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CODED SIGNALING SYSTEM

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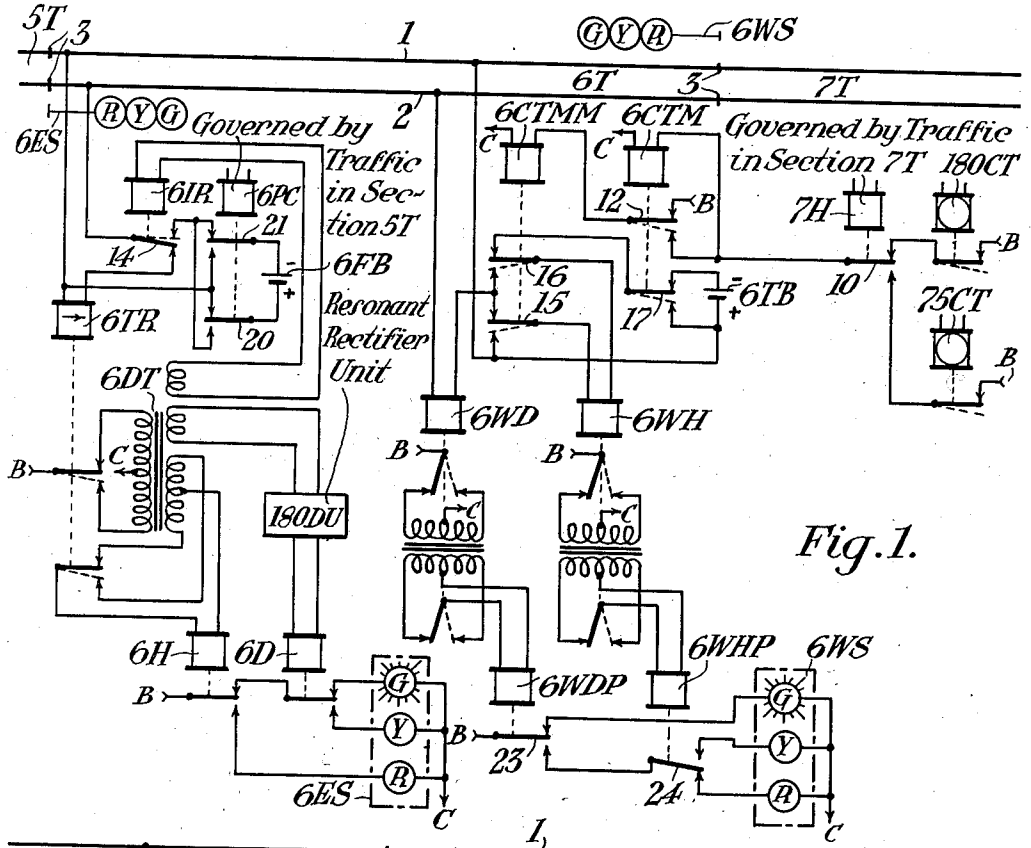


Fig. 1.

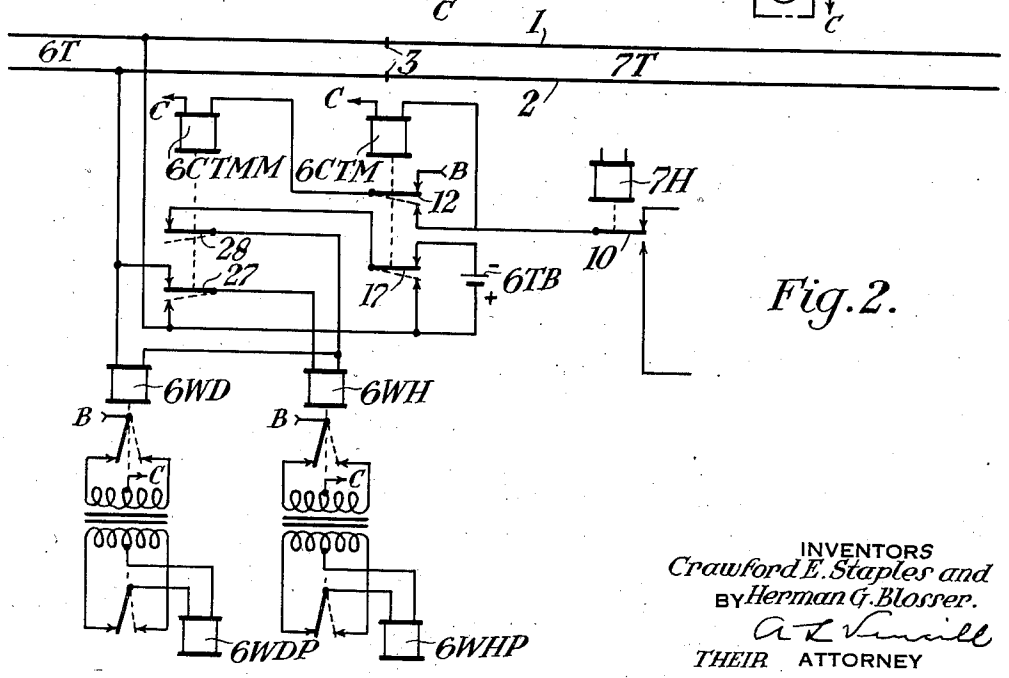


Fig. 2.

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CODED SIGNALING SYSTEM

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19 Claims. (Cl. 246—38)

Our invention relates to signaling apparatus employing coded energy.

In Letters Patent of the United States No. 2,021,944 to Frank H. Nicholson there is shown a signaling system in which master code is transmitted in one direction over a pair of conductors to operate a code following relay and thereby perform selected functions at one end of the conductors, while during the "off" periods in the master code feed-back energy is transmitted in the other direction over these conductors to operate a feed-back relay and thereby perform selected functions at the other end of the conductors.

It has heretofore been proposed to control the polarity of the feed-back energy so that this energy is of normal polarity at times and is of reverse polarity at other times, and to provide one feed-back relay responsive to energy of one polarity and another feed-back relay responsive to energy of the other polarity so that the feed-back energy may be employed to perform two different functions.

The systems of this type heretofore suggested have employed feed-back detector relays of the polar biased neutral type, the contacts of which release when the relay winding is deenergized, and which when released become picked up when and only when energy of a particular polarity is supplied to the relay.

It is preferred to employ feed-back detector relays of the polar stick type for this purpose, and it is an object of this invention to provide an improved system employing feed-back energy of both polarities and having feed-back detector relays of the polar stick type.

Another object of this invention is to provide an improved system of the type described which is arranged so that the contacts of both of the feed-back detector relays are moved to a selected one of their positions when master code energy is supplied to the conductors, and so that the contacts of one of the feed-back detector relays are moved to their other position by feed-back energy of one polarity, and so that the contacts of the other one of the feed-back detector relays are moved to their other position by feed-back energy of the other polarity.

A further object of the invention is to provide an improved system of the type described which is adapted to be applied to the track circuit of a section of railway track and which is arranged so that energy stored in the track circuit as a result of the supply of master code energy to the section rails cannot falsely operate either feed-back detector relay.

Another object of the invention is to provide a system incorporating coding means for reversibly connecting one of the feed-back detector relays across the section rails and for supplying master code energy to the section rails in series with the windings of the feed-back detector relays so that the master code energy moves the contacts of both of the feed-back detector relays to a selected position and so that the feed-back detector relays respond to different polarities of feed-back energy.

A further object of the invention is to provide an improved system of the type described and incorporating means to delay reversal of the connection of one of the feed-back relays with the track rails for a short period subsequent to interruption of the supply of master code to the track circuit and thus enable energy stored in the track circuit as a result of the supply of master code energy to the track rails to be dissipated before connection of the feed-back relay with the track rails is reversed to thereby prevent operation of the feed-back relay by energy stored in the track circuit.

Other objects of the invention and features of novelty will be apparent from the following description taken in connection with the accompanying description.

We shall describe two forms of coded signaling apparatus embodying our invention, and shall then point out the novel features thereof in claims.

In practicing our invention we provide two feed-back detector relays of the stick polar type, while we employ two coding relays which are arranged so that when the contacts of both relays are picked up, master code energy is supplied to the rails of a section of railway track, or other pair of conductors, over a circuit including in series therewith the windings of the feed-back detector relays so that the contacts of both feed-back relays are moved to a selected position by master code energy supplied through their windings. The coding relays are also arranged so that one of these relays releases before the other and so that the first one of the coding relays to release interrupts the supply of master code to the section rails, while the other coding relay reversibly connects one of the feed-back detector relays across the section rails so that both feed-back detector relays will respond in the same manner to master code but will respond only to different polarities of feed-back energy. The interval between release of the first coding relay to interrupt the supply of master code energy to

the section rails, and release of the second coding relay to reverse connection of one of the feed-back detector relays with the section rails, provides time for energy stored in the track circuit to be dissipated so that there is no possibility that this energy will falsely operate the feed-back relays.

In both forms of the invention when the coding relays are released, the feed-back detector relays are connected in series across the section rails. In the system shown in Fig. 1 when the coding relays are picked up, the detector relays are connected in series across the section rails, while in the system shown in Fig. 2 when the coding relays are picked up, the feed-back detector relays are connected in multiple across the section rails.

In the drawing Fig. 1 is a diagram of a section of railway track equipped with track circuit apparatus embodying our invention, and

Fig. 2 is a diagram showing a different arrangement of apparatus which we may employ.

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

Referring to Fig. 1 of the drawing, there is shown therein a stretch of railroad track having track rails 1 and 2 divided by insulated joints 3 into track sections for signaling purposes. One complete track section, designated 6T, together with portions of the adjoining sections 5T and 7T, is shown in the drawing.

The track circuit apparatus for section 6T is arranged so that master code of one frequency or another determined by occupancy of section 7T is supplied to the section rails at the right-hand end of the section, while feed-back energy of one polarity or the other determined by occupancy of section 5T is supplied to the section rails at the left-hand end of the section.

The equipment at each end of the track section includes a source of direct current, such as a storage battery, not shown, the terminals of which are designated B and C.

The equipment is shown in the condition which it assumes when the track stretch is vacant. At this time relay 7H, which is controlled by traffic in section 7T, is picked up, and relay 6PC, which is governed by traffic in section 5T, is also picked up. The relays 7H and 6PC may be controlled in any appropriate manner, and in order to simplify this disclosure, the means for controlling these relays have not been shown.

As relay 7H is picked up, its contact 10 establishes the circuit controlled by the contact of code transmitter 180CT for supplying energy to coding relays 6CTM and 6CTMM and these relays operate at the 180 code frequency. On closing of the contact of code transmitter 180CT energy is supplied to the winding of coding relay 6CTM, and prior to picking up of the contacts of relay 6CTM, is supplied over back contact 12 of relay 6CTM to the winding of relay 6CTMM, while on picking up of relay 6CTM energy is supplied directly from the source to relay 6CTMM over front contact 12 of relay 6CTM. On opening of the contact of code transmitter 180CT the supply of energy to relay 6CTM is cut off, and its contacts release so that contact 12 interrupts the circuit of relay 6CTMM with the result that its contacts release. As the supply of energy to relay 6CTMM is maintained until the contacts of relay 6CTM release, the contacts of relay 6CTMM will not release until after the contacts of relay 6CTM release, while there will be a short time interval between release of the contacts of relay 6CTM and release of the contacts of relay 6CTMM.

As explained below, the supply of energy from the track battery 6TB to the rails of section 6T is cut off when relay 6CTM releases, and as explained in Letters Patent of the United States No. 2,285,891, issued June 9, 1942 to Herman G. Blosser, the interval between release of relay 6CTM and release of relay 6CTMM provides a period during which energy stored in the track circuit may be dissipated so that the relays 6WD and 6WH will not be operated by this energy.

When relays 6CTM and 6CTMM are both picked up, master code energy is supplied from track battery 6TB to the track relay 6TR over the circuit which is traced from the positive terminal of the battery over track rail 1, through the winding of track relay 6TR, back contact 14 of relay 6IR, track rail 2, winding of relay 6WD from left to right, front contact 15 of relay 6CTMM, winding of relay 6WH from left to right, front contact 16 of relay 6CTMM, and front contact 17 of relay 6CTM to the negative terminal of the battery.

The energy supplied over this circuit picks up the contacts of the track relay 6TR, while it causes the contacts of relays 6WD and 6WH to move to their normal position if they are not already in that position.

On release of the contacts of the code transmitter controlling the supply of energy to the coding relays 6CTM and 6CTMM, the relay 6CTM releases and its contact 12 interrupts the circuit of relay 6CTMM but the operating characteristics of the relay 6CTMM are such that its contacts remain picked up for a short period subsequent to release of the relay 6CTM. In addition, on release of relay 6CTM its contact 17 interrupts the circuit of the track battery 6TB and establishes a circuit to connect relays 6WD and 6WH across the section rails as long as relay 6CTMM remains picked up. When front point of contact 17 of relay 6CTM opens, the supply of energy from the battery 6TB to the section rails is cut off, but because of the inductance of the track circuit, or of other conditions, energy will continue to flow therein in the same direction in which it had been flowing, and energy may still be flowing in the track circuit when the back point of contact 17 closes. If energy is flowing in the track circuit when back point of contact 17 closes, this energy will flow from rail 2 through the winding of relay 6WD from left to right, over front contact 15 of relay 6CTMM, through the winding of relay 6WH from left to right, and over front contact 16 of relay 6CTMM and back contact 17 of relay 6CTM to track rail 1. The direction of flow of this energy through the windings of relays 6WD and 6WH is such as to hold the contacts of these relays in their left-hand or normal position, that is, in the position to which they were moved by the supply of master code energy through the relay windings.

On release of the contacts of relay 6CTMM the connection of the relay 6WH across the section rails is reversed so the left-hand terminal of the winding of this relay is connected to track rail 1 and the right-hand terminal of the winding of this relay is connected through the winding of relay 6WD to track rail 2. If energy resulting from inductance of the track circuit or other condition should now flow from rail 2 to rail 1 through the windings of relays 6WD and 6WH it would cause the contacts of relay 6WH to move from their left-hand to their right-hand position.

However, as pointed out above there is a short time interval between the instant at which contact 17 of relay 6CTM releases and interrupts the circuit of the battery 6TB, and the instant at which relay 6CTMM releases to reverse connection of relay 6WH with the track rails, and this time interval is long enough to permit energy present in the track circuit as a result of supply of energy to the track circuit from the track battery to be dissipated. Accordingly, there is no possibility that the relays 6WD and 6WH will be operated by energy stored in the track circuit.

On interruption of the supply of energy from the track battery 6TB to the section rails the track relay 6TR releases, while on release of the track relay contacts an impulse of energy is supplied through the decoding transformer 6DT to the relay 6IR and is of the polarity effective to pick up the contacts of relay 6IR to thereby cause an impulse of energy to be supplied from battery 6FB to the section rails while disconnecting the track relay from the section rails.

An impulse of energy was also supplied from the decoding transformer to the relay 6IR on picking up of the track relay contacts. However, the relay 6IR is of a type the contacts of which when released pick up only when energy of a particular polarity is supplied to the relay winding, and the various parts of the apparatus are arranged so that the energy supplied to relay 6IR on picking up of the track relay contacts is of the wrong polarity to pick up the contacts of relay 6IR.

At this time section 5T is unoccupied so relay 6PC is picked up and the impulse of energy supplied from battery 6FB to the section rails is of normal polarity, and flows from the positive terminal of the battery over front contact 20 of relay 6PC, track rail 1, back contact 15 of relay 6CTMM, winding of relay 6WH from left to right, back contact 16 of relay 6CTMM, winding of relay 6WD from right to left, track rail 2, front contact 14 of relay 6IR, and front contact 21 of relay 6PC to the negative terminal of the battery 6FB.

The impulse of energy supplied from battery 6FB to the section rails sends energy to relays 6WH and 6WD in series, and as the impulse of energy is of normal polarity, it holds the contacts of relay 6WH in their normal position, while it causes the contacts of relay 6WD to move to their right-hand or reverse position.

After a short time interval the relay 6IR releases and cuts off the supply of energy from battery 6FB to the section rails and connects track relay 6TR across the section rails. During the next picked-up period of the relays 6CTM and 6CTMM energy is supplied from battery 6TB through the windings of relays 6WH and 6WD and over the track rails to track relay 6TR to pick up the track relay contacts. The energy supplied through the winding of relay 6WD causes the contacts of this relay to move to their left-hand or normal position, while the energy supplied through the winding of relay 6WH holds the relay contacts in their normal position.

On continued supply of master code to the section rails the contacts of relay 6WD are returned to their normal position each time that master code is supplied to the section rails, while the track relay 6TR is operated so that relay 6IR causes impulses of feed-back energy to be supplied to the section rails in the intervals between the impulses of master code, and the polarity of the feed-back impulses is such that each impulse of feed-back energy moves the contacts of relay 6WD to their reverse position.

As a result of code following operation of track relay 6TR, energy is supplied through the decoding transformer 6DT to relay 6H, while as the track relay is being operated by energy of 180 code frequency, energy is supplied through the resonant rectifier unit 180DU to relay 6D, and the contacts of relays 6H and 6D are picked up and establish the circuit of the green or clear lamp G of signal 6ES which governs movement of traffic from left to right through section 6T.

The resonant rectifier unit 180DU includes a capacitance and an inductance which are arranged and proportioned to pass sufficient energy to pick up the relay 6D when and only when the track relay 6TR is operated at the 180 code rate, while the unit includes a rectifier for rectifying the energy supplied through the unit.

As a result of movement of the contacts of relay 6WD between their two positions, energy is supplied through the associated decoding transformer to relay 6WDP and its contact 23 is picked up to interrupt the circuit of the lamps Y and R of signal 6WS and to establish the circuit of the lamp G of signal 6WS which governs movement of traffic from left to right in section 6T.

At this time the contacts of relay 6WH remain in their left-hand or normal positions so that energy is not supplied to relay 6WHP and its contact 24 remains released.

Operation of equipment on movement of a train through the track stretch from left to right

When a train moving from left to right enters section 5T, relay 6PC releases and changes the energy supplied from battery 6FB to the section rails from normal to reverse polarity. On picking up of relay 6IR at a time when relays 6CTM and 6CTMM are released, energy flows from the positive terminal of the battery over back contact 20 of relay 6PC, front contact 14 of relay 6IR, track rail 2, winding of relay 6WD from left to right, back contact 16 of relay 6CTMM, winding of relay 6WH from right to left, back contact 15 of relay 6CTMM, track rail 1, and back contact 21 of relay 6PC to the negative terminal of the battery 6FB. The direction of flow of feed-back energy through the windings of relays 6WD and 6WH is such that the contacts of relay 6WD are held in their left-hand or normal position, while the contacts of relay 6WH are moved to their right-hand or reverse position.

On release of the contact of relay 6IR the supply of energy from the battery 6FB to the section rails is interrupted, and the track relay 6TR is connected across the section rails, while on picking up of the relays 6CTM and 6CTMM an impulse of master code energy is supplied from battery 6TB to the section rails in series with the windings of relays 6WH and 6WD. As explained above, the direction of flow of this energy through the windings of relays 6WH and 6WD is such as to hold the relay contacts in their normal position, or to move them to that position if they are not already in their normal position. Accordingly, the contacts of relay 6WH are moved to their normal position while the contacts of relay 6WD are held in their normal position.

On continued operation of the equipment the contacts of relay 6WH are moved to their right-hand position by the feed-back energy and are returned to their left-hand position by the master code impulses, while the track relay 6TR operates

in the usual manner to cause energy to be supplied through the transformer 6DT to relays 6H and 6D. As a result of movement of the contacts of relay 6WH between their two positions, energy is supplied through the associated transformer to relay 6WHP and its contact 24 picks up, while as the contacts of relay 6WD remain in their normal positions, energy is no longer supplied to relay 6WDP and its contact 22 releases and interrupts the circuit of the green lamp G and establishes the circuit including front contact 24 of relay 6WHP for supplying energy to the yellow lamp Y of signal 6WS. Accordingly, when an eastbound train enters section 5T, signal 6ES continues to display its green or clear indication, while the polarity of the feed-back energy supplied over the rails of section 6T is changed so that relay 6WDP releases and relay 6WHP picks up to thereby cause signal 6WS to display its yellow instead of its green indication.

When the train moving from left to right enters section 6T, the track relay 6TR is shunted and ceases to follow code so energy is no longer supplied to relays 6H and 6D and they release and cause signal 6ES to display its red or stop indication. In addition, when track relay 6TR ceases to follow code, energy is no longer supplied to relay 6IR and its contact remains released so that feed-back energy is no longer supplied to the track rails and the contacts of relay 6WH remain in their normal position and relay 6WHP releases so that its contact 24 interrupts the circuit of the yellow lamp Y and establishes the circuit of the red lamp R of signal 6WS.

When the train vacates section 5T, relay 6PC picks up so that on subsequent operation of relay 6IR the impulses of feed-back energy supplied to the track rails are of normal polarity.

When the train advances into section 7T, relay 7H releases and transfers control of coding relays 6CTM and 6CTMM from code transmitter 180CT to code transmitter 75CT and the coding relays operate at the 75 code rate.

When the train vacates section 6T, the master code of 75 code frequency supplied to the section rails feeds to the track relay 6TR and operates it so that energy is supplied through the decoding transformer 6DT to pick up the relay 6H but not to pick up the relay 6D. Accordingly, signal 6ES now displays its yellow or caution indication.

In addition, on operation of the track relay energy is supplied to the relay 6IR and it operates to supply impulses of feed-back energy to the section rails. As relay 6PC is picked up, the impulses of feed-back energy are of normal polarity and they operate relay 6WD so that energy is supplied to relay 6WDP and its contact 23 picks up to interrupt the circuit of the red lamp R and establish the circuit of the green lamp G of signal 6WS.

When the train vacates section 7T, relay 7H picks up and transfers control of coding relays 6CTM and 6CTMM to code transmitter 180CT so that energy of 180 code frequency is supplied to the rails of section 6T, and on resultant operation of track relay 6TR by energy of 180 code frequency the relay 6D picks up and interrupts the circuit of the yellow lamp Y and establishes the circuit of the green lamp G of signal 6ES.

Operation of equipment on movement of a train through the track stretch from right to left

When a train moving from right to left enters section 7T, relay 7H releases and changes the energy supplied to section 6T from 180 to 75 code frequency and the rate of operation of track relay 6TR is reduced so that relay 6D releases and interrupts the circuit of the green lamp G and establishes the circuit of the yellow lamp Y of signal 6ES. At this time relay 6PC is picked up while relay 6IR continues to operate and feed-back energy of normal polarity is supplied to the section rails and it causes relay 6WDP to be picked up so the signal 6WS displays its green indication.

When the train advances into section 6T, the track relay 6TR is shunted and ceases to follow code so relay 6H releases and causes signal 6ES to display its red indication, while feed-back energy ceases to be supplied to the section rails and relay 6WD ceases to operate and relay 6WDP releases to cause signal 6WS to display its red indication.

When the train enters section 5T, relay 6PC releases so that on subsequent operation of relay 6IR the feed-back energy supplied to the section rails is of reverse polarity.

When the train vacates section 7T, relay 7H picks up so that coding relays 6CTM and 6CTMM operate at the 180 code rate, but as long as section 6T is occupied, the track relay remains released and feed-back energy is not supplied over the section rails so that signals 6ES and 6WS continue to display their stop indications.

When the train vacates section 6T, the master code of 180 code frequency supplied to the section rails operates the track relay 6TR so that relays 6H and 6D pick up and cause signal 6ES to display its green indication, while relay 6IR is operated to supply feed-back energy to the track rails. As relay 6PC is released, the feed-back energy is of reverse polarity and operates relay 6WH so that relay 6WHP picks up and causes signal 6WS to display its yellow or caution indication.

When the train vacates section 5T, relay 6PC picks up so that the polarity of the feed-back impulses is changed from reverse to normal with the result that relay 6WD operates instead of relay 6WH and relay 6WDP picks up to cause signal 6WS to display its green indication.

Modification shown in Fig. 2 of the drawing

In Fig. 2 of the drawing there is shown a modified arrangement of apparatus which we may employ at the end of the track circuit at which master code is supplied to the section rails.

The equipment shown in Fig. 2 is similar to that shown in Fig. 1, but differs therefrom in that in the system shown in Fig. 2 master code is supplied to the section rails over a circuit including in series therewith the winding of the relays 6WD and 6WH in multiple, while in the system shown in Fig. 1 the master code is supplied to the section rails over a circuit including in series therewith the windings of the relays 6WD and 6WH in series.

In operation, when the coding relays 6CTM and 6CTMM are both picked up, energy is supplied from the battery 6TB over the circuit which is traced from the positive terminal of the battery to track rail 1, through the winding of the track relay, not shown, over track rail 2, through winding of relay 6WD from left to right, and also from rail 2 over front contact 21 of relay 6CTMM and through winding of relay 6WH in multiple with the winding of relay 6WD, over front contact 28 of relay 6CTMM and front contact 17 of relay 6CTM to the negative terminal of the battery 6TB. As master code energy supplied to the sec-

tion rails flows through the windings of the relays 6WD and 6WH from left to right, the contacts of these relays are moved to their left-hand or normal position, or are held in that position if they are already in that position.

On release of the relays 6CTM and 6CTMM the supply of energy from battery 6TB to the section rails is cut off, while relays 6WD and 6WH are connected in series across the track rails over the circuit which is traced from rail 1 over back contact 27 of relay 6CTMM, through winding of relay 6WH from left to right, and through winding of relay 6WD from right to left.

As the relays 6WD and 6WH are connected across the section rails when the relays 6CTM and 6CTMM are released, feed-back energy supplied to the section rails may flow through the windings of relays 6WD and 6WH to operate them. When the polarity of the feed-back energy is such that the positive terminal of the feed-back battery is connected to track rail 1, the direction of flow of feed-back energy through the winding of relay 6WD is such that the contacts of this relay are moved to their right-hand or reverse position, while the direction of flow of energy through the winding of relay 6WH is such that the contacts of this relay are held in their left-hand or normal position.

Similarly, when the polarity of the feed-back energy is such that the positive terminal of the feed-back battery is connected to the track rail 2, the direction of flow of energy through the winding of relay 6WD is such that the contacts of this relay are held in their left-hand or normal position, while the direction of flow of energy through the winding of relay 6WH is such that the contacts of this relay are moved to their reverse or right-hand position.

On picking up of the contacts of relays 6CTM and 6CTMM master code energy is again supplied through the windings of relays 6WD and 6WH to the section rails, and, as explained above, this energy moves the contacts of relays 6WH or 6WD to their left-hand or normal position, or holds them in that position if they are already in their normal position.

Accordingly, the modification shown in Fig. 2 operates so that one or the other of the relays 6WD and 6WH is operated by feed-back energy, the one depending on the polarity of the feed-back energy, while master code energy supplied to the section rails restores to their normal position the contacts of whichever one of the relays 6WH and 6WD that was operated by the feed-back energy.

As a result of operation of relay 6WD or 6WH by feed-back energy, the relay 6WDP or 6WHP is picked up and these relays may control a signal in the manner explained in connection with the system shown in Fig. 1.

The modification shown in Fig. 2 also operates like that shown in Fig. 1 to prevent false operation of the feed-back detector relays by energy stored in the track circuit.

As pointed out above, when the coding relays 6CTM and 6CTMM are picked up, the track battery 6TB is connected across the section rails in series with the windings of relays 6WD and 6WH in multiple. At this time the positive terminal of the battery is connected to track rail 1, while the negative terminal of the battery is connected over front contact 17 of relay 6CTM and front contact 28 of relay 6CTMM to the right terminals of the windings of relays 6WH and 6WD so this terminal of the battery is connected through the winding of relay 6WD to track rail 2, and is also connected through winding of relay 6WH and front contact 27 of relay 6CTMM to track rail 2. Under these conditions, energy from the track battery flows through the windings of relays 6WD and 6WH from left to right and causes the contacts of these relays to occupy their left-hand or normal position.

On release of the contacts of relay 6CTM its contact 12 interrupts the circuit of relay 6CTMM, but the contacts of relay 6CTMM remain picked up for a short time interval. In addition, on release of relay 6CTM its contact 17 interrupts the circuit traced above for supplying energy from the track battery through the windings of relays 6WD and 6WH to the track rails, and establishes a circuit to connect the relays 6WD and 6WH across the track rails so that energy which continues to flow in the track circuit subsequent to interruption of the supply of energy from the track battery will flow through the windings of relays 6WD and 6WH in the direction to maintain their contacts in the normal position.

As pointed out above, prior to release of relay 6CTM, the positive terminal of the track battery is connected to track rail 1, and energy from the track battery flows through the windings of the relays 6WD and 6WH from their left-hand to their right-hand terminals and the relay contacts are moved to their left-hand or normal position. When contact 17 of relay 6CTM releases and interrupts the circuit of the track battery, energy in the track circuit due to inductance of the track circuit or other conditions, continues to flow in the same direction in which it had been flowing. Accordingly, this energy flows from track rail 2 through the winding of relay 6WD from left to right, and over front contact 28 of relay 6CTMM and back contact 17 of relay 6CTM to track rail 1. In addition, energy flows from track rail 2 over front contact 27 of relay 6CTMM, through winding of relay 6WH from left to right, and over front contact 28 of relay 6CTMM and back contact 17 of relay 6CTM to track rail 1. Since energy stored in the track circuit flows through the windings of relays 6WD and 6WH from left to right, this energy holds the contacts of these relays in their left-hand or normal position.

After a short time interval the relay 6CTMM releases and interrupts the above traced circuit for connecting relays 6WD and 6WH in multiple across the track rails and connects these relays in series across the track rails with the left-hand terminal of the winding of relay 6WH connected to the track rail 1 so that relays 6WD and 6WH are responsive to different polarities of feed-back energy.

As explained in connection with Fig. 1, after release of relay 6CTM the relay 6CTMM remains picked up for a period long enough for energy stored in the track circuit to be dissipated before the relay 6CTMM releases to reverse connection of relay 6WH with the track rails. This insures that on release of relay 6CTMM, and resultant reversal of the connection of relay 6WH with the section rails, that energy stored in the track circuit will not falsely operate the relay 6WH.

While the invention has been illustrated and described in connection with a track circuit for a section of railway track, the invention is not limited to use in such situations and it might be employed in other ways, as for example on a line

circuit. Likewise, while in the track circuits illustrated and described the feed-back energy is employed to govern a signal controlling movement of traffic in one direction through the track section, the feed-back energy is not limited to use for this purpose, and the feed-back energy may be employed to perform any appropriate functions.

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

Having thus described our invention, what we claim is:

1. In a coded signaling system, in combination, a pair of conductors extending between a first and a second location, a first and a second polarized detector relay at said first location, a coding device having contacts continuously actuated between a first and a second position, the contacts of said coding device being effective when in their first position to connect a source of unidirectional energy across said conductors through the windings of said detector relays so that energy supplied from said source to the conductors moves the contacts of both detector relays to their normal position, the contacts of said coding device being effective when in their second position to connect said detector relays across said conductors in such manner that the contacts of one of said relays are moved to their reverse position by energy of one polarity and so that the contacts of the other of said relays are moved to their reverse position by energy of the other polarity, a code following relay at said second location operated by energy supplied over said conductors from said first location, means at said second location for supplying to said conductors during the intervals between the impulses of energy supplied to said conductors at the first location energy which at times is of one polarity and at other times is of the other polarity, signaling means governed by said code following relay, and signaling means governed by said detector relays.

2. In a coded signaling system, in combination, a pair of conductors extending between a first and a second location, a first and a second polarized detector relay at said first location, a coding device having contacts continuously actuated between a first and a second position, the contacts of said coding device being effective when in their first position to connect a source of unidirectional energy across said conductors through the windings of said detector relays so that an impulse of master code energy is supplied to said conductors and the contacts of both of said detector relays are caused to occupy their normal positions, the contacts of said coding device being effective when in their second position to connect said detector relays across said conductors in such manner that the contacts of one of said relays are moved to their reverse position by energy of one polarity supplied over said conductors and so that the contacts of the other of said relays are moved to their reverse position by energy of the other polarity supplied over said conductors, a code following relay at said second location operated by master code energy supplied over said conductors, means at said second location for supplying impulses of feed-back energy to said conductors in the intervals between the impulses of master code, means for causing the feed-back energy to be of one polarity at times and to be of the other polarity at other times, signaling means governed by said code following relay, and signaling means governed by said detector relays.

3. In a coded railway signaling system, a section of railway track, a first and a second polarized detector relay at one end of said track section, a coding device having contacts continuously actuated between a first and a second position, the contacts of said coding device being effective when in their first position to connect a source of unidirectional energy across the rails of said track section through the windings of said detector relays so that an impulse of master code energy is supplied to the section rails and the contacts of said detector relays are caused to occupy their normal position, the contacts of said coding device being effective when in their second position to connect said detector relays across said track rails in such manner that the contacts of one of said relays are moved to their reverse position by energy of one polarity supplied over the track rails and so that the contacts of the other of said relays are moved to their reverse position by energy of the other polarity supplied over said track rails, a code following track relay at the end of said track section remote from said detector relays and operated by master code energy supplied over the section rails, means associated with said track relay for supplying impulses of feed-back energy to said track rails in the intervals between the impulses of master code, means for causing the feed-back energy to be of one polarity at times and to be of the other polarity at other times, signaling means governed by said track relay, and signaling means governed by said detector relays.

4. In a coded signaling system, in combination, a pair of conductors extending between a first and a second location, a first and a second coding device and a first and a second polarized relay at said first location, each of said coding devices having contacts movable between a first and a second position, a circuit effective when the contacts of both of said coding devices are in their first position to connect a source of unidirectional current across said conductors through the windings of said detector relays so that energy supplied through said relay windings moves the relay contacts to their normal position, a circuit effective when the contacts of said second coding device are in their second position to connect said detector relays across said conductors so that the contacts of one of said relays are moved to their reverse position by energy of one polarity supplied over said conductors and the contacts of the other of said relays are moved to their reverse position by energy of the other polarity supplied over said conductors, a code following relay at said second location operated by energy supplied over said conductors from said first location, means at said second location for supplying energy to said conductors in the intervals between impulses of energy supplied to said conductors at said first location, means for causing the energy supplied to said conductors at said second location to be of one polarity at times and of the other polarity at other times, means for moving the contacts of both of said coding devices to their first position and for moving the contacts of the first coding device to their second position and for thereafter moving the contacts of the second coding device to their sec-

ond position, whereby there is a time interval between interruption of the supply of energy to said conductors at said first location and connection of said detector relays across said conductors and energy stored in the circuit of said conductors will be dissipated before said detector relays are connected across said conductors, signaling means governed by said code following relay, and signaling means governed by said detector relays.

5. In a coded signaling system, in combination, a pair of conductors extending between a first and a second location, a first and a second coding device and a first and a second polarized relay at said first location, each of said coding devices having contacts movable between a first and a second position, means for moving the contacts of both of said coding devices to their first position and for moving the contacts of the first coding device to their second position and for thereafter moving the contacts of said second coding device to their second position, means effective when the contacts of both of said coding devices are in their first position to connect a source of unidirectional current across said conductors through the windings of said detector relays in series so that energy supplied through the windings of said detector relays causes the relay contacts to occupy their normal position, a circuit effective when the contacts of said second coding device are in their second position to connect said detector relays across said conductors so that the contacts of one of said relays are moved to their reverse position by energy of one polarity supplied over said conductors and the contacts of the other of said relays are moved to their reverse position by energy of the other polarity supplied over said conductors, a code following relay at the second location operated by energy supplied over said conductors from the first location, means at the second location for supplying energy to said conductors in the intervals between the impulses of energy supplied to the conductors at the first location, means for causing the energy supplied to said conductors at said second location to be of one polarity at times and of the other polarity at other times, signaling means governed by said code following relay, and signaling means governed by said detector relays.

6. In a coded signaling system, in combination, a pair of conductors extending between a first and a second location, a first and a second coding device and a first and a second polarized relay at said first location, each of said coding devices having contacts movable between a first and a second position, means for moving the contacts of both of said coding devices to their first position and for moving the contacts of the first coding device to their second position and for thereafter moving the contacts of said second coding device to their second position, means effective when the contacts of both of said coding devices are in their first position to connect a source of unidirectional current across said conductors through the windings of said detector relays in multiple so that energy supplied through the windings of said detector relays causes the relay contacts to occupy their normal position, a circuit effective when the contacts of said second coding device are in their second position to connect said detector relays across said conductors so that the contacts of one of said relays are moved to their reverse position by energy of one polarity supplied over said conductors and the contacts of the other of said relays are moved to their reverse position by energy of the other polarity supplied over said conductors, a code following relay at the second location operated by energy supplied over said conductors from the first location, means at the second location for supplying energy to said conductors in the intervals between the impulses of energy supplied to the conductors at the first location, means for causing the energy supplied to said conductors at said second location to be of one polarity at times and of the other polarity at other times, signaling means governed by said code following relay, and signaling means governed by said detector relays.

7. In a coded railway signaling system, a section of railway track, a first and a second polarized detector relay at one end of said track section, a coding device having contacts continuously actuated between a first and a second position, the contacts of said coding device being effective when in their first position to connect a source of unidirectional energy across the rails of said track section through the windings of said detector relays in series so that an impulse of master code energy is supplied to the section rails and the contacts of said detector relays are caused to occupy their normal position, the contacts of said coding device being effective when in their second position to connect said detector relays across said track rails in such manner that the contacts of one of said relays are moved to their reverse position by energy of one polarity supplied over the track rails and so that the contacts of the other of said relays are moved to their reverse position by energy of the other polarity supplied over said track rails, a code following track relay at the end of said track section remote from said detector relays and operated by master code energy supplied over the section rails, means associated with said track relay for supplying impulses of feed-back energy to said track rails in the intervals between the impulses of master code, means for causing the feed-back energy to be of one polarity at times and to be of the other polarity at other times, signaling means governed by said track relay, and signaling means governed by said detector relays.

8. In a coded railway signaling system, a section of railway track, a first and a second polarized detector relay at one end of said track section, a coding device having contacts continuously actuated between a first and a second position, the contacts of said coding device being effective when in their first position to connect a source of unidirectional energy across the rails of said track section through the windings of said detector relays in multiple so that an impulse of master code energy is supplied to the section rails and the contacts of said detector relays are caused to occupy their normal position, the contacts of said coding device being effective when in their second position to connect said detector relays across said track rails in such manner that the contacts of one of said relays are moved to their reverse position by energy of one polarity supplied over the track rails and so that the contacts of the other of said relays are moved to their reverse position by energy of the other polarity supplied over said track rails, a code following track relay at the end of said track section remote from said detector relays and operated by master code energy supplied over the section rails, means associated with said track relay for supplying impulses of feed-back energy to said

track rails in the intervals between the impulses of master code, means for causing the feed-back energy to be of one polarity at times and to be of the other polarity at other times, signaling means governed by said track relay, and signaling means governed by said detector relays.

9. In a coded railway signaling system, a section of railway track, a first and a second polarized detector relay at one end of said track section, a coding device having contacts continuously actuated between a first and a second position, the contacts of said coding device being effective when in their first position to connect a source of unidirectional energy across the rails of said track section so that an impulse of master code energy is supplied to the section rails, the contacts of said coding device also being effective when in their first position to cause to be supplied to windings of said detector relays energy effective to cause the contacts of said detector relays to occupy their normal position, the contacts of said coding device being effective when in their second position to connect said detector relays across said track rails in such manner that the contacts of one of said relays are moved to their reverse position by energy of one polarity supplied over the track rails and so that the contacts of the other of said relays are moved to their reverse position by energy of the other polarity supplied over said track rails, a code following track relay at the end of said track section remote from said detector relays and operated by master code energy supplied over the section rails, means associated with said track relay for supplying impulses of feed-back energy to said track rails in the intervals between the impulses of master code, means for causing the feed-back energy to be of one polarity at times and to be of the other polarity at other times, signaling means governed by said track relay, and signaling means governed by said detector relays.

10. In a coded railway signaling system, in combination, a first and a second coding device and a first and a second polarized detector relay at one end of said track section, each of said coding devices having contacts movable between a first and a second position, means for moving the contacts of both of said coding devices to their first position and for moving the contacts of the first coding device to their second position and for thereafter moving the contacts of said second coding device to their second position, means effective when the contacts of both of said coding devices are in their first position to connect a source of unidirectional energy across the rails of said track section so that an impulse of master code is supplied to the section rails, means effective when the contacts of both of said coding devices are in their first position to cause to be supplied to windings of said detector relays energy effective to cause the contacts of said detector relays to occupy their normal positions, means effective when the contacts of said coding devices are in their second position to connect said detector relays across the track rails in such manner that the contacts of one of said relays are moved to their reverse position by energy of one polarity supplied over the track rails and so that the contacts of the other of said relays are moved to their reverse position by energy of the other polarity supplied over said track rails, a code following track relay at the end of said track section remote from said detector relays and operated by master code energy supplied over the section rails, means associated with said track relay for supplying impulses of feed-back energy to said track rails in the intervals between the impulses of master code, means for causing the feed-back energy to be of one polarity at times and of the other polarity at other times, signaling means governed by said track relay, and signaling means governed by said detector relays.

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