March 13, 1962 C. R. CRAIN 3,025,393

HIGHWAY CROSSING SIGNAL CONTROL SYSTEM

Filed July 16, 1957 2 Sheets-Sheet 1

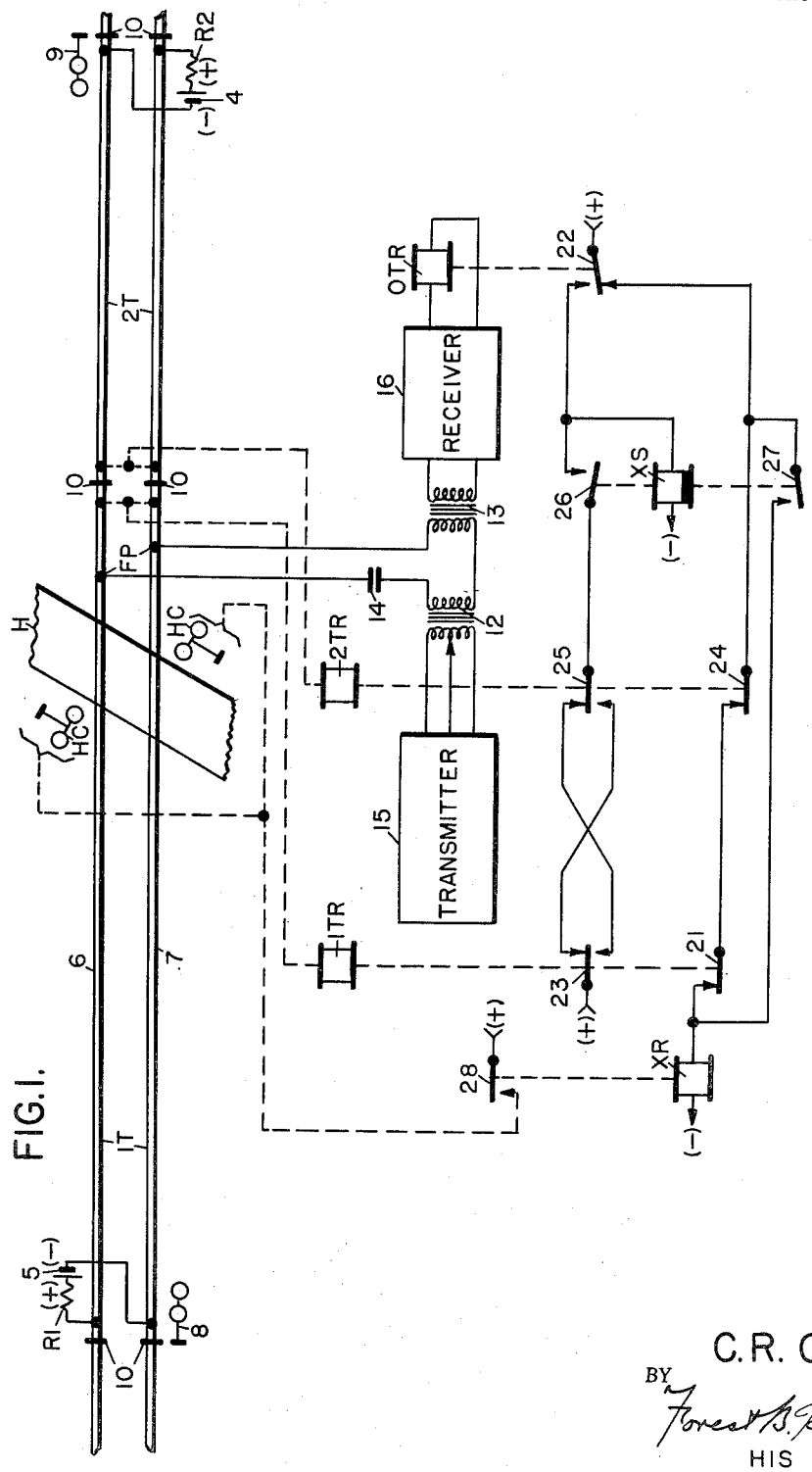


FIG. 1.

INVENTOR.
C. R. CRAIN
BY Forrest B. Hitchcock
HIS ATTORNEY

March 13, 1962 C. R. CRAIN 3,025,393

HIGHWAY CROSSING SIGNAL CONTROL SYSTEM

Filed July 16, 1957 2 Sheets-Sheet 2

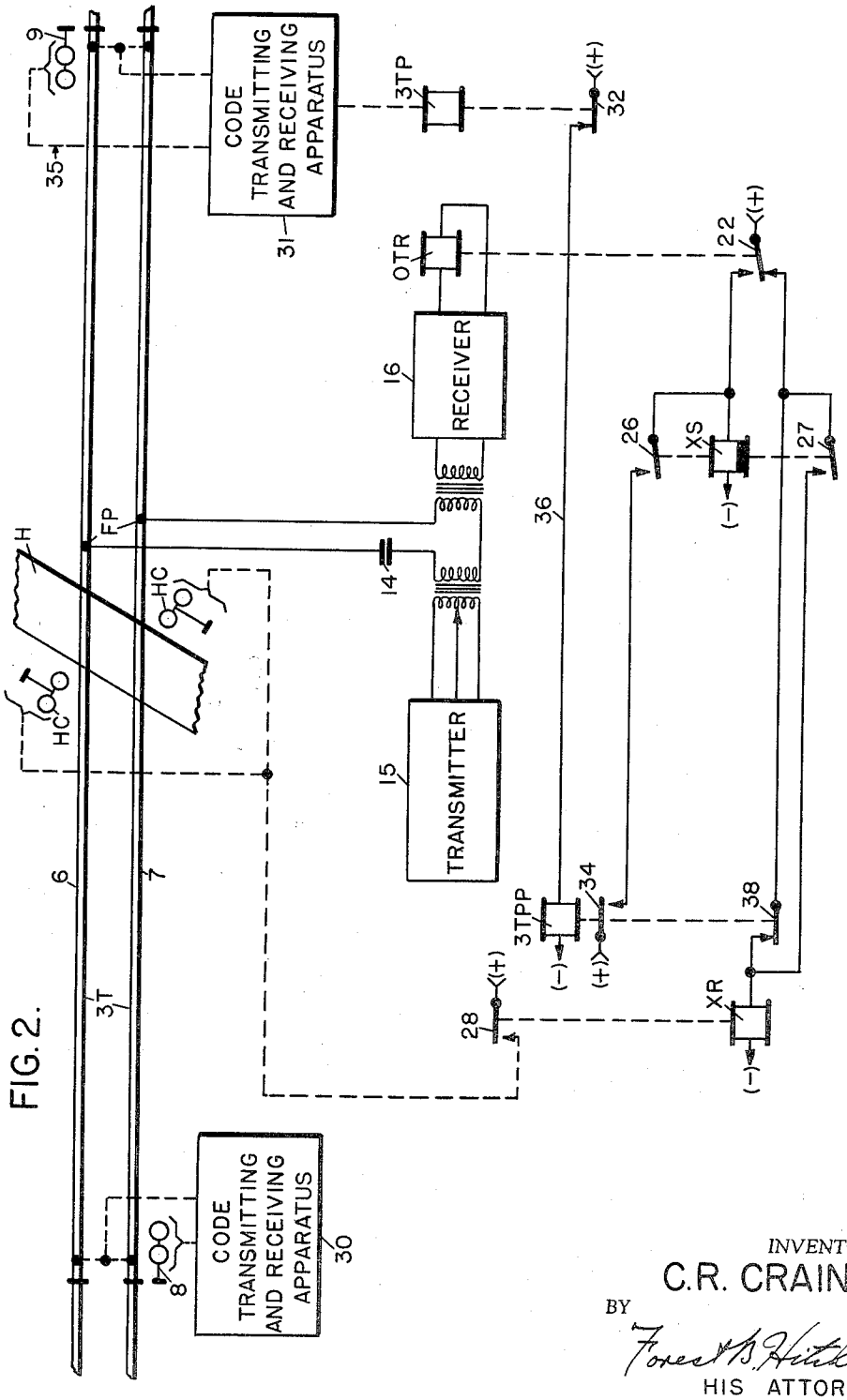


FIG. 2.

INVENTOR.
C.R. CRAIN
BY
Forest B. Hitchcock
HIS ATTORNEY

United States Patent Office

3,025,393

Patented Mar. 13, 1962

3,025,393

HIGHWAY CROSSING SIGNAL CONTROL SYSTEM

Chester Russell Crain, Kansas City, Mo., assignor to General Railway Signal Company, Rochester, N.Y.

Filed July 16, 1957, Ser. No. 672,270
11 Claims. (Cl. 246—130)

This invention relates generally to railway signalling apparatus and specifically to a simplified control system for highway crossing warning devices located at the intersection of a highway and a stretch of railway track.

In present systems where the highway intersection crosses a railway track section, it is customary to provide an "island section" adjacent the highway to provide for the deenergization or shutting off of the highway crossing warning devices after the rear of a train passes the highway intersection. This "island section" constitutes a separate track section which is isolated from the main track section by appropriate insulated joints. In order for the highway crossing warning system to properly cooperate with the regular railway signal apparatus, it is also necessary to provide special control circuits which cause the presence of a train in the island section to give a continuous condition of occupancy for the conventional railway track circuit. This additional island circuit and the other equipment pertaining thereto is relatively expensive especially where a highway section includes a plurality of parallel tracks or track switches.

In addition to the above considerations, it is proposed according to this invention to provide a simplified control system for a highway crossing warning device which is operative for trains travelling in both directions wherein the highway crossing warning signals cease to operate immediately after the rear of a train has passed the highway intersection.

It is also proposed to provide a new and novel circuit organization in a highway crossing warning system which utilizes an "overlay track circuit apparatus" as described in the application of John H. Auer, Jr. et al., Ser. No. 538,552, and filed October 5, 1955, now Patent No. 2,896,068, dated July 21, 1959, to which reference may be made for a more complete and detailed description thereof.

It is further proposed to provide an improved highway crossing warning system which does not utilize an insulated "island track section," and which will operate the highway crossing warning devices in response to an approaching train and which will cause them to continue operating until the rear of the train has receded a predetermined distance from the crossing. If, however, the train should stop before it reaches the crossing, or after it has passed the crossing a distance insufficient to cause the signals to cease operation, and then reverses its direction of movement to recede from the crossing, the warning devices will cease operation when the train recedes a predetermined distance from the highway intersection. If a train completely passes the crossing thereby causing the warning devices to cease operation behind it, any subsequent reversal of direction of movement of the train will cause the warning devices to be again put into operation.

It is an object of this invention to provide an improved highway crossing system which may be used on

a stretch of railway track without interfering with the regular track circuit apparatus which is used to control the traffic in the track stretch and which improved highway crossing system does not necessitate the utilization of an "island track circuit" to provide for shutting off the highway crossing signal after the rear of a train has passed the highway intersection.

Another object of this invention is to provide a new and novel organization employing an overlay track circuit of the type described in the aforesaid application of John H. Auer, Jr. et al. in a highway crossing system to provide for deenergization or shutting off the highway crossing signals when the rear of a train is receding from the highway crossing.

A still further object of this invention is to provide an improved highway crossing system which is so arranged that the crossing signals are controlled jointly by the conventional track circuit and the overlay track circuit arranged in such a manner that the failure of the overlay track circuit will not result in the failure of the crossing signals, thereby insuring adequate warning of the approach of a train under any condition.

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

In describing the invention in detail, references may be made to the accompanying drawings, in which like reference characters designated corresponding parts throughout the several views, and in which:

FIG. 1 illustrates diagrammatically one embodiment of the present invention as applied to a highway crossing signal system on a section of railway track employing direct current track circuits; and

FIG. 2 illustrates another embodiment of the present invention as applied to a highway crossing signal system on a section of railway track employing conventional coded track circuits.

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.

Referring to FIG. 1, the rails 6 and 7 of a stretch of track intersects at grade a highway H. Train traffic is assumed to travel in both directions over the stretch of track. This has been indicated in the drawings by the signal symbols 8 and 9. This has been indicated to illustrate that the territory in which this stretch of track is located is assumed to be signalled for traffic in both directions. However, the signals 8 and 9 may or may not be located exactly at the beginning of the section associated with the control of the highway crossing signals.

The stretch of track is divided by insulated rail joints 10 into separate track sections 1T and 2T. The track section 1T has a track circuit including a battery 5, a resistor R1 and the winding of a track relay 1TR. The relay 1TR is normally energized by a circuit which can be traced from the (+) side of the battery 5, through resistor R1, rail 6, the winding of relay 1TR and the rail 7 to (−) side of the battery 5. The arrival of a train

on the track section 1T will produce a low resistance shunt through the wheels and axles of the cars which serves to lower the interrail voltage and reduce the current in the winding of relay 1TR causing its armature to drop away. The track section 2T has a similar track circuit including a battery 4, a resistor R2 and the winding of a relay 2TR.

An overlay track circuit is provided to be responsive to the presence of a train a short distance each side of the highway H. The overlay track circuit comprises an electronic transmitter 15 which generates a relatively high audiofrequency (i.e. in the order of 10,000 cycles) appearing across the secondary winding of a transformer 12. A receiver 16 including an electromagnetic relay OTR is responsive to the voltage induced in the primary winding of a transformer 13 associated with the receiver. The secondary winding of the transformer 12 associated with the transmitter and the primary winding of the transformer 13 associated with the receiver, are connected in series with capacitor 14 and then across the track rails 6 and 7 at feed points FP. The series circuit is completed by the wheels and axles of a train shunting the track rails 6 and 7 thereby coupling the energy of the transmitter to the receiver which causes the relay OTR to pick up. The overlay circuit is so arranged that it will not affect or be affected by extraneous frequencies such as may be used in a conventional coded track circuit. The capacitor 14 is so selected that an effective rail shunt at a relatively short distance from the feed points FP will result in a maximum current through the winding of relay OTR. The feed points FP are placed so that an effective rail shunt for the overlay track circuit will occur a short distance i.e. in the order of 50 feet, on each side of the highway H.

Two crossing signals HC are shown located on opposite sides of the track and adjacent to the highway H. The signals HC are represented as flashing lights; however, any other well known type of crossing signal may be used such as bells or gates. The signals HC are energized by the closure of a back contact 28 of relay XR and are thus set into operation to warn highway traffic.

A highway crossing signal control relay XR is normally energized when the track sections 1T and 2T are vacant, thereby keeping the signals HC from operating. This normal energizing for relay XR can be traced from (+) through a circuit including a back contact 22 of relay OTR, front contact 24 of relay 2TR, front contact 21 of relay 1TR, windings of relay XR, to (—).

A crossing stick relay XS is provided to cause the signals HC to cease operation when the rear of a train has passed the highway H. It has a pick-up circuit which extends from (+), and includes front contact 22 of relay OTR, windings of relay XS, to (—). One of the stick circuits for relay XS extends from (+) and includes front contact 23 of relay 1TR, back contact 25 of relay 2TR, front contact 26 of relay XS, windings of relay XS to (—). The other stick circuit for relay XS extends from (+), and includes back contact 23 of relay 1TR, front contact 25 of relay 2TR, front contact 26 of relay XS, windings of relay XS, to (—).

When there are no trains occupying the stretch of track the relays 1TR, 2TR and XR are energized, and the relays OTR and XS are deenergized.

To describe the circuit operation, assume that a train is moving eastward (from left to right in FIG. 1) into the stretch of track.

When the train enters track section 1T, the shunt produced by the train in the associated track circuit causes relay 1TR to be dropped away, thereby causing its front contact 21 to open, thus opening the previously described normal energizing circuit for relay XR. As previously described, the deenergizing of relay XR and closure of back contact 28 causes the highway crossing signals HC to operate.

As the train proceeds toward the highway intersection and the vicinity of the feed points FP, the overlay track circuit apparatus is rendered active which results in the energizing of the relay OTR and the picking up of its contacts. The picking up of relay OTR removes (+) energy from the energizing circuit for the relay XR by the opening of back contact 22 of relay OTR. The closing of the front contact 22 of the relay OTR energizes the relay XS by completing its previously described pick-up circuit.

When the front of the train passes the highway intersection and enters the track section 2T, the track relay 2TR is deenergized thereby causing its contacts 24 and 25 to move from fronts to backs; but at this time the train is assumed to still occupy a portion of the track section 1T, a portion of the track section 2T, and the area controlled by the overlay track circuit. As the train leaves the area controlled by the overlay track circuit and the track section 1T, the relay XS is held in its energized condition by the previously described stick circuit which includes the front contact 23 of the relay 1TR and the back contact 25 of the relay 2TR. The relay XR is not energized until the relay OTR assumes a deenergized position closing back contact 22.

When the relay OTR is no longer affected by the presence of a train in the vicinity of the feedpoints FP, the relay OTR is deenergized which results in the energizing and picking up of the relay XR by completing its auxiliary energizing circuit which includes the front contact 27 of the relay XS and back contact 22 of relay OTR. The signals are now in an "off" condition and the train is receding from the highway intersection and occupying the track section 2T. As the train vacates the track section 2T the previously described stick circuit for relay XS is broken by the picking up of the track relay 2TR, thereby causing the relay XS to drop away. The relay XR is now held in its energized position by the energizing circuit which includes the front contact 24 of relay 2TR and the front contact 21 of relay 1TR.

In the arrangement as illustrated in FIG. 1, the rear of the train travelling from left to right will simultaneously leave the influence of the overlay track circuit and the track section 1T thus causing relay OTR to become deenergized and relay 1TR to become energized at the same time. This relay XS is made slow acting to prevent it from dropping away during the cross-over time of the contact 23 of relay 1TR from its back to its front position. In other words, front contact 23 is assumed to be closed before front contact 26 opens.

In the event that a train should approach the highway intersection and influence the overlay track circuit, thereby picking up the relay OTR, and then reverses its direction of movement to recede from the highway in the same direction from whence it came; the highway crossing signals will cease to operate as the front of the train vacates the section of track controlled by the overlay track circuit. This is particularly desirable when a train is awaiting further orders and its presence does not necessitate the stopping of highway traffic. If the train should then proceed in a direction toward the highway intersection, the signals HC will commence operating when the train again influences the operation of the overlay track circuit thus energizing the relay OTR. The energizing of the relay OTR under this situation removes energy from the relay XR at back contact 22 of the relay OTR. As the train crosses the highway and proceeds in its normal direction, the signal HC will cease operation when the rear of the train leaves the overlay track circuit area in this same manner as hereinbefore described.

If the train should completely cross the highway intersection and vacate the stretch of railway track controlled by the overlay track circuit, its subsequent stopping and reversal of direction will again cause the highway crossing signals HC to operate when the train enters the area controlled by the overlay track circuit, and they will continue to operate until the front of the train has

receded to a point on the opposite side of the highway intersection away from the area controlled by the overlay track circuit.

In the event that a train is following the train which causes the highway crossing signals to cease operation after it has receded a predetermined distance from the highway intersection, the presence of the following train on the track section 1T deenergizes the relay 1TR which breaks the stick circuit for the relay XS by opening the front contact 23 of the relay 1TR thereby causing the relay XS to drop away which opens the energizing circuit for relay XR at front contact 27 of relay XS and the highway crossing signals HC commence operating.

As the circuit operation of this invention is similar for a train travelling in either direction, it is considered unnecessary to describe in detail the circuit operation for a train travelling in the opposite direction.

In the event that the overlay track circuit apparatus should become disabled, the highway crossing signals HC will still be in a position to warn highway traffic of an approaching train because the alternate or auxiliary energizing circuit for the relay XR through front contact 27 cannot be complete until the relay OTR picks up its front contact 22 to energize the relay XS. In the event that the overlay track circuit apparatus should become shorted thus maintaining the relay OTR in an energized position even though no train is occupying the highway intersection, the highway crossing signals HC will operate, indicating false occupancy of this area by removing energy from the relay XR at the back contact 22 of relay OTR. Thus, it is apparent that the circuit arrangement herein is arranged on the failsafe principle of operation.

In connection with the above description, traffic has been assumed to travel in opposite directions at appropriate times and such traffic may be controlled by any suitable signalling system one type of which is known as absolute-permissive-block signalling system conveniently termed A.P.B. system. The particular kind of signalling system employed to provide for the proper controls of signals 8 and 9 forms no part of the present invention, but it is desired to point out that such a system would ordinarily be provided with line wires to give the proper controls. These line wires would include front contacts of the track relays 1TR and 2TR so that the presence of trains in track section 1T and 2T would properly act on the signalling system. When a conventional type highway crossing system is used, its "island track circuit" also has a track relay which must have its front contacts also connected into the line circuits of the signalling system.

However, the above description of the present invention shows how an "island track circuit" is unnecessary with the present invention. This absence of a track relay belonging to an "island track circuit" eliminates such connections in the line circuit of the signalling system. Also, since the overlay track circuit merely has to do with the release of the highway crossing signal control, it is not relied upon by the signalling system for detecting train presence and for this reason the relay OTR need not have any control on the associated line circuits of the signalling system. From this it can be readily understood that the highway crossing signal control is simplified in its relationship to the regular signalling system.

FIG. 2 shows a modified form of the present invention which is particularly adaptable for use with coded track circuits. It is of course understood that coded track circuits may have track sections which are longer than the conventional direct current track circuits and for this reason the section for the control of the highway crossing signals could be arranged to have only a single coded track circuit.

Since the present invention is particularly useful in connection with highway crossing signals where traffic may travel over the railroad in both directions, the signals 8 and 9 are illustrated as being controlled by a suitable coded track circuit signalling system including code transmitting and receiving apparatus 30 associated with signal 8 and similar code transmitting and receiving apparatus 31 associated with signal 9. Although the coded track circuit signalling system might be of any suitable type known in the art, for convenience in considering the present invention and rendering the present disclosure complete, it is assumed that the coded track circuit signalling system shown and disclosed in the Judge Patent No. 2,703,839, dated March 8, 1955, has been employed.

The stretch of track formed by rails 6 and 7 is shown as divided into a single track section 3T. The particular details of the coded track circuit code transmitting and receiving apparatus units 30 and 31 are unimportant except to note that the presence of the train any where in the track section 3T is effective on the coded track circuit apparatus at both signal locations and thus effective on the entire coded track circuit signalling system. For such purposes, suitable apparatus is employed both in the unit 30 and the unit 31; but for the purposes of the present invention, it is to be noted that a relay 3TP is associated with the unit 31 and is normally picked up during the absence of a train in the track section 3T. For convenience in the disclosure this relay 3TP is shown as controlling a repeater relay 3TPP over a line wire 35 which extends from the signal 9 location to the location of the highway crossing apparatus adjacent the highway crossing. Even if the signals 8 and 9 are not located directly adjacent the end of the track section 3T there would be suitable apparatus at the ends of section 3T to provide the relay 3TP with the proper control during the presence of a train in the section 3T. It should also be understood that if desired the repeater relay 3TPP may be controlled over a suitable line wire from the code transmitting and receiving apparatus 30 at the left-hand end of the track section 3T.

The normally energized relay 3TP is responsive to the code transmitting and receiving apparatus so that when a train enters the track section 3T the relay 3TP is deenergized and drops away. A relay 3TPP is provided to repeat the operation of the relay 3TP. The energizing circuit for relay 3TPP extends from (+), and includes front contact 32 of relay 3TP, a line wire 36, and the winding of the relay 3TPP, to (−). The line wire 36 extends from the coded track circuit apparatus to the highway crossing system apparatus.

The overlay track circuit illustrated in FIG. 2, comprising a transmitter 15 and receiver 16 and a relay OTR, is similar to the apparatus illustrated in FIG. 1 and functions in a like manner. As in FIG. 1 the relay OTR is energized whenever a train approaches the vicinity of the feedpoints FP which are located adjacent the highway H. The signals HC in FIG. 2 are also controlled in the same manner as the signals in FIG. 1 that is by the closing of back contact 28 of relay XR. When the relay XR is deenergized the signals commence operating to warn highway vehicles of an approaching train.

The energizing circuit for the relay XR extends from (+), and includes back contact 22 of the relay OTR and either front contact 38 of relay 3TPP and the winding of relay XR, to (−), or the front contact 27 of a relay XS and the winding of relay XR, to (−).

As in FIG. 1, a relay XS is provided to maintain the highway crossing signals HC in an "off" condition after a train has passed the highway H and is receding from the area controlled by the overlay track circuit.

To describe the circuit operation for this invention in combination with a coded track circuit, assume that a train is moving eastward (from left to right in FIG. 2) into the track section 3T.

When the train enters the track section 3T the code transmitting and receiving apparatus deenergizes the relay 3TP. The dropping away of the relay 3TP interrupts the energizing circuit for the relay 3TPP which in turn deenergizes the normally energized relay XR by the opening of front contact 38 of relay 3TPP in the energizing circuit

of relay XR. The closure of back contact **28** then causes the highway signal HC to commence operating.

As the train proceeds toward the highway intersection and enters the area controlled by the overlay track circuit, the relay OTR is energized which picks up the relay XS by a circuit which extends from (+), and includes front contact **22** of relay OTR, and the winding of relay XS, to (−). It is also apparent that the opening of back contact **22** of relay OTR removes energy from the energizing circuit for relay XR thereby preventing the relay XR from becoming energized through its previously described energizing circuit which includes the front contact **27** of relay XS.

As the rear of the train recedes from the area controlled by the overlay track circuit apparatus, the relay OTR is deenergized which causes the signals HC to cease operation by energizing the relay XR through its previously described energizing circuit which includes the front contact **27** of the relay XS.

When the train recedes from the track section 3T the relay 3TP is again energized which causes the relay 3TPP to become energized thereby breaking the stick circuit for the relay XS which extends from (+), and includes back contact **34** of the relay 3TPP, front contact **26** of relay XS, and the winding of relay XS, to (−). The dropping away of relay XS interrupts the energizing circuit for the relay XR which includes the front contact **27** of relay XS, and the relay XR is maintained energized to keep the signals HC from operating by the completion of its energizing circuit which includes the front contact **38** of the relay 3TPP.

It is apparent from FIG. 2 that a train approaching the highway intersection a distance sufficient to cause the relay OTR to become energized and then reversing its direction, the highway crossing signals HC will cease operation when the train has receded a predetermined distance from the highway intersection outside of the area controlled by the overlay track circuit. If a train should completely pass the highway intersection to a point where the highway crossing signals HC had ceased operation behind it and then reverses its direction, the signals HC will commence operating when the rear of the train reaches the area controlled by the overlay track circuit and will continue operating until the front of the train recedes a predetermined distance from the highway intersection outside of the area controlled by the overlay track circuit.

It is apaprent from FIG. 2 that if the overlay track circuit apparatus should become disabled, the highway crossing signals HC would still operate to warn highway traffic of an approaching train. Thus, it is apparent that this invention utilized in combination with a coded track circuit operates in a manner similar to the disclosure of FIG. 1 and is arranged to function on the fail-safe principle.

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

In the above description with regard to FIG. 2 traffic is assumed to travel in either direction controlled by the signalling system including signals **8** and **9** having the code transmitting and receiving apparatus **30** and **31** respectively associated therewith. As the conventional type of highway crossing signalling system where employed with such a coded track circuit signalling system, an "island track circuit" would be located adjacent the highway and would employ a direct current track relay with suitable track relay and resistor. In such a case either a cable or suitable line wires would be employed to carry the coded track circuit around the "island track circuit." Cable or line wires would have to be selected through front contacts of the track relay for the "island track circuit" so that a train passing over the stretch of track would have continuous affect on the coded track circuit, even though it were in the "island track circuit." This involves considerable added apparatus and introduces contacts into the coded track circuit which is objectionable since contacts always introduce added resistance in the relatively low voltage coded track circuit. It is readily apparent that the use of the present invention leaves the coded track circuit intack without requiring any contacts or connecting cable or line wires. This is a highly desirable attribute of the present invention, since the application of coded track circuits to signalling systems for both directions of traffic very often requires provisions for a large number of highway crossings.

Having described two forms of highway crossing signalling aparatus embodying the present invention, it is desired to be understood that these forms are 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, adaptions 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 claim is:

1. In a system for controlling a highway crossing warning device located at the intersection of a highway and a stretch of railway track wherein the highway intersects a continuous track section intermediate the insulated joints at opposite ends of the track section, a highway crossing warning device, track circuit means connected to the rails of said continuous track section for detecting the presence of a train approaching said highway intersection over such track, control circuit means governed by said track circuit means for operating said warning device in response to the detection of the presence of a train by said track circuit means, an overlay track circuit means including a relatively high frequency transmitter and receiver connected to the track rails for detecting the presence of a train in a portion of said track section that extends across said highway for a predetermined distance on opposite sides thereof, and a second circuit means controlled by said overlay track circuit means when a train is in said portion of said track section for rendering said track circuit means ineffective on said control circuit means for causing said highway crossing device to cease operating after such train has receded from said portion of said track section and ceases to be detected by said overlay track circuit means.

2. A system for controlling a highway warning device located at the intersection of a highway and a railroad track wherein the highway intersects a continuous track section intermediate the insulated joints at opposite ends of the track section, a track circuit means operative to be connected to the track rails of said track section to be operated from one condition to the other when a train enters said track section and to be operated from said other condition to said one condition when a train leaves said track section, detecting means effective to be operated from one condition to the other upon detecting the presence of a train entering a continuous portion of said track section that extends across said highway for a predetermined distance on opposite sides thereof and effective to be operated from said other condition to said one condition when a train leaves said continuous portion, a first circuit means including said track circuit means and said detecting means adapted to be electrically connected operatively to said warning device to control said device to operate to warn users of the highway of an approaching train upon the operation of either of said track circuit means and said detecting means to their other condition, a second circuit means adapted to be operatively connected to said warning device effective to be established upon the operation of said detecting means to its other condition to cause said detecting means to control said warning device, holding means operative to cause said detecting

means to maintain control of said warning device when said second circuit means is established and while said track circuit means is in said other condition to operate said device in accordance with the presence of a train in said continuous portion of said track section, and means effective to cause said holding means to disestablish said second circuit means upon the operation of said track circuit means to its said one condition when said detecting means is in said one condition whereby said warning device operates to warn users of the highway once a train enters said track section and ceases operating after the train enters and leaves said portion of the track section in either direction.

3. A system as claimed in claim 2 wherein the detecting means includes an overlay track circuit having a relatively high frequency transmitter and receiver operatively connected to the track rails, the effective length of said portion of the track section being determined by the attenuation of said frequency in the track rails.

4. A system as claimed in claim 2 wherein said first circuit means includes a source of energy and said track circuit means and said detecting means connected in series, said first circuit means being normally energized to keep said warning device inoperative when said track circuit means and said detecting means are both in their said one condition.

5. A system as claimed in claim 2 wherein said second circuit means includes a closed contact of a crossing stick relay, said crossing stick relay being operated upon operation of said detecting means to its other condition, wherein said holding means includes a stick circuit for said relay, said stick circuit being closed to hold said relay operated when said track relay means is in said other condition while said detecting means is in said one condition, said closed contact being connected in series in said second circuit means when said detection means is in said one condition whereby said warning device is rendered inoperative when said relay contact is closed only when said detecting means is in said one condition.

6. A system as claimed in claim 2 wherein said track circuit means is a coded track circuit and said frequency is an audio frequency superimposed on the coded track circuit.

7. A system for operating a warning device located at the intersection of a highway and a railroad track wherein the highway intersects a continuous track section intermediate the insulated joints at opposite ends of the track section, a track circuit means operatively connected to the track rails of said track section effective to be operated from one condition to the other when a train enters said track section and effective to be operated from said other condition to said one condition when a train leaves said track section, an overlay track circuit means having a relatively high frequency transmitter and receiver operatively connected to the track rails for applying a superimposed frequency on the track rails for an effective distance determined by the attenuation of said frequency, detecting means connected to said receiver effective to be operated from one condition to the other upon detecting the presence of a train entering a continuous portion of said track section that extends across said highway for a predetermined distance along said track rails on opposite sides thereof and effective to be operated from said other condition to said one condition when a train leaves said continuous portion, a normally closed circuit means including a source of energy and said track circuit means and said detecting means in series connection to keep said warning device inoperative when both said track circuit means and said detecting means are in their said one condition, a relay, means effective to operate said relay upon the operation of said detecting means to its said other condition, a stick circuit for said relay effective to keep said relay operated while said track relay means is in said other condition and said detecting means is in said one condition, a closed circuit means including a contact of said relay when operated connected in series with said detection means when said detection means is in said one condition to render said warning device inoperative, and means effective to release said stick circuit to open said closed relay contact upon the operation of said track circuit means to its said one condition when said detecting means is in said other condition, whereby said warning device operates to warn users of the highway once a train enters said track section and ceases operating after the train enters and leaves said portion of the track section in either direction.

8. A system for controlling a highway crossing warning device located at the intersection of a railroad track and a highway, an insulated joint spaced from said highway to separate said track electrically into two adjacent track sections wherein said highway intersects one of said track sections only, a highway crossing warning device adapted to be operated to warn users of an approaching train, a track circuit means for each of said adjoining track sections operatively connected to the track rails of its associated section, each track circuit means being effective to be operated from one condition to the other when a train enters its associated track section and effective to be operated from said other condition to said one condition when a train leaves its associated track section, detecting means connected to one of said track sections effective to be operated from one condition to the other upon detecting the presence of a train entering a continuous portion of said one track section that extends across said highway for a predetermined distance on opposite sides thereof and effective to be operated from said other condition to said one condition when a train leaves said continuous portion, a first circuit means including both said track circuit means and said detecting means electrically connected operatively to said warning device to control said device to operate upon operation of any one of said track circuit means and said detecting means to their other condition, a second circuit means operatively connected to said warning device effective to be established upon the operation of said detecting means to its other condition to cause said detecting means to control said warning device, holding means operative to cause said detecting means to maintain control of said warning device when said second circuit means is established and while one of said track circuit means is in said one condition and the other of said track circuit means is in said other condition to operate said device in accordance with the presence of a train in said continuous portion of said one track section, and means effective to cause said holding means to disestablish said second circuit means when both said track circuit means are caused to be operated to the same condition, whereby said warning device will operate to warn users of the highway when a train enters one of said track sections and ceases operating after the train enters and leaves said portion of the track section in either direction.

9. A system as claimed in claim 8 wherein the detecting means includes an overlay track circuit having an audio frequency transmitter and receiver connected to the track rails, the effective length of said continuous portion of the track section being determined by the attenuation of said frequency in the track rails.

10. A system according to claim 8 wherein said first circuit means includes a source of energy and both said track circuit means and said detecting means in series connection, said first circuit means being normally energized to hold said warning device inoperative when both said track circuit means and said detecting means are all in their said one condition.

11. A system as claimed in claim 8 wherein said second circuit means includes a closed contact of a crossing

stick relay, said crossing stick relay being operated upon operation of said detecting means to its other condition, wherein said holding means includes a stick circuit for said relay, said stick circuit being closed to hold said relay operated when both said track relay means are in opposite conditions while said detecting means is in said one condition, said closed contact being connected in series in said second circuit means to hold said warning device inoperative when said detection means is in said one condition, regardless of the condition of said track circuit means.

References Cited in the file of this patent

UNITED STATES PATENTS

1,094,894	Hawkins	Apr. 28, 1914
1,820,170	Willard et al.	Aug. 25, 1931
1,960,467	Wallace	May 29, 1934
2,162,911	Crago	June 20, 1939
2,317,562	Tizzard	Apr. 27, 1943
2,703,839	Judge	Mar. 8, 1955
2,896,068	Auer et al.	July 21, 1959
2,930,888	Crawford et al.	Mar. 29, 1960