May 29, 1945. A. L. JEROME 2,376,967

CODED TRACK CIRCUITS

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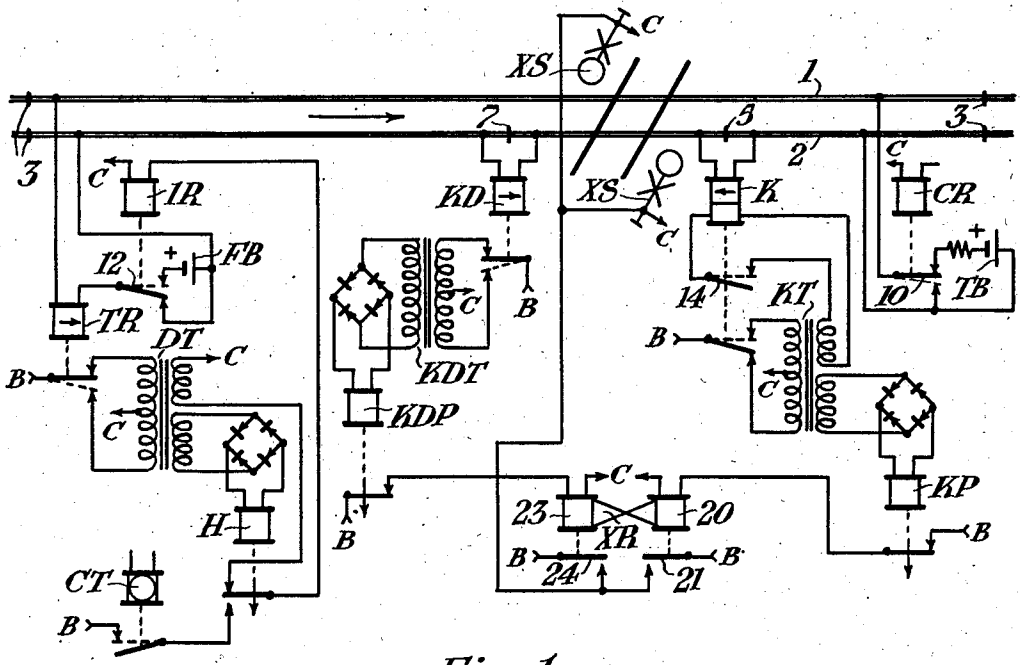


Fig. 1.

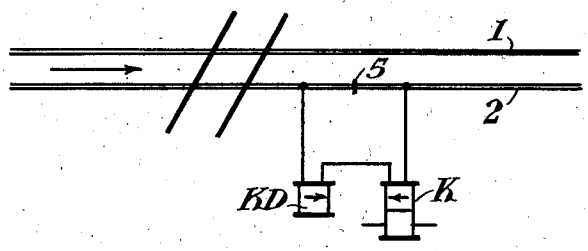


Fig. 2.

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CODED TRACK CIRCUITS

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4 Claims. (Cl. 246—130)

My invention relates to railway signaling apparatus and particularly to improved means for indicating at an intermediate point in a track section equipped with coded track circuit apparatus when a train enters the section.

It has heretofore been proposed to provide for a section of railway track a track circuit comprising a code following track relay at the entrance end of the track section together with means at the exit end of the section for supplying to the track relay over the section rails impulses of master code which are separated by intervals during which no energy is supplied. In addition it has been proposed to provide means associated with the track relay for supplying to the section rails in the intervals between impulses of master code, impulses of feed-back energy which operate a feed-back detector relay at the exit end of the track section.

Where a track section includes an intersection with a highway it is desired to provide means adjacent the highway governed by occupancy of the track section for controlling the signals which protect the crossing.

It is an object of this invention to provide improved means adapted, for use in a track section equipped with coded track circuit apparatus for indicating at an intermediate point in the track section when a train enters the section.

A further object of the invention is to provide improved means of the type described which operates to detect entrance of a train into the track section at either end.

Another object of the invention is to provide means of the type described which may be employed to detect occupancy of a portion only of a track section.

A further object of the invention is to provide means of the type described which may be employed to selectively detect occupancy of the portion of a track section at either side of a highway intersection.

Another object of the invention is to provide means of the type described which on movement of a train through the track section in either direction continues operation of the crossing signals until the train clears the intersection.

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

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

In practicing my invention I provide means at the exit end of a track section for supplying to the section rails impulses of master code to operate the code following track relay at the entrance end of the track section, while the track relay has associated therewith means for supplying impulses of feed-back energy to the section rails in the intervals between the impulses of master code, to also cause energy to be supplied to the section rails when the track relay is not following code.

An intersection with a highway is located at an intermediate point in the track section and a first insulated joint is located on one side of the highway intersection and a second insulated joint is located on the other side of the intersection and a detector relay is connected around each of these joints, while there is means governed by these detector relays for controlling the crossing signals for the intersection. Each of these detector relays is arranged to be controlled by energy supplied from the end of the section on the side of the highway intersection opposite from that of the insulated joint around which the relay is connected so that on movement of a train through the section in either direction operation of the crossing signals will be continued until the train clears the crossing.

In a modification of the invention only one insulated joint is provided and is located in advance of the highway crossing and the two detector relays are connected around this joint.

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

Fig. 2 is a diagram showing a modification which I may employ.

Referring to Fig. 1 of the drawing there is shown therein a section of railway track having track rails 1 and 2 over which traffic normally moves in the direction indicated by the arrow, that is from left to right. The rails of the track section are separated from the rails of the adjoining track sections by insulated joints 3.

A code following track relay TR is connected across the section rails at the entrance end of the section, while this relay is operated by master code supplied over the section rails from the track battery TB at the exit end of the section. The supply of energy from the track battery to the section rails is controlled by a coding relay CR which may be governed in ay manner well known in the art by traffic conditions in the adjacent

section in advance. In a typical system the relay CR may be operated to supply energy of 75 code frequency to the section rails when the adjacent section in advance is occupied and to supply energy of 180 code frequency to the section rails when the adjacent section in advance is vacant.

The track relay TR and the detector relay K each have associated therewith a source of direct current, not shown, the terminals of which are designated B and C in the drawing.

The track section includes an intersection with a highway, while an insulated joint 5 is located in one of the track rails at a point on the right hand side of the highway crossing. A detector relay K has one terminal of its winding connected to the track rail at one side of the insulated joint 5 while the other terminal of the relay winding is connected to the track rail at the other side of the insulated joint. The relay K is of the polar biased type the contacts of which become picked up when and only when energy flows through the relay winding in a particular direction, while the relay K controls the supply of energy through a decoding transformer to a relay KP. A track rail of the track section has an insulated joint 17 therein at a point on the left-hand side of the highway intersection and a relay KD has its winding connected around the joint 7. The relay KD controls a relay KDP while the relays KP and KDP control the circuits of an interlocking relay XR which governs the crossing signals XS.

When the contact 10 of coding relay CR is moved to its picked-up position the track battery is connected across the section rails with the positive terminal of the battery connected to track rail 1. Accordingly, master code energy flows from the positive terminal of the battery over contact 10 of relay CR, track rail 1, winding of track relay TR from left to right, back contact 12 of relay IR, track rail 2, windings of relays KD and K from left to right, and track rail 2 to the negative terminal of the battery TB.

The track relay TR is of the polar biased type the contact of which picks up when and only when energy flows through the relay winding in a particular direction, while the track relay is connected in the track circuit so that its contact picks up when energy flows through the relay winding from left to right which is the direction in which energy from the track battery flows through the winding of the track relay.

Similarly, the relay KD is of the polar biased type and is connected with the track rails in such manner that the relay contact picks up when energy flows through the relay winding from left to right, which is the direction in which energy from the track battery flows through the winding of this relay.

The relay K is also of the polar biased type and is connected in the track circuit in such manner that the relay contacts pick up only when energy flows through the relay winding from right to left. Accordingly, when contact 10 of relay CR picks up to cause energy to be supplied from the track battery to the section rails energy flows through the windings of relays TR, KD and K, while this energy will pick up the contacts of relays TR and KD, but will not pick up the contacts of relay K.

On movement of the contact of relay CR to its released position, the supply of energy from the track battery to the section rails is cut off, while contact 10 establishes connection between the section rails. When the supply of energy from the track battery is cut off the track relay TR releases and causes an impulse of energy to be supplied from the decoding transformer DT to relay IR to pick up its contact momentarily and cause an impulse of energy to be supplied from the feed-back battery FB to the section rails. This energy flows from the positive terminal of the battery FB over front contact 12 of relay IR, through winding of relay TR from right to left, track rail 1, back contact 10 of relay CR, track rail 2, windings of relays K and KD from right to left, and track rail 2 to the negative terminal of the battery FB. The energy supplied from battery FB flows through the windings of relays TR and KD in the wrong direction to pick up the relay contacts so the contacts of these relays remain released at this time. The energy supplied from the battery FB flows through the winding of relay K in the right direction to pick up its contacts so the contacts of relay K pick up on the supply of an impulse of feed-back energy to the section rails. Accordingly, as long as the section is vacant the track relay TR and the detector relay KD are operated by master code supplied over the section rails, while the relay K is operated by feed-back energy supplied over the section rails.

As a result of code following operation of the track relay TR energy is supplied through the decoding transformer DT to relays H and IR and the contacts of relay H are maintained picked up, while relay IR operates to supply impulses of feed-back energy to the section rails. The relay H may be employed in the well-known manner to control the signal for the track section and to control the supply of coded energy to the rails of the adjacent section in the rear.

As a result of code following operation of relay K energy is supplied through the decoding transformer KT to relay KP to maintain the contacts of relay KP picked up and establish the circuit of winding 20 of relay XR. In addition, on picking up of the relay K a contact 14 of the relay establishes a circuit to supply an impulse of energy from a secondary winding of transformer KT to a local winding of relay K. The various parts of the apparatus are arranged so that the energy supplied from the transformer KT to relay K is of the same polarity as the energy supplied from the feed-back battery to the track winding of the relay and aids the energy supplied to the track winding of the relay to maintain the relay contacts picked up. The energy supplied from the transformer KT to the relay K prolongs the picked-up periods of the relay enough to insure that sufficient energy is supplied from transformer KT to relay KP even though the impulses of feed-back energy are relatively short.

On code following operation of relay KD energy is supplied through transformer KDT to relay KDP and its contacts are picked up to establish the circuit of winding 23 of relay XR and as both windings of relay XR are energized the supply of energy to the crossing signals XS is interrupted and these signals are not operating. As the relay KD is operated by master code impulses, and as these impulses are substantially as long as the "off" intervals between code impulses, it is unnecessary to provide means for prolonging the picked-up periods of the contacts of relay KD.

When the contact 10 of coding relay CR is picked up it connects the track battery TB across the section rails, and when the section is vacant this energy feeds over the section rails and

through the winding of relay K and picks up relays TR and KD. On movement of the contact 10 of coding relay CR to its released position the supply of energy from the track battery is cut off and relays TR and KD release. On release of relay TR and the relay IR is picked up momentarily to supply energy from the battery FB to the section rails. This energy picks up the contacts of relay K.

Accordingly, when the section is vacant relays TR and KD are operated by the master code impulses, while relay K is operated by the feed-back impulses. As track relay TR follows code relay H is picked up and connects relay IR to a secondary winding of the decoding transformer DT, while as a result of code following operation of relays K and KD the relays KP and KDP are picked up and establish the circuits of the windings of the interlocking relay XR to prevent operation of the crossing signals XS.

When a train moving in the normal direction of traffic enters the track section the track relay TR is shunted and ceases to follow code so relay H releases and transfers control of relay IR to a coding device CT so that relay IR continues to operate to supply impulses of feed-back energy to the section rails. However, because of presence of the train in the track section, the energy supplied from the feed-back battery to the section rails is prevented from reaching the relay K so it ceases to follow code and relay KP releases and interrupts the circuit of winding 20 of relay XR with the result that contact 21 releases and establishes the circuit of the crossing signals XS and they operate to warn users of the highway of the approach of a train. At this time relay KD continues to be operated by master code supplied to the section rails so relay KDP is picked up and maintains the circuit of the winding 23 of relay XR.

When the train advances beyond joint 7 relay KD is shunted and ceases to be operated by impulses of master code so relay KDP releases and interrupts the circuit of winding 23 of relay XR, but because of the internal construction of the relay the contact 24 is prevented from moving all of the way to its released position.

When the train advances far enough in the track section for the rear of the train to be located in advance of insulated joint 5, at which time the train will have cleared the intersection, feed-back energy supplied to the section rails as a result of operation of relay IR by the coding device CT will flow through the winding of relay K and operate it so that relay KP is picked up to establish the circuit of winding 20 of relay XR and pick up contact 21 to discontinue operation of the crossing signals XS.

The feed-back energy supplied to the section rails at this time flows through the winding of relay KD, but is of the wrong polarity to operate the relay so its contacts remain released and relay KDP remains released.

When the train vacates the section master code energy supplied from the track battery to the track rails feeds to the track relay during a released period of relay IR and picks up the track relay so that energy is supplied through the decoding transformer DT to relay H and it picks up to transfer control of relay IR from coding device CT to the decoding transformer DT. Thereafter the relay IR operates in the usual manner to supply impulses of feed-back energy to the section rails in the interval between impulses of master code, and these impulses of feed-back code operate relay K to keep relay KP picked up. In addition, the master code supplied over the section rails after the section is vacated operates relay KD so that relay KDP picks up and establishes the circuit of the winding 23 of relay XR and the equipment is now in its normal condition.

The apparatus shown in Fig. 1 also operates to provide the desired control of the crossing signals XS on movement of a train through the track section in the reverse of the normal direction.

When a train moving from right to left enters the track section the supply of master code from the track battery over the section rails is cut off and relays TR and KD cease to operate so energy is no longer supplied to relays H and KDP and their contacts release. On release of relay H control of relay IR is transferred from the decoding transformer DT to the coding device CT and the relay IR is operated to supply impulses of feed-back energy from the battery FB to the section rails and this energy operates the relay K so that energy is supplied through the transformer KT to relay KP to keep its contacts picked up. The relay KP is enough slower in releasing than the relay H to remain picked up at these times until after relay H releases and causes relay IR to be operated by the coding device CT. As relay KP remains picked up at this time it maintains the circuit of the winding 20 of relay XR and prevents release of contact 21 of relay XR.

On release of relay KDP the circuit of the winding 23 of relay XR is interrupted and contact 24 releases to initiate operation of the crossing signals XS.

When the train advances beyond insulated joint 5 the relay K is shunted with respect to energy supplied from battery FB so the relay K ceases to follow code and relay KP releases and interrupts the circuit of the winding 20 of relay XR. However, because of the internal construction of the relay XR contact 21 is prevented from moving to its released position as contact 24 is already released.

When the rear of the train advances beyond insulated joint 7, at which time the train will have cleared the highway intersection, impulses of master code energy from the track battery TB feed to relay KD and operate it so that energy is supplied through transformer KDT to relay KDP and the contact of relay KDP picks up to establish the circuit of winding 23 of relay XR. Accordingly, contact 24 of relay XR picks up to discontinue operation of the crossing signals XS, while contact 21 continues to be prevented from moving to its released position.

When the train vacates the track section master code feeds to the track relay TR during a released period of the contact of relay IR and picks up the track relay TR so that energy is supplied to relay H to pick up its contacts and transfer control of relay IR from the coding device CT to the decoding transformer DT. After the train vacates the track section energy supplied from the battery FB feeds to the relay K and operates it so that relay KP picks up and establishes the circuit of the winding 20 of relay XR and the equipment is again in its normal condition.

From the foregoing it will be seen that the apparatus shown in Fig. 1 operates to provide the desired control of the crossing signals on movement of a train through the track section in either direction. Furthermore, the apparatus shown in Fig. 1 operates on movement of a train in either direction through the track section to continue

operation of the crossing signals until the train clears the highway intersection.

In some situations on movement of a train through the track section in the reverse of the normal direction it is not required to maintain operation of the crossing signals until the train clears the highway intersection. Where this method of control of the crossing signals is adequate the equipment may be arranged as shown in Fig. 2. Referring to this figure of the drawing the relays K and KD are connected in series around the joint 5 which is located in advance of the highway intersection. The equipment is otherwise the same as that shown in Fig. 1 of the drawing.

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

Having thus described my invention, what I claim is:

1. In a coded railway signaling system, in combination, a section of railway track through which traffic normally moves in a given direction, said track section having a first and a second track rail and including at an intermediate point in the section an intersection with a highway, a crossing signal at said intersection, a coding device at the exit end of the section having a contact continuously actuated between a first position in which it establishes connection between the section rails and a second position in which it connects a first source of energy across the section rails with the positive terminal of said source connected to said first track rail, a code following track relay at the entrance end of said track section operated by energy supplied over the section rails from said first source, means associated with the track relay for connecting across the track rails in the intervals during which the coding device contact is in its first position a second source of energy with the positive terminal of said source connected to said first track rail, a first detector relay having its winding connected in series with one track rail of said track section at a point in said section on the side of the highway intersection adjacent the track relay, a second detector relay having its winding connected in series with one track rail of said track section at a point in said section on the side of said highway intersection remote from the track relay, each of said detector relays having a contact which is moved from a first to a second position when and only when energy flows through the relay winding in a particular direction, said detector relays being arranged so that energy from said first source flows through the winding of the first detector relay in said particular direction and so that energy from said second source flows through the winding of the second detector relay in said particular direction, and means governed by said first and second control relays and controlling said crossing signal.

2. In a coded railway signaling system, in combination, a section of railway track through which traffic normally moves in a given direction, said track section having a first and a second track rail and including at an intermediate point in the section an intersection with a highway, a crossing signal at said intersection, a coding device at the exit end of the section having a contact continuously actuated between a first position in which it establishes connection between the section rails and a second position in which it connects a first source of energy across the section rails with the positive terminal of said source connected to said first track rail, a code following track relay at the entrance end of said track section operated by energy supplied over the section rails from said first source, means associated with the track relay for connecting across the track rails in the intervals during which the coding device contact is in its first position a second source of energy with the positive terminal of said source connected to said first track rail, a first and a second detector relay each having a winding connected in series with a track rail of said track section at a point in said section adjacent said highway intersection, each of said detector relays having a contact which is moved from a first to a second position when and only when energy flows through the relay winding in a particular direction, said detector relays being arranged so that energy from said first source flows through the winding of the first detector relay in said particular direction and so that energy from said second source flows through the winding of the second detector relay in said particular direction, and means governed by said first and second detector relays and governing said crossing signal.

3. In a coded railway signaling system, in combination, a section of railway track through which traffic normally moves in a given direction, said track section having a first and a second track rail and including at an intermediate point in the section an intersection with a highway, a crossing signal at said intersection, a coding device at the exit end of the section having a contact continuously actuated between a first position in which it establishes connection between the section rails and a second position in which it connects a first source of energy across the section rails with the positive terminal of said source connected to said first track rail, a code following track relay at the entrance end of said track section operated by energy supplied over the section rails from said first source, means operative when said track relay is responding to coded energy to connect across the track rails during the released periods of the track relay a second source of energy with the positive terminal of said source connected to said first track rail, means operative when said track relay is not responding to coded energy to recurrently connect said second source of energy across the track rails with the positive terminal of said source connected to said first track rail, a first detector relay having its winding connected in series with one track rail of said track section at a point in said section on the side of the highway intersection adjacent the track relay, a second detector relay having its winding connected in series with one track rail of said track section at a point in said section on the side of said highway intersection remote from the track relay, each of said detector relays having a contact which is moved from a first to a second position when and only when energy flows through the relay winding in a particular direction, said detector relays being arranged so that energy from said first source flows through the winding of the first detector relay in said particular direction and so that energy from said second source flows through the winding of said second detector relay in said particular direction, and

means governed by said first and second detector relays and controlling said crossing signal.

4. In a coded railway signaling system, in combination, a section of railway track through which traffic normally moves in a given direction, said track section having a first and a second track rail and including at an intermediate point in the section an intersection with a highway, a crossing signal at said intersection, a coding device at the exit end of the section having a contact continuously actuated between a first position in which it establishes connection between the section rails and a second position in which it connects a first source of energy across the section rails with the positive terminal of said source connected to said first track rail, a code following track relay at the entrance end of said track section operated by energy supplied over the section rails from said first source, means operative when said track relay is responding to coded energy to connect across the track rails during the released periods of the track relay a second source of energy with the positive terminal of said source connected to said first track rail, means operative when said track relay is not responding to coded energy to recurrently connect said second source of energy across the track rails with the positive terminal of said source connected to said first track rail, a first and a second detector relay each having a winding connected in series with a track rail of said track section at a point in said section adjacent said highway intersection, each of said detector relays having a contact which is moved from a first to a second position when and only when energy flows through the relay winding in a particular direction, said detector relays being arranged so that energy from said first source flows through the winding of said first detector relay in said particular direction and so that energy from said second source flows through the winding of said second detector relay in said particular direction, and means governed by said first and second detector relays and controlling said crossing signal.

ARTHUR L. JEROME.

CERTIFICATE OF CORRECTION.

Patent No. 2,376,967. May 29, 1945.

ARTHUR L. JEROME.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, first column, line 65, claim 1, for "control" read --detector--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of September, A. D. 1945.

(Seal)

Leslie Frazer
First Assistant Commissioner of Patents.