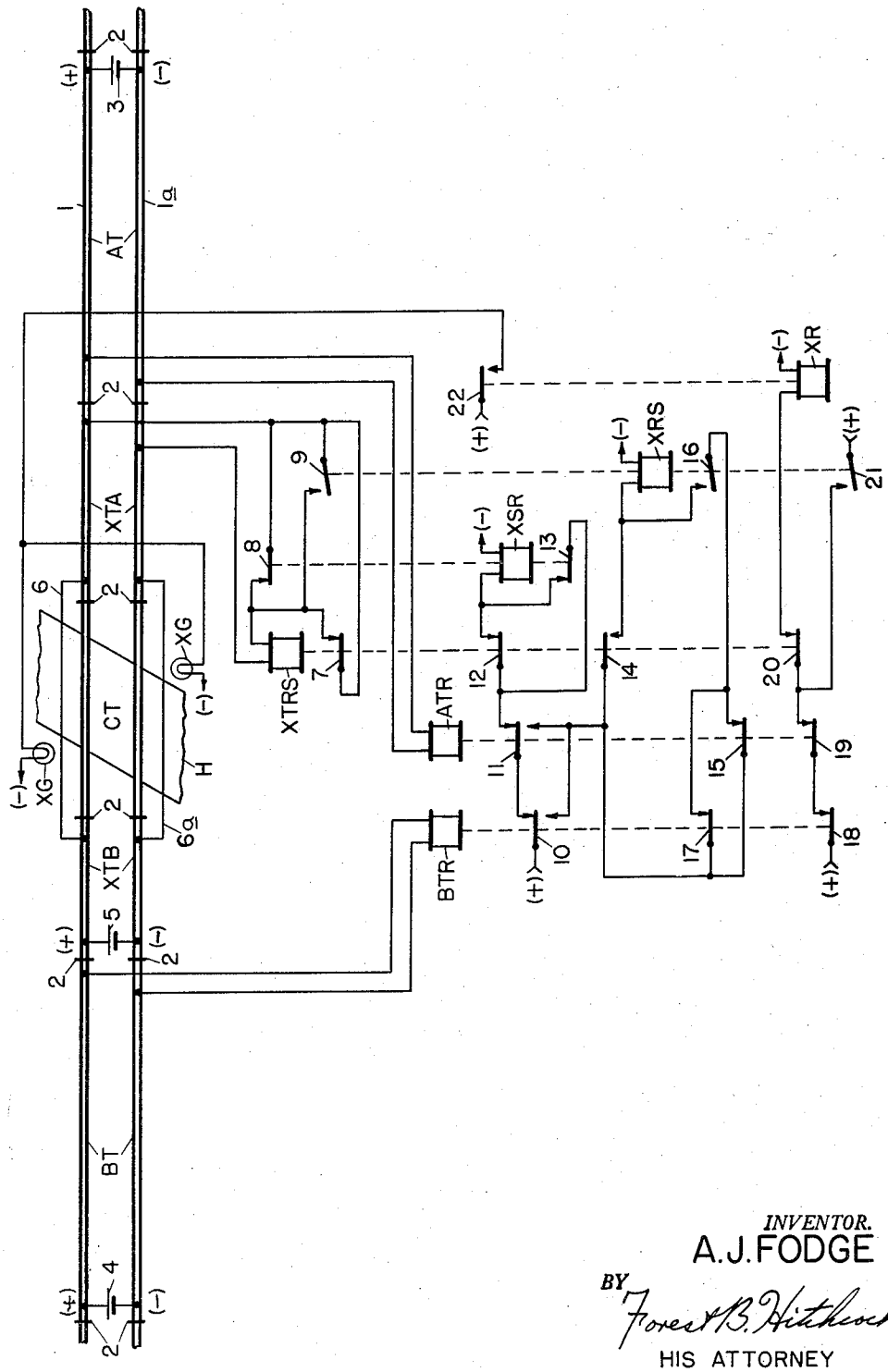
April 7, 1959 A. J. FODGE 2,881,309

HIGHWAY CROSSING WITH INSULATED TRACK SECTION AT CROSSING

Filed April 2, 1954



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United States Patent Office 2,881,309
Patented Apr. 7, 1959

2,881,309

HIGHWAY CROSSING WITH INSULATED TRACK SECTION AT CROSSING

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Application April 2, 1954, Serial No. 420,641

3 Claims. (Cl. 246—130)

This invention relates to highway crossing warning systems for the protection of crossings and particularly relates to highway crossing warning systems employing track circuits which, when occupied by trains, cause warning devices to be actuated. More particularly, this invention relates to track circuit operated highway crossing warning systems in which the highway section of track is insulated from the track circuits.

Since track circuit operated highway crossing warning systems depend on shunts produced by trains in the track circuits for their operation, it is considered advantageous to insulate the highway section of track into a dead section whenever track circuits at the crossing might receive shunts from highway traffic crossing the tracks. This is especially true in northern or rural areas where sleighs are used, the runners of the sleighs producing shunts in any track circuit present at the crossing. The absence of a track circuit through the highway section of track is also advantageous at locations where the passage of highway traffic can cause deposits of mud, clay, sand or other substances to form on the rails. Such deposits can cause a loss of shunt in a track circuit, especially when the shunt is provided by a light-weight car.

In addition to the above considerations, it is proposed by this invention to cause the warning devices to operate whenever a train is approaching or occupying the highway crossing. It is further proposed that the warning devices, after being caused to operate, be caused to cease operation whenever a train is receding from and is not occupying the crossing.

More specifically, it is proposed that if a train is detected approaching the highway crossing the warning devices are operated; and the operation of the warning devices is sustained until the train completely passes the crossing. If, however, the train stops before reaching the crossing and reverses its direction of movement to recede from the crossing the warning devices are caused to cease operation. If a train does completely pass the crossing, causing the warning devices to cease operation behind it, it is proposed that any subsequent stopping and reversing of direction of movement by the train is to cause the warning devices to be again actuated.

An object of this invention is to provide a highway crossing warning system operated by track circuits, the highway section of track being a dead section, insulated from the track circuits.

Another object of this invention is to provide a highway crossing warning system of the type described in which the warning devices are actuated whenever a train is approaching or occupying the crossing.

Another object of this invention is to provide a highway crossing warning system of the type described in which the warning devices are caused to cease operation whenever a train is receding from the crossing and is not occupying the crossing.

Other objects, purposes and characteristic features of the present invention will be in part obvious from the accompanying drawing, and in part pointed out as the description of the invention progresses.

The accompanying drawing shows diagrammatically a highway crossing location along with warning signal operating circuits which constitute one embodiment of this invention. In the accompanying drawing:

The symbols (+) and (—) represent the positive and negative terminals respectively of suitable batteries or other sources of direct current energy.

The relays represented are of the direct current tractive type which, when energized, attract their armatures to close their various front contacts and to open their various back contacts. The relays are identified by reference characters given to their windings.

The reference characters **1** and **1*a*** indicate the rails of a stretch of track which intersects a highway H at grade. Train traffic is assumed to travel in both directions over the stretch of track.

The stretch of track is divided by insulated rail joints **2** into approach track sections AT and BT, crossing track sections XTA and XTB and a highway track section CT.

The approach track section AT has a track circuit including a battery **3** and the winding of a track relay ATR. The relay ATR is normally energized by a circuit which can be traced from (+), of the battery **3** through the rail **1**, the winding ATR and the rail **1*a*** to (—) of the battery **3**. The arrival of a train on the track section AT will produce a low resistance shunt through the various wheels and axles of the cars which serves to critically lower the voltage across the winding of the relay ATR causing it to allow its armature to drop away. The approach track section BT has a similar track circuit including a battery **4** and the winding of a track relay BTR.

The crossing track sections XTA and XTB have a common track circuit including a battery **5** and the winding of a track relay XTRS. Each of the track sections XTA and XTB is assumed to be longer than the longest engine or railway car. The two track sections XTA and XTB are electrically connected by bond wires **6** and **6*a*** which bridge the electrically inert track section CT. Once energized the relay XTRS is held energized by a stick circuit which can be traced from (+) of the battery **5** through the rail **1** in conjunction with the bond wire **6**, a front contact **7** of the relay XTRS, the winding of the relays XTRS, and the rail **1*a*** in conjunction with the bond wire **6*a*** to (—) of the battery **5**. A shunt produced by the arrival of a train on either track section XTA or XTB will cause the armature of the relay XTRS to drop away as previously described for the track relays ATR and BTR. The relay XTRS is energized after the removal of the train-shunt by a pick-up circuit which can be traced from (+) of the battery **5** through the rail **1** in conjunction with the bond wire **6**, through either a front contact **8** of a relay XSR or a front contact **9** of a relay XRS, the winding of the relay XTRS, and the rail **1*a*** in conjunction with the bond wire **6*a*** to (—) of the battery **5**. Thus, once the relay XTRS is deenergized by a train occupying the track circuit described, it can be reenergized only if the front contact **8** of the relay XSR or the front contact **9** of the relay XRS is closed.

The crossing stick relay XSR is provided to continuously detect the presence of a train moving through the crossing location and will detect the presence of the train even in the case of a light engine or a motor car which might, for a time, sit completely within the dead section of track CT. The relay XSR is in effect a repeater of the track relays ATR, BTR and XTRS and has a

pick-up circuit which can be traced from (+) through a front contact **10** of the relay BTR, a front contact **11** of the relay ATR, a front contact **12** of the relay XTRS, and the winding of the relay XSR, to (—). A stick circuit for the relay XSR is provided and can be traced from (+), through the front contact **10** of the relay BTR, the front contact **11** of the relay ATR, a front contact **13** of the relay XSR and the winding of relay XSR, to (—).

The crossing receding stick relay XRS is provided to indicate that a train, in moving through the stretch of track, has advanced to occupy either track section XTA or XTB adjacent to the highway section CT and is receding from the crossing section in either direction. The relay XRS is energized by a pick-up circuit which can be traced from (+) through a back contact **10** of the relay BTR, a back contact **14** of the relay XTRS, and the winding of the relay XRS, to (—). An alternate pick-up circuit can be traced from (+), through a front contact **10** of the relay BTR, a back contact **11** of the relay ATR, the back contact **14** of the relay XTRS, and the winding of the relay XRS, to (—). Thus, the relay XRS is energized by sequential occupancies of an approach track section AT or BT and a crossing track section XTA or XTB, or conversely. A stick circuit for the relay XRS can be traced from (+), through the back contact **10** of the relay BTR, a front contact **15** of the relay ATR, the front contact **16** of the relay XRS, and the winding of the relay XRS, to (—). An alternate stick circuit for the relay XRS can be traced from (+), through the front contact **10** of the relay BTR, the back contact **11** of the relay ATR, a front contact **17** of the relay BTR, the front contact **16** of the relay XRS, and the winding of the relay XRS, to (—). Thus, either stick circuit for the relay XRS includes a series connection of a back contact of one approach track relay ATR or BTR and a front contact of the other approach track relay.

A crossing relay XR is provided to control the operation of two crossing signals XG. The relay XR is normally energized by a pick-up circuit which can be traced from (+), through a front contact **18** of the relay BTR, a front contact **19** of the relay ATR, a front contact **20** of the relay XTRS, and the winding of the relay XR, to (—). The described pick-up circuit can be opened by the occupancy of any track circuit by a train. An alternate pick-up circuit can be traced from (+), through a front contact **21** of the relay XRS, the front contact **20** of the relay XTRS, and the winding of the relay XR, to (—); and this pick-up circuit is closed when a train, in receding from the crossing, vacates either track section XTA or XTB.

The two crossing signals XG are shown located on opposite sides of the track and adjacent to the highway H. For simplicity the signals XG are represented as direct current lamps; however, any well known type of crossing signal such as flashing lights, bells, or gates could be substituted. The signals XG are energized by a circuit which can be traced from (+), through a back contact **22** of the relay XR and the signal lamps XG, to (—).

When there are no trains occupying the stretch of track the relays ATR, BTR, XTRS, XR and XSR are energized, the relay XRS being deenergized.

To describe circuit operation assume that a train is moving westward (from right to left on the drawing) into the stretch of track, the train being of sufficient length to completely occupy the stretch of track.

When the train enters the track section AT the shunt produced by the train in the associated track circuit critically deenergizes the relay ATR, causing the front contact **19** of the relay ATR to open the energizing circuit previously described for the relay XR. The back contact **22** of the relay XR closes the energizing circuit for the crossing signals XG, causing the signals to be illuminated. The front contact **11** of the relay ATR opens the energizing circuits previously described for the relay XSR, causing that relay to be deenergized.

As the train advances to occupy the track section XTA in addition to the track section AT, the shunt produced in the track circuit for the section XTA critically deenergizes the relay XTRS. The closing of the back contact **14** of the relay XTRS in conjunction with the previously closed back contact **11** of the relay ATR completes the pick-up circuit previously described for the relay XRS. The closing of the front contact **16** of the relay XRS completes a stick circuit for the relay XRS through the previously closed back contact **11** of the relay ATR and the closed front contact **17** of the relay BTR. The front contact **20** of the relay XTRS opens to maintain deenergization of the relay XR while the front contact **21** of the relay XRS closes to precondition the alternate pick-up circuit for the relay XR.

As the train continues to advance, occupying the track sections AT, XTA, CT and XTB, no change in circuit operation occurs.

When the train occupies the track section BT in addition to the other track sections, the shunt produced by the train in the track circuit associated with the track section BT critically deenergizes the relay BTR. The front contact **18** of the relay BTR opens the previously opened pick-up circuit for the relay XR at another point. The front contact **17** of the relay BTR opens in the stick circuit for the relay XRS. The front contact **10** of the relay BTR opens one pick-up circuit for the relay XSR but the back contact **10** of the relay BTR closes in time to maintain the energization of the relay XRS through the alternate pick-up circuit, the stick circuit for the relay XRS being opened by the front contact **17** of the relay BTR.

As the train continues movement and leaves the track section AT but continues to occupy the other track sections, the removal of the shunt from the track circuit associated with the track section AT causes the relay ATR to be energized. The front contact **19** of the relay ATR closes in the pick-up circuit for the relay XR; but the relay XR remains deenergized. The front contact **15** of the relay ATR closes to re-establish a stick circuit for the relay XRS.

Further movement of the train causes no change in the operation of the circuit until the train has vacated the track section XTB. When the train leaves the track section XTB the removal of the shunt produced by the train in the track circuit associated with the track section XTB causes the relay XTRS to be energized through the pick-up circuit including the front contact **9** of the relay XRS. The front contact **7** of the relay XTRS closes to establish the stick circuit previously described for the relay XTRS. The front contact **20** of the relay XTRS closes the alternate pick-up circuit including the closed front contact **21** of the relay XRS to energize the relay XR. The back contact **22** of the relay XR opens to remove energy from the crossing signals XG. At this point the train has cleared the track circuit adjacent to the highway section and, by completely clearing the highway section, has caused the cessation of warning signal operation. The back contact **14** of the relay XTRS opens the pick-up circuit for the relay XRS; but the relay XRS remains energized through its stick circuit.

When the train leaves the track section BT, removing the shunt which it had produced in the associated track circuit, the relay BTR is energized. The back contact **10** of the relay BTR opens to remove energy from the stick circuit for the relay XRS, thus deenergizing the relay XRS. The front contact **9** of the relay XRS opens in one of the previously described pick-up circuits for the relay XTRS, the relay XTRS remaining energized through its stick circuit. The front contact **21** of the relay XRS opens the alternate pick-up circuit for the relay XR; but the front contact **18** of the relay BTR closes to establish the normal pick-up circuit for the relay XR before the

front contact 21 of the relay XRS opens the alternate circuit. In this manner the relay XR, after being energized when the train vacated the track section XTB, is not permitted to be momentarily deenergized to cause an operation of the crossing signals XG. The relay XSR is energized by the closing of the front contact 10 of the relay BTR in conjunction with the closed front contact 11 of the relay ATR and the closed front contact 12 of the relay XTRS.

The front contact 13 of the relay XSR prevents non-operational deenergizations of the relay XSR by the opening of the front contact 12 of the relay XTRS. In other words, once the relay XSR is energized it cannot be deenergized unless a train occupies one of the approach track sections AT or BT. If the relay XTRS becomes deenergized because of a battery failure or disconnection, the relay XTRS can be reenergized only if either the front contact 8 of the relay XSR or the front contact 9 of the relay XRS is closed. The front contact 9 of the relay XRS cannot be closed unless a train is moving through the stretch of track; therefore, the front contact 8 of the relay XSR must be closed. It can be seen then that if the front contact 13 of the relay XSR did not exist, a non-operational deenergization of the relay XTRS would cause deenergization of the relay XSR by the opening of the front contact 12 of the relay XTRS. Thus, the two relays XTRS and XSR would be held mutually deenergized until a train entered an approach track section AT or BT causing the relay XRS to be energized; and the warning signals XG to be deenergized as the train approaches the crossing. Therefore, the possibility of false warning signal operation is precluded by the stick circuit described for the relay XSR.

An eastbound train moving through the stretch of track will obviously cause the various track relays to be deenergized in a sequence which is the reverse of that described for a westbound train. However, is can be seen in the accompanying drawing that the resultant circuit operation is independent of the direction of train movement; and eastbound and westbound trains produce identical effects in over-all operational control of the warning signals XG.

Assume now that a light engine, motor car or other car having a length less than that of any of the track sections is moving westward through the stretch of track.

When the car enters the track section AT the shunt produced by the train in the associated track circuit critically deenergizes the relay ATR. The front contact 19 of the relay ATR opens to deenergize the relay XR. The back contact 22 of the relay XR closes to energize the crossing signals XG. The relay XSR is deenergized by the opening of the front contact 11 of the relay ATR in its pick-up circuit.

As the car advances to occupy the track sections AT and XTA jointly, the shunt produced by the train maintains the deenergization of the relay ATR and critically deenergizes the relay XTRS. The closing of the back contact 14 of the relay XTRS in conjunction with the previously closed back contact 11 of the relay ATR completes the pick-up circuit previously described for the relay XRS. The closing of the front contact 16 of the relay XRS completes a stick circuit for the relay XRS through the previously closed back contact 11 of the relay ATR and the closed front contact 17 of the relay BTR. The front contact 20 of the relay XTRS opens to maintain deenergization of the relay XR while the front contact 21 of the relay XRS closes to precondition the alternate pick-up circuit for the relay XR.

When the car leaves the track section AT and occupies the track section XTA only, the relay ATR is energized because of the removal of the shunt produced by the train in the track circuit. The relay XRS is deenergized by the opening of the back contact 11 of the relay ATR.

Further advancing of the car to occupy the track sections XTA and CT jointly produces no change in circuit operation.

As the car advances to occupy the dead track section CT only, no change occurs in circuit operation even though the shunt produced by the car in the track section XTA has been removed. The relay XTRS cannot be energized after the removal of the shunt because the front contact 8 of the relay XSR and the front contact 9 of the relay XRS are open, the relays XSR and XRS having been previously deenergized.

When the car jointly occupies the track sections XTB and CT no change occurs in the circuit operation although a shunt is reintroduced by the car in the track circuit associated with the track sections XTA and XTB.

As the car advances to occupy the track section XTB only no change in circuit operation occurs.

Further movement of the car resulting in joint occupancy of the track sections XTB and BT causes the critical deenergization of the relay BTR due to the shunt introduced into the track circuit associated with the track section BT. The front contact 18 of the relay BTR opens in the already opened pick-up circuit of the relay XR. The relay XRS is energized by the closing of the back contact 10 of the relay BTR in conjunction with the previously closed back contact 14 of the relay XTRS.

When the car leaves the track section XTB and occupies the track section BT only, the relay XTRS becomes energized because of the removal of the shunt produced by the car in the track circuit associated with the track section XTB, the relay XTRS being energized through the pick-up circuit including the front contact 9 of the relay XRS. The back contact 14 of the relay XTRS opens the pick-up circuit of the relay XRS; but the relay XRS remains energized through its stick circuit. The front contact 20 of the relay XTRS closes the alternate energizing circuit for the relay XR, causing the back contact 22 of the relay XR to open the circuit which energizes the crossing signals XG. When the car leaves the track section BT the removal of the shunt produced by the car in the associated track circuit causes the relay BTR to be energized. The back contact 10 of the relay BTR opens to deenergize the relay XRS. The front contact 21 of the relay XRS opens the alternate pick-up circuit for the relay XR; however, the front contact 18 of the relay BTR closes the other pick-up circuit for the relay XR holding that relay energized. The relay XSR is energized by the closing of the front contact 10 of the relay BTR in the pick-up circuit including the closed front contact 11 of the relay ATR and the closed front contact 12 of the relay XTRS. The car has now departed from the stretch of track, restoring the circuits to the normal condition.

Thus, it can be seen that the warning signal operation is the same for either a long or a short train, even though in the case of a single car, the car might for a time occupy only the dead section of track CT.

In view of the preceding description of circuit operation for trains moving progressively through the stretch of track, consideration can be given to a train which enters the stretch of track from one direction, stops at any point and reverses its direction of movement. The following description applies to westbound trains, it being understood that except for the sequence of track relay operation the description applies to eastbound trains. In the following description, train movements are described first for a long train which can occupy the entire stretch of track and then for a light engine or a single car which can sit entirely in any of the various track sections.

Assume that a long train enters the track section AT, stops and reverses its direction to leave the track section AT. Upon the entrance of a train into the track section AT the track relay ATR is critically deenergized, causing the relay XSR to be deenergized by the opening of the front contact 11 of the relay ATR and caus-

ing the relay XR to be deenergized by the opening of the front contact 19 of the relay ATR; and the warning signals XG are energized by the closing of the back contact 22 of the relay XR. When the train leaves the track section AT the relay ATR becomes energized, causing the relay XSR to be energized by the closing of the front contact 11 of the relay ATR and causing the relay XR to be energized by the closing of the front contact 19 of the relay ATR; and the warning signals XG are deenergized by the opening of the back contact 22 of the relay XR.

Assume now that a long train advances to occupy the track sections AT and XTA, stops and reverses its direction of movement. While the train occupies the two track circuits AT and XTA, the relays ATR and XSR, XR and XTRS are deenergized, the warning signals XG are energized and the relay XRS is energized by the closing of the back contact 14 of the relay XTRS. After reversing its direction of movement to leave the track section XTA, the train allows the relay XTRS to be energized through the pick-up circuit including the front contact 9 of the relay XRS. The relay XRS is held energized by its stick circuit and is unaffected by the opening of the back contact 14 of the relay XTRS in the pick-up circuit. The relay XR is energized by the closing of the front contact 20 of the relay XTRS in conjunction with the closed front contact 21 of the relay XRS; and the warning signals XG are deenergized by the opening of the back contact 22 of the relay XR. Further movement of the train to leave the track section AT restores the circuit to the normal condition.

It can be said that a long train advancing beyond the track section XTA to occupy all track sections produces no effect other than that described except for the deenergizing of the track relay BTR when the track section BT is occupied.

Assume now that a long train has moved through the stretch of track to a point where the track sections XTB and BT only are occupied. At this point the relays BTR, XTRS and XSR are deenergized, the relay XRS being energized. When the train leaves the track section XTB and occupies the track section BT only, the relay XTRS is allowed to become energized resulting in the energization of the relay XR by the closing of the front contact 20 of the relay XTRS in conjunction with the closed front contact 21 of the relay XRS. The warning signals XG are deenergized by the opening of the back contact 22 of the relay XR. Reversal in the direction of movement by the train to again occupy the track section XTB in addition to the track section BT causes the critical deenergization of the relay XTRS. The relay XR is deenergized by the opening of the front contact 20 of the relay XTRS, resulting in the energization of the warning signals XG by the closing of the back contact 22 of the relay XR. Further movement in the reverse direction by the train causes circuit operation as previously described for a train which advances as far as the track section XTA. In other words, the warning signals XG will remain energized until the train clears the track section XTA.

If a short train, or car, enters the track section AT, stops and reverses its direction of movement to leave the track section AT, the circuit operation will be identical to that described for a long train. Similarly, a car advancing to occupy the track sections AT and XTA before reversing its direction of movement will produce the same circuit operation as described for a long train.

Assume now that a car advances into the track section XTA and sits completely within that track section before reversing its direction of movement. At the time when the train occupies both the track sections AT and XTA the relays ATR, XSR, XR and XTRS are deenergized, the relay XRS and the warning signals XG being energized. When the train leaves the track section AT the relay ATR becomes energized causing the relay XRS to be deenergized by the opening of the back contact 11 of the relay ATR. The relay XR remains deenergized because the front contact 20 of the relay XTRS is open; and the warning signals XG remain energized.

When the car, after reversing its direction of movement, again occupies both of the track sections XTA and AT, the relay ATR is critically deenergized. The relay XRS is energized by the closing of the back contact 11 of the relay ATR in conjunction with the closed back contact 14 of the relay XTRS. When the car leaves the track section XTA, the relay XTRS is energized through a pick-up circuit including the front contact 9 of the relay XRS; and the relay XTRS is then held energized by its stick circuit. The relay XR is energized by the closing of the front contact 20 of the relay XTRS in conjunction with the closed front contact 21 of the relay XRS, causing the warning signals XG to be deenergized. When the car leaves the track section AT the circuit is restored to the normal condition.

The preceding description for a car moving onto the track section XTA before reversing its direction of movement also applies to a car moving to occupy the track sections CT or XTB before reversing its direction of movement. This is true because the track sections XTA and XTB have a common track circuit, the track circuit, in effect, embracing the dead section of track CT.

Assume now that a car moves through the stretch of track to the point where it sits entirely within the track section BT before reversing its direction of movement. At the time when the car sits within the track section XTB the relays XTRS, XSR, XRS and XR are deenergized while the relay ATR and the warning signals XG are energized. When the train occupies the track sections XTB and BT the relay BTR is deenergized while the relay XRS is energized by the closing of the back contact 10 of the relay BTR. As the train moves off the track section XTB the relay XTRS is energized through the pick-up circuit including the closed front contact 9 of the relay XRS. The relay XR is energized by the closing of the front contact 20 of the relay XTRS in conjunction with the closed front contact of the relay XRS, causing the warning signals XG to be deenergized by the opening of the back contact 22 of the relay XR. When the car, after reversing its direction of movement, again occupies the track section XTB in addition to the track section BT the relay XTRS is deenergized resulting in the deenergization of the relay XR by the opening of the front contact 20 of the relay XTRS; and the warning signals XG are energized by the closing of the back contact 22 of the relay XR. Further movement in the reverse direction by the car produces the same circuit operation as that previously described for a car advancing into the track sections XTA, CT, or XTB before reversing its direction of movement.

In view of the preceding description of circuit operation, a reason for the requirement that the track sections XTA and XTB each be of a length greater than the length of the wheel-base of any railway car can be stated.

If a westbound car having a wheel-base longer than the track section XTA enters the approach track section AT, relays ATR, XSR and XR are caused to be energized as previously described, causing the warning signals XG to be energized. When the car moves to occupy the track section XTA in addition to the track section AT, relay XTRS is critically deenergized resulting in the energization of relay XRS; and relay XRS is held energized by its stick circuit as long as back contact 11 of relay ATR remains closed. If the car then moves to a position where its front wheels are in the dead section of track CT and its rear wheels are in the track section AT, relay XTRS can become energized by the pick-up circuit including front contact 9 of relay XRS. Relay XR is then energized by the pick-up circuit including front contacts 20 and 21

of relays XTRS and XRS, respectively, causing the warning signals XG to be deenergized.

The conditions assumed above are hazardous in that a cessation of warning signal operation caused by the straddling of track section XTA by a car might occur at a time when a preceding car occupies the highway crossing section of track. Thus, the length of the track section XTA (and XTB) must be greater than the wheelbase of any railway car to preclude unsafe conditions.

Having described a form of apparatus as one specific embodiment of the present invention, it is desired to be understood that this form is selected to facilitate in the disclosure of the invention rather than to limit the number of forms which it may assume; and, it is to be further understood that various modifications, adaptations and alterations may be applied to the specific form shown to meet the requirements of practice, without in any manner departing from the spirit or scope of the present invention.

What I now claim is:

1. In a signaling system for the protection of highway vehicles crossing a railroad track, a stretch of dual rail track divided by insulated joints into a plurality of adjoining track circuit sections including an electrically inert middle section intersected by the highway crossing, two intermediate sections on opposite sides of said middle section and two approach sections on opposite sides of said intermediate sections, bond wires connecting the respective track rails of the intermediate track sections around said middle section, a track circuit for said intermediate sections including a source of energy and a normally energized intermediate track relay connected across the track rails through its own front stick contact, a track circuit for each of said approach sections including a source of energy and a normally energized approach track relay each connected directly across the track rails of its section, a repeater relay having an energizing circuit including in series a source of energy and a front contact of each of said approach track relays and a front contact of said intermediate track relay, a circuit including a front contact of said repeating relay shunting said front stick contact on said intermediate track relay, a receding relay having a pick-up circuit including a source of energy, a back contact of said intermediate track relay and contacts on said approach track relays connected to close such pick-up circuit when one of such approach track relays is deenergized, stick circuit means for said receding relay effective to maintain said relay energized only when one or the other of said approach track sections is occupied, circuit means including a front contact of said receding relay for shunting said front stick contact of said intermediate track relay, a first signal control circuit including in series front contacts of said approach and intermediate track relays, and a second signal control circuit including in series front contacts of said receding and said intermediate track relays, either of said signal control circuits when deenergized providing a warning to said highway vehicles of the presence of a train on said track in approach of or crossing said highway.

2. In a signaling system for the protection of highway vehicles crossing a railroad track, a stretch of dual rail track divided by insulated joints into a plurality of adjoining track sections including a crossing section intersected by the highway, two approach track sections one adjoining each end of said crossing track section, a track circuit for each of said approach track sections including

a source of energy and an approach track relay connected across the rails of that section, a track circuit for said crossing track section including a source of energy and a normally energized crossing track relay each connected across the track rails through its own front stitck contact, a repeater relay having an energizing circuit including in series a source of energy and a front contact of each of said approach track relays and a front contact of said crossing track relay, a circuit including a front contact of said repeating relay for shunting said front stick contact on said crossing track relay, a receding relay having a pick-up circuit including in series a source of energy, a back contact on said crossing track relay, and contacts on said approach track relays connected to effect a closure of said pick-up circuit when one of such approach track relays is deenergized, stick circuit means for said receding relay effective to maintain said relay energized only when one or the other of said approach track sections is occupied, circuit means including a front contact of said receding relay for shunting said front stick contact of said crossing track relay, a warning signal control circuit including in series front contacts of said approach and crossing track relays, and a circuit including a front contact of said receding relay for shunting said front contacts of said approach track relays included in said warning signal control circuit.

3. In a warning system for the protection of highway traffic crossing a railroad track, a stretch of dual rail track divided by insulated joints to form a crossing track section intersected by the highway, an approach track section adjoining each end of said crossing track section, a track circuit for each of said track sections including a source of energy and a track relay each connected across the rails of each section, electroresponsive means including the track relay of said crossing track section and being operated to a distinctive condition upon the entrance of a train into said crossing track section in either direction for detecting the presence of said train, control means including the track relays of said approach sections for controlling said electroresponsive means to said distinctive condition upon the entrance of a train into one of said approach sections and subsequently into said crossing section, restoration means responsive to the deenergized condition of said track relay of said crossing section and controlled by said track relays for said approach track sections when one or the other of such track relays is deenergized for providing pick-up circuit means for said electroresponsive means to restore it to its normal condition when the train leaves said crossing section, holding means for said restoration means effective when only one or the other of said approach track sections is occupied, and signal control circuit means controlled by front contacts of all of said track relays in series to give a warning signal while a train is approaching and crossing said highway, said signal control circuit means being rendered ineffective by said restoration and said electroresponsive means when a train is receding from said highway in either direction in one of said approach track sections.

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