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CONTROLLING APPARATUS FOR HIGHWAY CROSSING SIGNALS

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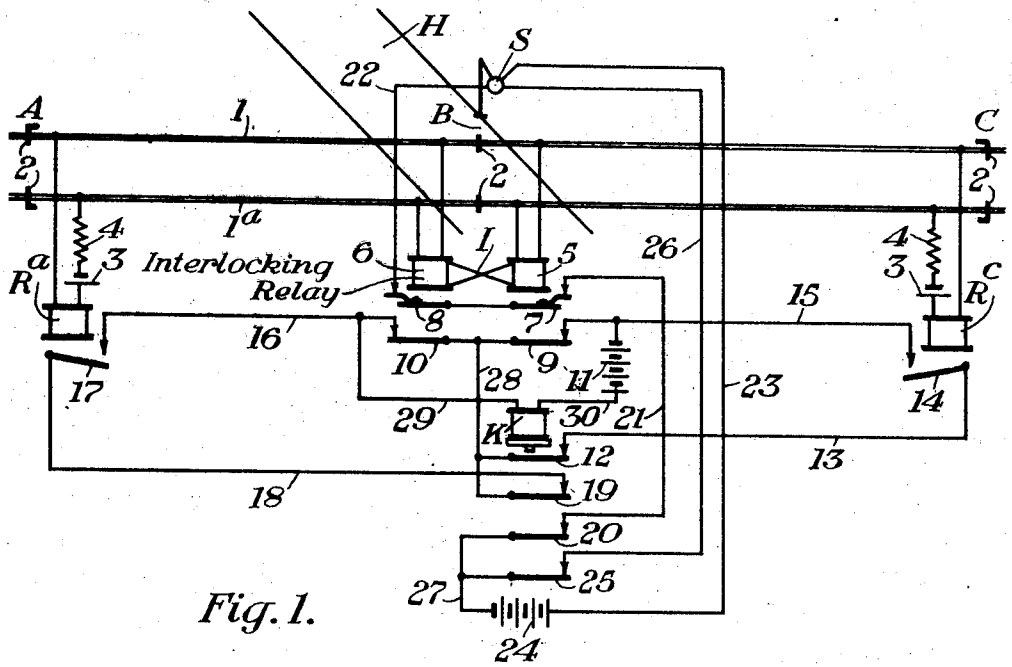



Fig. 1.

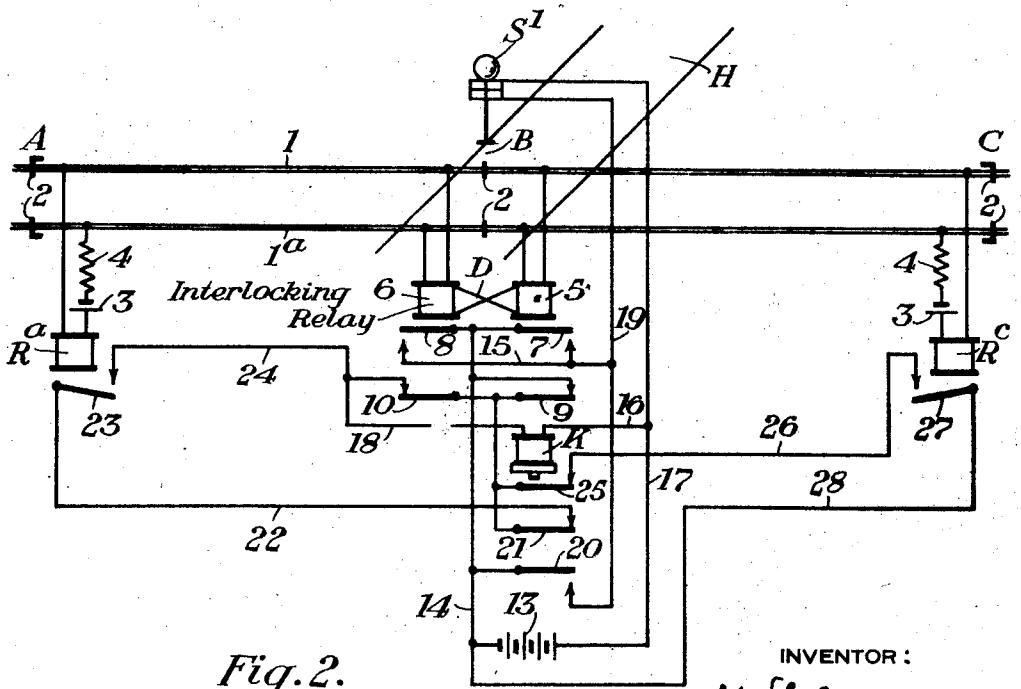



Fig. 2.

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# UNITED STATES PATENT OFFICE.

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## CONTROLLING APPARATUS FOR HIGHWAY-CROSSING SIGNALS.

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My invention relates to controlling apparatus for highway crossing signals, that is, to means for the control of signals which are placed at intersections of railways and highways for the purpose of warning users of the highway when a train is approaching a crossing.

More specifically, my invention relates to apparatus of this character involving track circuits.

One objects of my invention is to provide means for detecting failures in the track circuits, such as a failure of the track battery, an open circuit in the track battery leads to the rail, a broken rail, or an open track relay circuit.

A further object of my invention is to provide means whereby a reverse move of a train at a highway crossing after failure of the last relay to drop its armature, will give a warning indication at the crossing.

I will describe two forms of apparatus embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawing, Fig. 1 is a diagrammatic view illustrating one form of apparatus embodying my invention as applied to an automatic flagman. Fig. 2 is a view showing a modified form of the apparatus of Fig. 1 applied to a crossing bell and also embodying my invention.

Similar reference characters designate similar parts in both views.

In Fig. 1, reference characters 1 and $1^a$ designate the track rails of a stretch of railway track intersecting a highway H. Insulated joints 2 divide the track rails 1 and $1^a$ into two insulated track sections A—B and B—C, the junction B being located at or near the highway crossing H. A signal S is placed adjacent to the highway.

Current is supplied to the track sections A—B and B—C by batteries 3 which are connected in series with relays $R^a$ and $R^c$ as well as with the usual impedance devices 4. Relays $R^a$ and $R^c$ are each of a low resistance type which is adjusted to pick up its armature when the associated track section is occupied by a train and to release its armature when the associated track section is unoccupied.

An interlocking relay I is located at the junction B of the two track sections A—B and B—C, the operating coils 5, 6 being connected across the rails of the two sections respectively.

Relay I is provided with contacts 9 and 10 which in their closed positions complete a pick-up circuit for slow release stick relay K through battery 11 and connecting wires 29 and 30. Relay I also has contacts 7 and 8 which control the automatic flagman S in a manner which will be described hereinafter.

Relay K is provided with four front contacts 12, 19, 20 and 25. Contact 12 forms a part of the stick circuit of relay K from the positive side of battery 11, wire 15, contact 14 of relay $R^c$, wire 13, contact 12, wire 28, contact 10, wire 29, relay K and wire 30 to battery 11. Contact 19 forms part of a similar stick circuit through contact 17 of relay $R^a$ and contact 9 of relay I. Contact 20 of relay K is included in the holding circuit of signal S which circuit is from battery 24 through wire 27, contact 20, wire 21, contacts 7 and 8 of relay I, wire 22, signal S, wire 23 to battery 24. Contact 25 is included in the operating circuit of signal S which circuit is from battery 24, wire 27, contact 25, wire 26, signal S, wire 23, and back to battery.

The signal S is of the wig-wag type and has a holding winding which, when energized, latches the pendulum in one extreme position in which the signal indicates clear. When this winding is de-energized, it sets into operation a motor which causes the pendulum to swing back and forth to give a warning indication.

It will thus be seen that opening the holding circuit of signal S at either contact 7 or 8 will cause the signal to swing back and forth unless the contact 25 of the operating circuit is opened, in which case the signal disc will hang straight down to give an "out-of-order" indication. Whenever relay K is de-energized both contacts 20 and 25 are opened so that both the holding circuit and the operating circuit of the signal are open and the signal disc will hang straight down.

As shown in the drawing all of the parts of the apparatus occupy the positions corresponding to the normal or unoccupied condition of the sections A—B and B—C.

In describing the operation of the apparatus in Fig. 1, I will first assume that an

eastbound train, that is, a train moving from left to right, enters the stretch of track shown in the drawing. When the train enters the section A—B coil 6 is de-energized, contact 8 drops opening the holding circuit of the signal S, and relay $R^a$ picks up, closing its contact 17 to complete one of the stick circuits for relay K. This circuit is from battery 11, through contact 9, wire 28, contact 19, wire 18, contact 17, wires 16 and 29, relay K and wire 30 back to battery. Contact 10 is opened simultaneously with the opening of contact 8 but the relay K being slow acting does not release until relay $R^a$ has operated to close the stick circuit of relay K just traced. The holding circuit of signal S being open at contact 8, and the operating circuit being closed at contact 25, the signal will continue to wig-wag until the train leaves the section A—B. While the train is in section A—B, if battery 3 supplying the track section A—B should fail or the connections from battery 3 to the rails should break, relay $R^a$ would release its contact 17, and this would open the stick circuit for relay K and cause the signal S to indicate "out-of-order", the holding circuit for the signal being open at contacts 8 and 20 and the operating circuit being open at contact 25. If a rail should break, or a connection to coil 6 should break, relay K would be de-energized after the train passed the break.

When the train moves out of section A—B coil 5 is de-energized and coil 6 is again energized, but due to the interlocking of relay I, contact 7 cannot open. The holding circuit for signal S becomes closed through contacts 7 and 8 and the signal S gives a clear indication. Contact 9 opens but before stick relay K releases its armature contact 14 of relay $R^c$ will close to complete a stick circuit for relay K through contacts 10 and 12, and so contact 25 of the operating circuit will be held closed. When the train passes out of section B—C coil 5 again becomes energized and relay $R^c$ opens.

If a failure of the track circuit of section B—C should occur while the east-bound train is in section B—C the contact 7 would be locked in its closed position but contact 9 would open and de-energization of relay $R^c$ would also cause contact 14 to open. The relay I is so constructed that upon de-energization of coil 5 contact 9 is open while contact 7 remains closed. In the same way contact 10 would open with coil 6 de-energized when contact 8 is locked closed. Relay K would be de-energized to open contacts 20 and 25 so that both the operating and holding circuits of signal S would be open and the disc would hang straight down to give an out-of-order indication.

My invention also guards against a condition in which, after the passage of an east-bound train out of section B—C, the coil 5 of relay I remains de-energized, due to a break in the rails or connections, or a failure of battery 3 of section B—C. Contact 7 will remain closed and contacts 9 and 14 will be open. This will deenergize relay K, and open contacts 20 and 25 in the holding and operating circuits of signal S so that the signal disc will give the "out-of-order" indication. If a west-bound train should enter section B—C, while the above condition exists, relay $R^c$ would close its contact 14, provided battery 3 and the connections from battery 3 to the rails are not broken. However, coil 5 cannot become energized as it is now shunted by the west-bound train in section B—C. Therefore contact 9 will remain open, and will prevent the picking up of relay K. Contacts 20 and 25 will also remain open so that signal S will continue to give the "out-of-order" indication. It will thus be seen that my invention will always give the "out-of-order" indication at the crossing when track circuit failures occur.

The operation of the circuits for a west-bound train is similar to that described in connection with an east-bound train and will be readily understood from the drawing without further explanation.

Referring now to Fig. 2 in which an embodiment of my invention is shown in connection with a crossing bell, track sections A—B, B—C and associated relays $R^a$ and $R^c$ are arranged in the same manner as those described in connection with Fig. 1. Interlocking relay D is arranged to hold contacts 7 and 8 open when coils 5 and 6 are energized, and also to hold either of them open when coil 5 or 6 is de-energized, and its respective armature is locked.

When sections A—B and B—C are unoccupied coils 5 and 6 are energized and relay K is energized through a circuit from battery 13, through wire 14, contacts 9 and 10 of relay D, wire 18, relay K and wires 16 and 17 back to battery. It will thus be seen that under normal conditions contacts 7, 8 and 20 are held open, and contacts 21 and 25 are held closed.

When an east-bound train enters the section A—B, coil 6 is de-energized and contact 8 closes to complete the circuit for bell $S^1$ from battery 13, through wire 14, contact 8, wires 15 and 19, bell $S^1$, and wire 17 back to battery. Under these conditions the bell will ring to warn users of the highway that a train is approaching. De-energization of coil 6 also releases contact 10 to open the pick-up circuit of stick relay K, but stick relay K is slow acting so that relay $R^a$ has time to close contact 23 and complete a stick circuit for relay K before contacts 21 and 25 can open. This stick circuit may be traced from battery 13 through wire 14,

contacts 9 and 21, wire 22, contact 23, wires 24 and 18, relay K and wires 16 and 17 back to battery. The bell $S^1$ will continue to ring as long as section A—B is occupied by a train.

If a failure should occur in any part of the track circuit of section A—B while a train is in this section approaching the crossing, contact 8 of relay D would remain closed and the bell $S^1$ would continue to ring in spite of the failure.

When the train leaves section A—B contacts 8 and 23 are opened and contact 10 is closed. Relay coil 5 is de-energized but contact 7 does not close because it is interlocked with contact 8. Relay $R^c$ picks up to close a stick circuit for relay K, through contacts 10, 25 and 27. If a failure should occur in track circuit B—C while the section is still occupied by the east-bound train, contact 27 would open thus de-energizing relay K and closing contact 20 to complete a circuit from battery 13 through wire 14, contact 20, wire 19, bell $S^1$ and wire 17 to battery 13. With connection made in this manner the bell will ring continuously to give a danger indication. It should also be understood that the position of the train when contact 27 opens is dependent upon the nature of the failure, as explained in connection with Fig. 1, but in any case, if contacts 9 and 27 are both open at the same time for a long enough period to allow relay K to de-energize, it is necessary that contact 9 close before relay K can again become energized. Contact 9 cannot close unless coil 5 is energized, and this can take place only when battery 3 and all connections of track circuit B—C are in proper working order.

When the train leaves section B—C, coil 5 becomes energized and contacts 7 and 9 are restored to normal positions. Relay $R^c$ drops its contact 27 and relay K remains energized through contacts 9 and 10.

The operation of the apparatus shown in Fig. 2 for westbound traffic is similar to that just described for the opposite direction and will be readily understood from the drawing.

Although I have shown and described only two forms of signaling apparatus embodying my invention, it is to be understood that various changes and modifications may be made therein without departing from the spirit and scope of my invention.

Having thus described my invention what I claim is:

1. In a highway crossing protecting apparatus, the combination with two adjacent track sections having an interlocking relay connected therewith and means for energizing said sections, of a plurality of other relays, one being connected to each of said sections, a signal, and means including a stick relay and controlled by said other relays for operating said signal when either of said track sections is de-energized.

2. In a highway crossing protecting apparatus, the combination with two adjacent track sections having an interlocking relay connected therewith and means for energizing said sections, of a low resistance relay connected to each of said sections, a signal, and means including a stick relay and controlled by said low resistance relays for operating said signal when either of said sections is de-energized.

3. In a highway crossing protecting apparatus, the combination with adjacent track sections having an interlocking relay connected therewith and means for energizing said sections, of a plurality of low resistance relays one being connected to each of said sections, a signal and means including said interlocking relay for causing said signal to operate when either of said track sections is de-energized.

4. In combination, two adjacent sections of railway track, an interlocking relay connected to said sections, a relay for each section adapted to pick-up its armature when a train enters the associated section, a stick relay jointly controlled by the interlocking relay and said other relays, and a highway crossing signal controlled by said stick relay.

5. In combination, two adjacent sections of railway track, means for energizing said sections, an interlocking relay having two operating magnets one energized from each of said track sections, a plurality of other relays one being connected with each of said track sections, a stick relay in circuit with both of said other relays, a crossing signal, and means controlled by said relays for causing said signal to indicate the failure of the track circuit for either of said track sections.

6. In combination, two adjacent sections of railway track, means for energizing said sections, an interlocking relay having two operating magnets one energized from each of said track sections, a plurality of other relays one being connected with each of said track sections, a signal having an operating circuit and a holding circuit, a multiple contact stick relay in circuit with both of said other relays, one of said contacts controlling said operating circuit and another said holding circuit, and means for opening said holding circuit when either of said track sections is de-energized.

In testimony whereof I affix my signature.

HENRY S. YOUNG.