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Brockman

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[54] **HIGHWAY CROSSING SIGNAL CONTROL SYSTEM FOR RAILROADS**

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[73] Assignee: **General Signal Corporation,** Rochester, N.Y.

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[52] **U.S. Cl.** **246/128,** 246/125

[51] **Int. Cl.** **B61l 1/02**

[58] **Field of Search** ..... 246/125, 126, 128, 246/130 R, 40

[56] **References Cited**

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Assistant Examiner—George H. Libman
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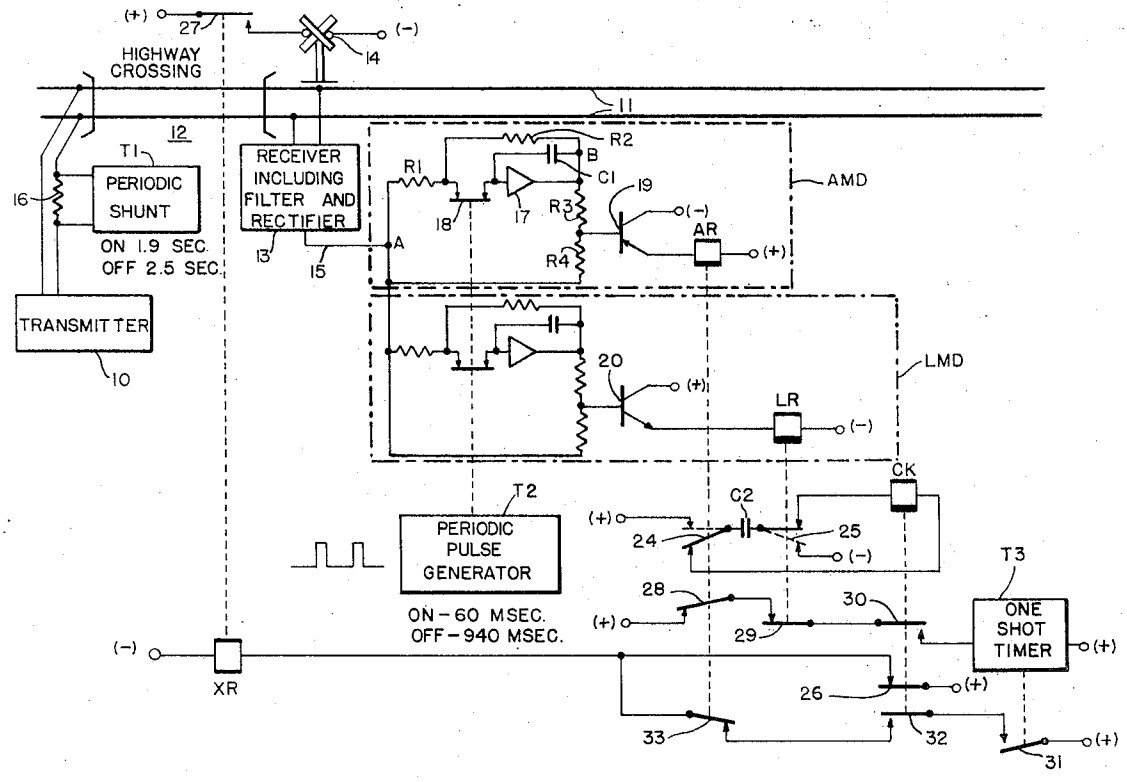
[57] **ABSTRACT**

A highway crossing signal control system is provided for railroads having an alternating current transmitter adapted to be connected to the track rails adjacent one side of the highway crossing and having a receiver adapted to be connected to the track rails at the other side of the highway crossing. An approach motion detector is provided for detecting the approach of a railway vehicle to the crossing by sensing a decrease in the input potential to the receiver. Similarly, a leaving motion detector is provided for detecting the leaving of the area of the crossing by a railway vehicle in accordance with sensing an increase in the received potential across the track rails. These motion detectors are respectively used to activate and deactivate a crossing signal. Checking means is provided for normally checking the operability periodically of the motion detectors, and such checking means is operable when active to deactivate the highway crossing signal.

10 Claims, 2 Drawing Figures



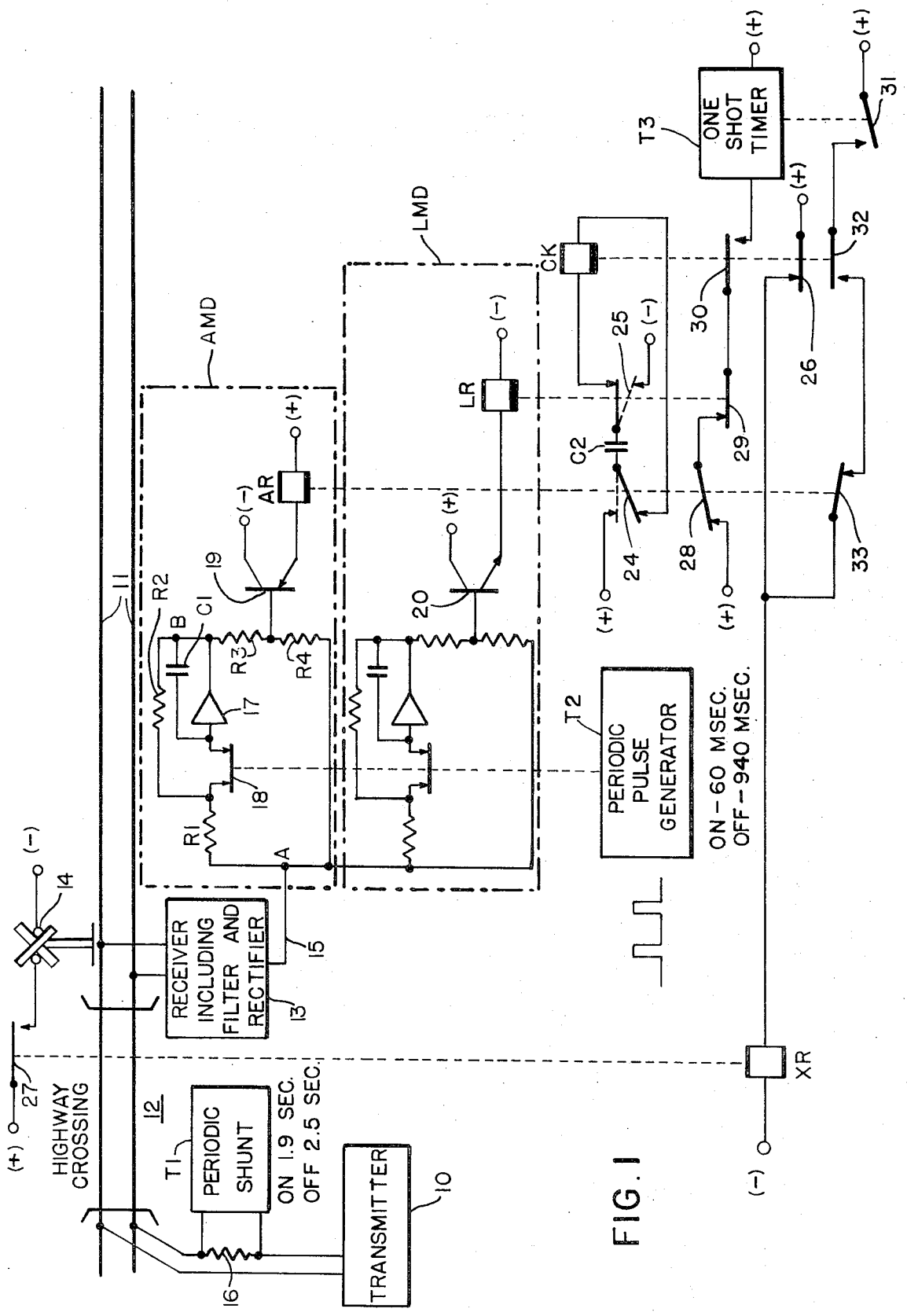

HIGHWAY CROSSING
PERIODIC SHUNT
ON 1.9 SEC.
OFF 2.5 SEC.
TRANSMITTER
RECEIVER INCLUDING FILTER AND RECTIFIER
AMD
LMD
AR
LR
CK
C2
C1
R1
R2
R3
R4
A
B
PERIODIC PULSE GENERATOR
ON - 60 MSEC.
OFF - 940 MSEC.
ONE SHOT TIMER
XR
T1
T2
T3
10
11
12
13
14
15
16
17
18
19
20
24
25
26
27
28
29
30
31
32
33
(+)
(-)

FIG. 1

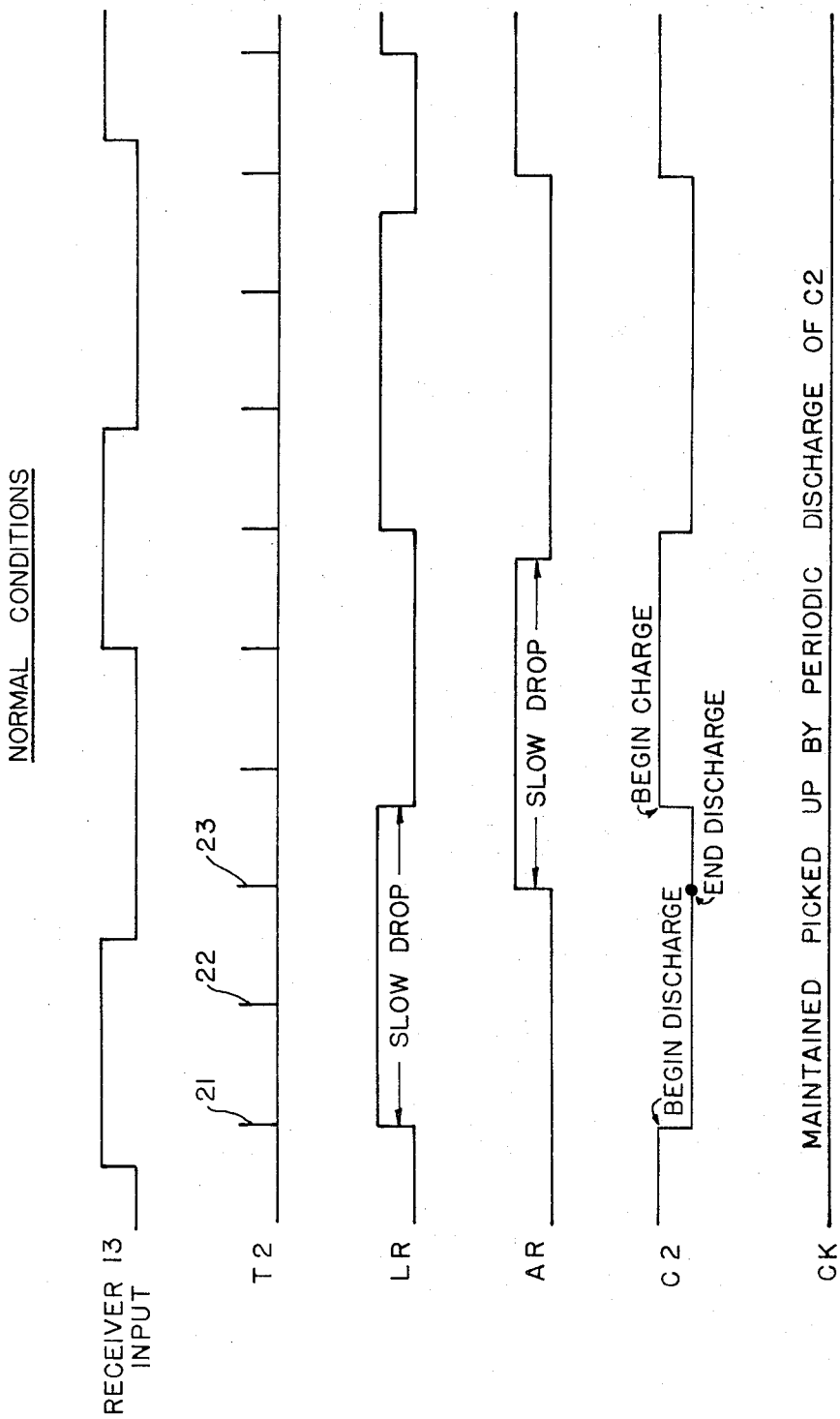

NORMAL CONDITIONS
RECEIVER 13 INPUT
T 2
21
22
23
LR
SLOW DROP
AR
SLOW DROP
C 2
BEGIN DISCHARGE
BEGIN CHARGE
END DISCHARGE
CK
MAINTAINED PICKED UP BY PERIODIC DISCHARGE OF C2

FIG. 2

HIGHWAY CROSSING SIGNAL CONTROL SYSTEM FOR RAILROADS

BACKGROUND OF THE INVENTION

This invention relates to highway crossing signal control systems for railroads.

The use of high speed trains over railroads having substantially continuous rail has made the protection of highway crossings by the control of highway crossing signals more difficult and expensive. In such systems it is desirable to provide crossing protection without the use of insulated joints, and without requiring the location of apparatus at points remote from the highway crossing.

Some highway crossing control systems are of the type wherein a uniform warning time is computed by the use of motion detectors for sensing the speed of railway vehicles approaching a highway crossing. These systems generally use control apparatus that is subject to failure, and such failure in some cases can fail to provide energization of a warning signal at the highway crossing when a train is approaching.

An object of the present invention is to provide an improved highway crossing signal control system which substantially obviates the disadvantages of the described prior systems.

SUMMARY OF INVENTION

A highway crossing signal control system for railroads is provided having an alternating current transmitter for delivering its output to track rails in close proximity to one side of a highway crossing and having an alternating current receiver for receiving an input potential through the track rails at a point in close proximity to the other side of the highway crossing. An output of the receiver is used for controlling the crossing signal. An approach motion detector is provided that is governed by the output of the receiver and activated alternately to first and second conditions in response to a decrease or no decrease respectively in the input potential for detecting approach of a railway vehicle to the highway crossing. Similarly, a leaving motion detector is governed by the output of the receiver and activated alternately to first and second conditions in response to an increase or no increase respectively in the input potential for detecting a railway vehicle leaving the crossing. Control means is provided that is governed by the approach motion detector and the leaving motion detector for selectively rendering the highway crossing signal active or inactive in accordance with whether a vehicle is approaching or leaving the highway crossing respectively. A checking circuit is provided that is normally active for periodically checking the ability of the approach detection means to respond to a small increase in potential across the track rails comparable to the approach of a slow moving railway vehicle at a time when there is no railway vehicle in approach of the crossing. The highway crossing signal is maintained inactive dependent upon the normal activity of the checking means. The invention is illustrated in the drawings wherein:

FIG. 1 is a schematic diagram of a high crossing signal control system as a preferred embodiment of the present invention; and

FIG. 2 is a time sequence chart showing diagrammatically the normal times of operations of the approach and leaving relays in accordance with the checking system.

With reference to FIG. 1, a highway crossing signal control system is illustrated having an alternating current transmitter 10 delivering a fixed frequency output across track rails 11 at the left-hand side of a highway crossing 12. An alternating current receiver 13 is connected across the track rails 11 at the right-hand side of the crossing 12. An output of the receiver 13 is used to control a highway crossing signal 14.

An approach motion detector AMD is provided having its input obtained from an output of the receiver 13 over line 15 for detecting approach of a railway vehicle to the highway crossing. The approach motion detector is activated alternately to first and second conditions in response to a decrease or no decrease respectively in the input potential to the approach motion detector AMD.

A leaving motion detector LMD is also provided and is governed by an output along line 15 from receiver 13 for detecting a railway vehicle leaving the area of the highway crossing 12. The leaving motion detector LMD is activated alternately to first and second conditions in response to an increase or no increase respectively in the input potential over line 15 from receiver 13.

Control circuits are provided for the signal 14 including a relay XR whose energization is governed jointly by outputs of the approach motion detector AMD and the leaving motion detector LMD.

Checking circuits are provided in the control of the relay XR for periodically checking the ability of the approach detector to respond to a small decrease in potential across the track rails comparable to the approach of a slow moving railway vehicle. These checking circuits are effective at a time when there is no railway vehicle in approach of the crossing. As long as the checking means is operable periodically, the relay XR is maintained in its picked up position for extinguishing the signal 14.

Transmitter 10 is connected across the track rails 11 through a resistor 16 which is periodically shunted by a timer T1. The timer T1 alternately shunts and unshunts the resistor 16 at intervals that can be, for example 1.9 seconds and 2.5 seconds respectively. This pulses the potential across the track rails as is illustrated in FIG. 2.

A second timer T2 is provided for periodically generating pulses for governing operation of the motion detectors AMD and LMD. For this embodiment of the present invention, the timer T2 can be assumed to time successive one second cycles during which an ON output is delivered for 60 milliseconds and an OFF output is delivered for 940 milliseconds.

The motion detectors AMD and LMD are of the sample and hold type, the motion detector AMD sensing a decrease in track circuit potential and thus detecting motion toward the crossing while the motion detector LMD senses an increase in potential across the track rails and thus detects trains leaving the crossing area. The motion detector AMD comprises a sample and hold circuit having an input resistor R1 connected to an operational amplifier 17 through an FET transistor 18. A capacitor C1 is connected across the operational amplifier for storing a sample voltage. A resistor R2 bridges the FET 18 and the operational amplifier 17, and the combination of resistors R1 and R2 sets the proportions for the amplification of amplifier 17. Pulse generator T2 gates the FET 18 switch and allows the

FET 18 to turn on amplifier 17 when the pulse generator T2 is in an ON condition. During this ON time, a sample of the potential at point A is taken and fed into amplifier 17 to be held on capacitor C1. This sample is then held in amplifier 17 for the OFF period of the pulse generator T2. At the next succeeding ON time of timer T2, the output of amplifier 17 at point B is compared with the input at A by a voltage divider circuit for a transistor 19 including resistors R3 and R4. The transistor 19 is of the PNP type so as to be turned on by a decrease in receiver input potential sensed by the sample and hold circuit. An approach relay AR is included in the emitter-collector circuit of the transistor 19 so as to be energized in response to sensing a decrease in potential across the track rails 11.

The leaving motion detector LMD has a similar structure to that described in detail for the approach motion detector AMD except that it is responsive only to increases in voltage potential across the track rails 11 as compared to the approach motion detector AMD being responsive only to decreases in potential across the track rails 11. Thus the leaving motion detector LMD has a sample and hold circuit similar to the one described in detail for the approach motion detector relay AMD, but it differs from the approach motion detector in that the transistor 20 of leaving motion detector LMD is of the NPN type so as to be responsive only to increases in potential sensed by the associated sample and hold circuit. A relay LR is connected in the emitter-collector circuit of transistor 20 to be responsive to the turning on of transistor 20.

The timer T1 periodically shunts resistor 16 at the specified rate, and thus produces a potential across the track rails varying periodically as is illustrated in FIG. 2. The rate of the timer T2 is also illustrated in FIG. 2. Assuming that each ON period of the timer T2 is also a sampling period, the operation of the relays AR and LR under normal conditions, with no trains present, can be plotted as is shown in FIG. 2. More specifically, the pulse 21 calls for a sampling showing an increase in potential across the track rails 11, and thus causes the picking up of relay LR. Pulse 22 does nothing because its comparison with the rail potential at the time 21 shows no change in potential. At the time of pulse 23, however, there has been a change to a lower potential across the track rails 11, thus causing the picking up of the approach relay AR. It will be readily apparent that the relative time setting of the timers T1 and T2 is such that the relays LR and AR are 7 altnerately actuated periodically during normal conditions of the system to test their ability to respond to small changes in the inter-rail potential.

The normal operability of the relays AR and LR as has been described is checked by a check relay CK which is normally in its picked up position, but becomes dropped away to manifest an abnormal condition in case of failure of either the approach relay AR or the leaving relay LR to follow the normal pulsing pattern. A capacitor C2 is alternately charged through front contact 24 and back contact 25 of relays AR and LR respectively, and discharged through back contact 24 and front 25 of relays AR and LR respectively and through the winding of relay CK. Relay CK is made slow to drop away so as to be maintained picked up during the charging of capacitor C2. With a check relay CK in its picked up position, front contact 26 of this relay energizes the crossing signal control relay XR, which in turn prevents energization of the crossing signal 14 by maintaining back contact 27 open.

To consider the mode of operation of the system upon passage of the train, it will be assumed that a vehicle approaches the crossing from either direction. Such approach causes a continuous decrease in the voltage potential sensed by receiver 13 across the rails 11 at the highway crossing 12, and in accordance with this continuous decrease in voltage, the approach motion detector relay Ar is maintained actuated continuously. Relay AR is made to be slow enough to drop away to be maintained picked up for the time between successive sampling periods.

Because of the relay AR being maintained steadily picked up, the check relay CK is dropped away upon failure of the capacitor C2 to be periodically charged and discharged. The dropping away of relay CK opens front contact 26 to cause the dropping away of the crossing control relay XR so as to activate the signal 14 upon closure of back contact 27.

After the rear end of the train has cleared the area of the highway crossing 12, the potential across the track rails 11 starts to increase, and in accordance with such increase, the relay LR is picked up in the leaving motion detector LMD. This relay is steadily energized at this time, and the approach relay AR, which responds only to decreases in input to the receiver 13, is steadily in its dropped away position. Under these conditions, a circuit is established to start a timing period of a one-shot timer T3. This circuit includes back contact 28 of approach relay AR, front contact 29 of relay LR and back contact 30 of relay CK. The rendering active of the one-shot timer 73 in this manner closes a circuit to energize the relay XR through front contact 31 of timer T3, back contact 32 of relay CK and back contact 33 of approach motion detector relay AR. The energization of relay XR under these conditions causes the extinguishing of the highway crossing signal 14 by the opening of back contact 27 of relay XR. If a second train should approach the crossing during this time, the picking up of the approach relay AR would be effective to cause the dropping way of relay XR by opening its circuit at back contact 33 and thus rendering the signal 14 again active upon the closure of back contact 27.

The timer T3 is to release the signal 14 positively upon clearance of the crossing 12 until the vehicle has had time to proceed far enough away from the crossing so that the normal conditions are established for the pulsing of approach relays AR and LR so as to pick up the relay CK and close front contact 26 in the control circuit for the relay XR to maintain the highway crossing signal 14 inactive after the expiration of the time of the one-shot timer T3. It is to be understood that once the timer T3 has been initiated by energization of its control circuit, it will maintain its contact 31 closed for one and only one entire time interval irrespective of the condition of the initiating circuit.

Having described a highway crossing signal control system as a preferred embodiment of the present invention, it is to be understood that various modifications and alterations may be made to the specific embodiment shown without departing from the spirit or scope of the invention.

What is claimed is:

1. A highway crossing signal control system for railroads having an alternating current transmitter for delivering its output to track rails in close proximity to

one side of a highway crossing and having an alternating current receiver for receiving an input potential through the track rails at a point in close proximity to the other side of the highway crossing, an output of the receiver being used for controlling the crossing signal, wherein the improvement comprises:

a. approach motion detection means governed by the output of the receiver and activated alternately to first and second conditions in response to a decrease or no decrease respectively in the input potential for detecting approach of a railway vehicle to the highway crossing,

b. leaving motion detection means governed by the output of the receiver and activated alternately to first and second conditions in response to an increase or no increase respectively in the input potential for detecting a railway vehicle leaving the crossing,

c. control means governed by the approach detection means and the leaving detection means for selectively rendering the highway crossing signal active or inactive in accordance with whether a vehicle is approach or leaving the highway crossing respectively, and

d. checking means normally active for periodically checking the ability of the approach detection means to respond to a small decrease in potential across the track rails comparable to the approach of a slow moving railway vehicle at a time when there is no railway vehicle in approach of the crossing.

2. A highway crossing signal control system according to claim **1** wherein the checking means is operable when there is no railway vehicle in approach of the crossing to alternately check operability of the approach motion detection means to be actuated to the first condition in response to slow motion of a railway vehicle in approach of the crossing and to the second condition in response to no motion of a railway vehicle in approach of the crossing.

3. A highway crossing signal control system according to claim **1** wherein the control means is governed by the checking means for deactivating the crossing signal when the checking means is active.

4. A highway crossing signal control system according to claim **1** wherein the checking means includes means for periodically modulating the output of the transmitter.

5. A highway crossing signal control system according to claim **4** wherein the checking means includes a resistor connected in series with the output of the transmitter and checking timing means is provided for periodically alternately shunting and unshunting the resistor.

6. A highway crossing signal control system according to claim **5** wherein the check timing means alternately shunts and unshunts the resistor for relatively short and long time intervals respectively.

7. A highway crossing signal control system according to claim **1** wherein the motion detector means are of a sample and hold type and sample timing means is provided for timing sampling intervals.

8. A highway crossing signal control system according to claim **1** wherein the checking means is also operable to periodically render the leaving motion detection means alternately active and inactive.

9. A highway crossing signal control system according to claim **1** wherein first and second timing means is provided for respectively timing checking periods of the checking means and sampling periods for the motion detection means, the duration of the checking periods being greater than the duration of the sampling periods.

10. A highway crossing signal control system according to claim **1** wherein the control means includes a binary device having an activated state for deenergizing the crossing signal and circuit means is provided for activating the device requiring the periodic operation between their first and second conditions of at least one of the motion detection means.

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