–4T to its normal condition, as shown, by operating relay 2RCTP to the left to supply steady current to the rails from battery 2RTB.

The coded track circuit system for the single track stretch in this case is restored to normal when the stretch is vacated by the eastbound train as described above in connection with Example (1), namely, by the transmission of a restoring code by relays 4RR and 4RRP to release the code sending relay corresponding to relay 2LCS, at the right-hand end of the block.

Although we have herein shown and described only one form of centralized traffic control system embodying our 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 our invention.

Having thus described our invention what we claim is:

1. In a centralized traffic control system for railroads for controlling traffic movements into a stretch of track which includes a single track portion and the main track of an adjoining double track portion comprising a main track and a side track, three block signals including one at each end of the stretch and one at the junction of said main track and single track portion for governing the movement of traffic into said stretch, a signal control relay for each signal manually controllable from a central office, two normally inactive reversible coded track circuit systems including one for said main track portion and one for said single track portion, each having a source of energy and a code following track relay at each end with a transmitter relay for alternatively connecting said source of energy or track relay to the rails of such track portion, each track portion also having a traffic relay at each end controllable from its opposite end, and a detector relay controlled by the track relay at each end, means for energizing each detector relay in response to the operation of the associated track relay when coded current is received over the rails of its track portion from the opposite end, means controlled by each traffic relay when energized for operating the associated transmitter relay periodically to supply coded current to the rails of its track portion, actuating means for controlling said traffic relays rendered effective by each signal control relay when operated to set the code transmitters at the remote ends of both said track circuit systems into operation to thereby indicate the unoccupied condition of said portions by the energization of the detector relays at the ends thereof nearest the location of the operated signal control relay in response to currents supplied to the rails by the transmitter relays at their opposite ends, and means controlled jointly by the operated signal control relay and the two detector relays governed thereby for clearing the corresponding signal when both such detector relays are energized.

2. In a centralized traffic control system arranged as described in claim 1, in which the detector relay for the end of the main track portion adjoining the single track portion controls the adjacent transmitter relay for the single track portion and the detector relay at that location for the end of the single track portion adjoining the main track portion controls the adjacent transmitter relay for the main track portion so that the coded track circuit systems for said two portions are energized in tandem when actuated by a signal control relay at the end of the stretch, said systems being operated in parallel to control said two detector relays at the same location when actuated by the signal control relay at the junction of the two portions of said stretch.

3. In a centralized traffic control system arranged as in claim 1 in which means are provided for restoring the operated signal control relay to its normal position when a train governed by the associated signal enters the stretch, and in which restoring means are provided for independently restoring the coded track circuit systems for said main track portion and said single track portion to their normal inactive condition when such portions are unoccupied, as manifested by the energization of the corresponding detector relays following the return of the operated signal control relay to its normal position, said system including means effective when

the route of a train includes both such portions for operating the restoring means for each portion as soon as each portion is vacated by the train, and effective when the route of a train includes only one of said portions for operating the restoring means for both portions when the train vacates such one portion.

4. In a centralized traffic control system arranged as described in claim 1, in which each signal is provided with the usual approach locking relay which is released when the signal is cleared and which picks up at the end of a predetermined time interval when the signal is put to stop manually by the operation of its control relay; manually controllable means for releasing each approach locking relay effective only when the two detector relays which govern the associated signal become energized, and means comprising front contacts of each approach locking relay for preventing the transmitter relay or relays at the same location from supplying coded current to the rails at that location except when such approach locking relay is energized.

5. In a centralized traffic control system arranged as described in claim 4 in which each transmitter relay at an end of the stretch is controlled over a circuit which includes a front contact of the approach locking relay for the adjacent signal for governing the movement of traffic into the stretch, and also includes a back contact of the associated track relay, and in which each transmitter relay at the junction of said portions is controlled over a circuit which includes a front contact of the approach locking relay for the adjacent signal and a back contact of the track relay for the same portion and in addition includes a front contact closed only when the detector relay for the adjacent end of the track circuit system for the other portion of the stretch is energized.

6. In a centralized traffic control system arranged as described in claim 4, in which each operated signal control relay is restored to its normal position and the associated approach locking relay reenergized automatically when a train governed by the associated signal occupies the stretch; restoring means for each portion of said stretch, means rendered effective upon the energization of the associated approach locking relay following the return of said operated signal control relay to its normal position for operating the restoring means for each portion provided the stretch is not occupied by a train which is approaching or is in such portion of the stretch, and means controlled by each restoring means when operated for releasing the operated traffic relay for such portion to thereby restore the track circuit system for the corresponding portion of the stretch to its inactive condition.

7. In a centralized traffic control system for railroads for controlling traffic movements into a stretch of track which includes a single track portion with a main track portion and a side track at one end, three block signals for controlling the movement of traffic through said stretch, the first of which is located at one end of the stretch to govern traffic movements through said main track and single track portions, the second is located at the other end of the stretch to govern traffic movements in the opposite direction through said portions, and the third is located at the junction of said portions to govern traffic movements from the side track through said single track portion only, three manually controllable signal control relays including one at the location of each signal, separate normally inactive reversible track circuit systems for said main track and said single track portions each having at each end a source of energy, a code detector relay, and a transmitter relay for alternatively connecting such track relay or source of energy to the rails of its section, actuating means responsive to the operation of each signal control relay for initiating the periodic operation of the transmitter relays at the remote ends of said track portions, to thereby cause coded energy to be supplied from the respective sources the rails of both track circuit systems to which said detector relays are responsive, the operation of the control relay for the first or second signal being effective to energize such systems in cascade to effect the energization of the detector relay at the location of the operated control relay only when both portions of the stretch are unoccupied, and the operation of the control relay for the third signal being effective to energize such systems in parallel, to effect the energization of the two detector relays at its location only when both portions of the stretch are unoccupied, and means controlled by each operated signal control relay and by the adjacent detector relay or relays, when energized, for clearing the corresponding signal.

8. In a centralized traffic control system arranged as described in claim 7, means for restoring each operated signal control relay to normal when a train governed by the associated signal enters the stretch, restoring means for each reversible track circuit system, effective when operated to deenergize the operated traffic relay for such system and thereby restore such system to its normally inactive condition, means rendered effective following the movement of a train governed by said first or second signal through said stretch for operating the restoring means for said two track circuit systems successively, each when the corresponding track portion is vacated by the train, and means rendered effective when a train governed by said third signal vacates the single track portion for concurrently operating the restoring means for said two track circuit systems.

9. In a centralized traffic control system arranged as described in claim 7, a directional stick relay at the location of said third signal, means for operating said stick relay when a train governed by said second signal enters said main track portion and for releasing such relay when said main track portion is vacated, and means controlled by said stick relay for clearing said third signal in response to the operation of its control relay to permit an opposing train to enter the single track portion in the rear of a receding train in said main track portion, said clearing means being effective when said directional stick relay is energized provided only the adjacent detector relay for the single track stretch becomes energized.

10. In a centralized traffic control system arranged as described in claim 7, means for restoring each operated signal control relay to normal when a train governed by the associated signal enters the stretch, restoring means for each track portion for restoring the track circuit system for such portion to its normal condition, means for operating the restoring means for the single track portion when a train governed by said second signal vacates said portion provided the control relay for such signal has been restored to normal, a directional stick relay at the location of said third signal, means for operat-

ing said stick relay when a train governed by said second signal enters said main track portion, means effective if the control relay for said third signal is operated when said stick relay is energized for re-energizing the track circuit system for said single track stretch following its restoration to normal after the passage of the train governed by said second signal, and means controlled by the control relay for the third signal for clearing such signal when said stick relay and the adjacent detector relay for the track circuit system for the single track stretch are both energized.

11. In a normally inactive coded track circuit system for a stretch of railway track having at each end the usual transmitter relay for supplying coded impulses of energy to the track rails at times and a code following track relay connected to the rails over contacts of such transmitter relay to render it responsive to coded impulses of energy received over the rails at other times, and also having a code detector relay at each end selectively responsive to the code operation of the associated track relay; the combination with the foregoing of a traffic relay and a traffic locking relay at each end of the stretch, a line circuit extending the length of the stretch and normally connected at each end to the winding of the adjacent traffic relay, means controlled by each traffic locking relay when energized for disconnecting the adjacent traffic relay from said line circuit and connecting a source of energy thereto to operate the traffic relay at the remote end thereof, manually controllable means for energizing each traffic locking relay effective only when the adjacent traffic relay is released, and a circuit for each transmitter relay controlled by a back contact of the associated track relay and completed when the associated traffic relay is energized to cause such transmitter relay to supply coded impulses of energy to the rails of the stretch.

12. In a normally inactive coded track circuit system of the type described in claim 11, in which an additional circuit is completed for the transmitter relay at one end of the stretch when the adjacent traffic locking and traffic relays are both released for causing such transmitter relay to supply steady energy to the rails of the stretch, for maintaining the code following track relay at the opposite end normally energized and in which means are provided for preventing the traffic locking relay at said opposite end from assuming its energized position except when said code following track relay is energized, a slow release track repeater relay controlled by said code following track relay, and a stick circuit for the associated traffic locking relay including a back contact of said slow release track repeater relay for preventing its release except when said slow release track repeater relay is energized.

13. In a normally inactive coded track circuit system of the type described in claim 12, in which a stick relay is provided at the end of the stretch at which said slow release track repeater relay is located having a pick-up circuit including a front contact of the adjacent traffic relay and a stick circuit including a back contact of said slow release track repeater relay, said stick relay when energized being effective to maintain the adjacent transmitter relay in operation to cause such relay to continue to supply coded energy to the rails as long as the associated track relay remains released.

14. In a normally inactive coded track circuit system of the type described in claim 12 in which an indication relay is provided at the end of the stretch opposite to the one at which steady energy is supplied to the rails of the stretch, said indication relay having an energizing circuit including a front contact of the slow release track repeater relay at said opposite end of the stretch, and in which the adjacent traffic relay is of the polarized type, and is effective only when energized to complete a second energizing circuit for said indication relay, said second energizing circuit including a polar contact of said traffic relay which is closed only when the polarity of the current supplied over said line circuit is reversed, said system also having means responsive to the energization of the track relay at said one end of the stretch when said steady energy is cut off and coded energy is supplied to the rails at the opposite end of the stretch for reversing the polarity of the current supplied to said line circuit, and a block indicator remotely controlled by said indication relay for indicating the occupied condition of said stretch.

15. In a centralized traffic control system for railroads, a first and a second block signal for governing the movement of traffic over a first track switch in its normal and its reverse position, respectively, and through a stretch of railway track including a second track switch which when reversed leads to a side track, track circuits for detecting the presence of a train in said stretch, indicators associated with said signals for authorizing the hand operation of said switches, a signal lever and a first and a second switch lever located at a control office, a signal control circuit closed when said signal lever is reversed and said track circuits indicate the unoccupied condition of said stretch, a circuit for energizing said first signal and a circuit for energizing said second signal each closed to cause such signal to indicate proceed when said signal control circuit is closed, said first switch lever occupies its normal or reverse position, respectively, and said first track switch occupies a corresponding normal or reverse position, a circuit for energizing the indicator associated with said first signal and a circuit for energizing the indicator associated with said second signal, each closed only when the associated signal indicates proceed and said second switch lever occupies its reverse position, each indicator serving when energized along with the associated signal to authorize the hand operation of said second track switch to its reverse position, and a second circuit for energizing the indicator associated with the second signal closed only when said signal indicates stop, said first switch lever occupies its reverse position, and said track circuits indicate the unoccupied condition of said stretch, the energization of said indicator over said second circuit serving to authorize the hand operation of said first track switch to its reverse position.

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