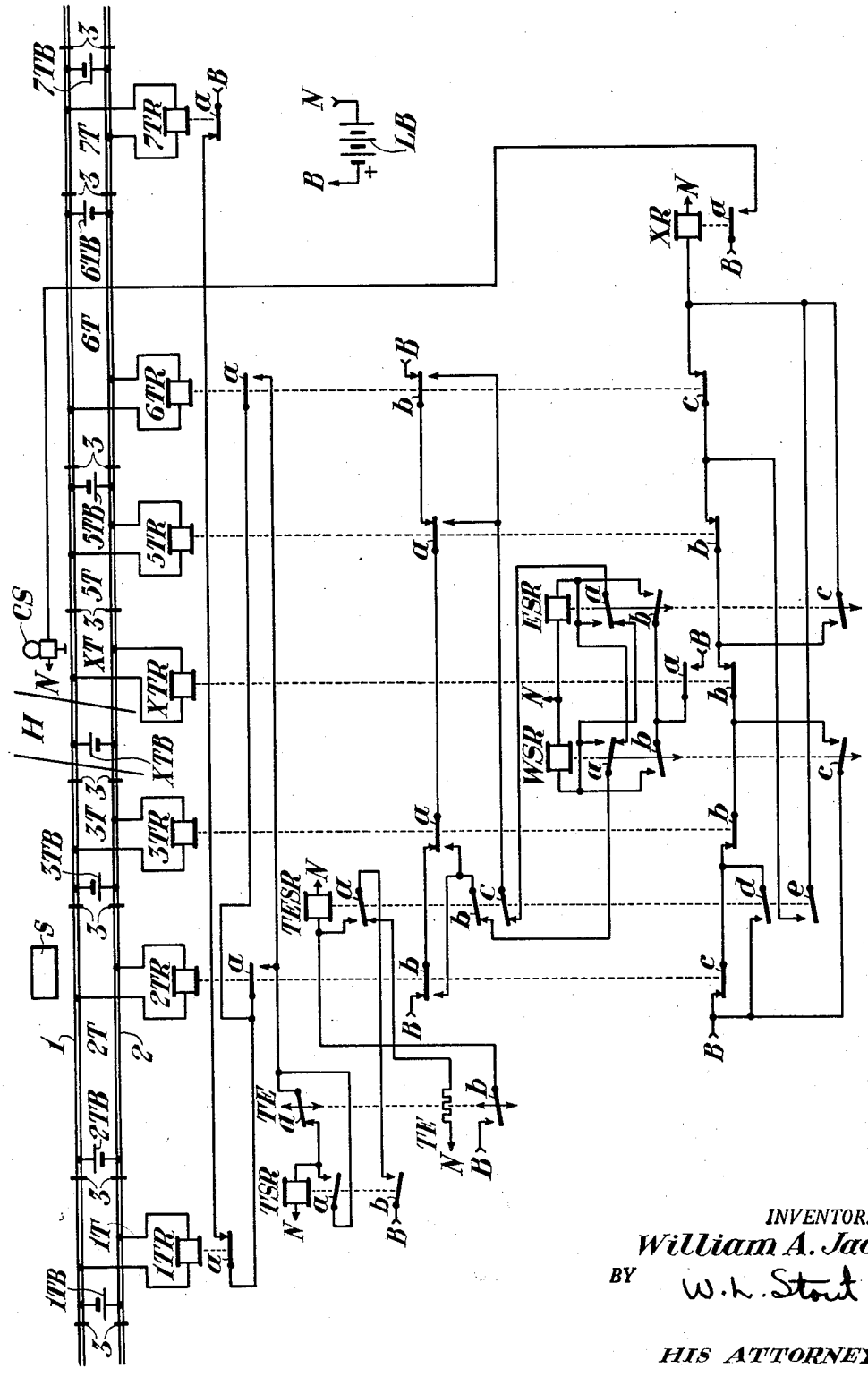
Sept. 16, 1958 W. A. JACOBS 2,852,666

HIGHWAY CROSSING PROTECTION CONTROL APPARATUS

Filed Dec. 31, 1952



INVENTOR.
William A. Jacobs
BY W. L. Stout
HIS ATTORNEY

United States Patent Office 2,852,666 Patented Sept. 16, 1958

2,852,666

HIGHWAY CROSSING PROTECTION CONTROL APPARATUS

William A. Jacobs, Wilkinsburg, Pa., assignor to Westinghouse Air Brake Company, Wilmerding, Pa., a corporation of Pennsylvania

Application December 31, 1952, Serial No. 329,047

5 Claims. (Cl. 246—130)

My invention relates to highway crossing protection control apparatus, and in particular to a circuit arrangement for protecting against broken rails in the track sections on each side of a highway crossing in non-signaled territory.

It has been common practice to employ directional stick relays in conjunction with track relays to effect the control of highway crossing signals. These directional stick relays are so controlled that a train entering a track section on one side of the intersection energizes one of the stick relays which, when energized, establishes a stick circuit to maintain itself energized while the train moves through the stretch. These directional stick relays also operate when energized to establish a circuit to supply energy to a highway crossing signal control relay when the track section which includes the intersection is vacated, so that the highway crossing signal ceases to operate when the train recedes from the crossing.

Under normal conditions, when the train vacates the section beyond the intersection, that is the receding section, the stick relay associated with that section becomes deenergized and the crossing signal is thereafter controlled by the track relays so that the operation of the signal will again be initiated on the approach of a second train moving in the same direction as the first train or in the opposite direction.

However, with the arrangements heretofore employed, if a rail in the receding section becomes broken when a train is moving through the section away from the crossing, the energized stick relay will remain energized. Thereafter, if a train approaches the intersection in the opposite direction to the first train, no warning of the approach of the second train will be given to highway traffic because, with the stick relay continuously energized, energy will be continuously supplied to the signal control relay which will keep the crossing signal deenergized.

It has further been common practice in stretches of track intersected by a highway to provide time element means to deenergize the crossing signal if a train approaching the intersection stops for a prolonged period of time in the approach section. This is usually accomplished by providing time element means which becomes energized upon the release of the track relay associated with the approach section and if the time element means operates its contacts due to its being energized for a predetermined period of time, the crossing signal will become deenergized. The purpose of such a system is to prevent prolonged warning of the approach of a train which would tend to make highway traffic careless when a crossing signal is operating.

In case a rail becomes broken in the approach section, the associated track relay will release and the time element means will operate in substantially the same manner as it would if a train occupied the approach section for more than the predetermined time interval. Accordingly, if a train subsequently approaches the intersection through the track section having a broken rail, the time

element means will have already operated and the presence of the train approaching the crossing will not be registered by operation of the crossing signal.

It will be obvious that in territory where wayside or cab signals control train movements, a broken rail condition will cause these signals to display a restrictive aspect. In such territory, therefore, a broken rail will not present the hazardous condition of a train speeding toward highway traffic which is not aware of the approach of the train. However, in non-signaled territory, no indication is given of the broken rail and it is therefore desirable to eliminate the possibility of the hazard existing.

It is therefore an object of my invention to provide improved means of the type described which is so arranged that if a rail in a receding section is broken during a receding move, the crossing signal will still operate for a train subsequently moving in the opposite direction to the first train.

A further object of my invention is to provide means of the type described which will prevent an energized directional stick relay from remaining energized if a rail in the receding section becomes broken during a receding move from a highway crossing.

Another object of my invention is to provide means for resetting time element means upon a train approaching a highway crossing to assure that the time element means is in a released condition so that the highway crossing protection control apparatus will operate in a normal manner regardless of the condition of the rails.

According to my invention, I provide a section on each side of the intersection, known as approach sections, and two relatively short track sections, one in approach to each of the approach sections. I also provide directional stick relays, one associated with each approach section. I further provide time element means which will operate after a vehicle occupies either approach section for a predetermined period of time and which, upon operating, will cause the highway crossing signal to cease operating. Means associated with each short track section is actuated when a train occupies one of the short sections to assure that the contacts of the time element means will be in their normal position when the train enters the adjacent approach section. Means are further provided for energizing the stick relays upon a train entering an approach section when the time element means is reset for a subsequent operation.

Accordingly, when a train or vehicle enters the stretch and traverses one of the short sections, the energizing circuit for the time element means will become open, thereby assuring that the time element means will be reset. With the time element means reset, the energizing circuit for the associated stick relay will be established upon the vehicle entering the approach section. Therefore the apparatus will function in the proper manner regardless of a broken rail in either approach section.

Other objects of my invention will appear hereinafter as the characteristic features of construction and mode of operation of my highway crossing protection control apparatus are described in detail.

I shall describe one form of highway crossing protection control apparatus embodying my invention, and shall then point out the novel features thereof in claims.

The single accompanying drawing is a diagrammatic view of a circuit arrangement for the control of highway crossing signals embodying my invention.

Referring now to the drawing, the reference characters 1 and 2 designate the track rails of a stretch of railway track over which traffic moves in both directions. These track rails are divided by insulated joints 3 into two relatively short track sections 1T and 7T, two relatively long approach sections 2T and 6T, two positive ringing sections 3T and 5T, and a crossing section XT

which is intersected by a highway H. A crossing signal CS is located adjacent the intersection to warn highway traffic of the approach of a train. The crossing signal CS may be of any appropriate type such as a flashing light signal, or as here shown, an electric bell. The track sections 1T through 7T are provided with track circuits including track batteries 1TB through 7TB and track relays 1TR through 7TR, respectively.

The crossing signal CS is controlled by a signal control relay XR. Signal control relay XR is, in turn, controlled by track relays 2TR, 3TR, XTR, 5TR and 6TR, stick relays WSR and ESR, and a stick relay TESR. Stick relays WSR and ESR are controlled by track relays 2TR, 3TR, XTR, 5TR and 6TR, in a manner which will be made clear presently. Stick relay TESR is controlled by time element means here shown as a thermal time element relay TE. Thermal time element relay TE is in turn controlled by another stick relay TSR which is controlled by track relays 1TR, 2TR, 6TR and 7TR. Energy for all the circuits in the arrangement other than the track circuits is supplied by any suitable source such as a battery LB. In the drawing, the apparatus is shown in the condition it normally assumes when the stretch is vacant. At this time all the track relays are energized by their track batteries over their respective track circuits. Accordingly, stick relay TSR will be deenergized and this will result in the energizing circuit for the heater element of thermal time element relay TE being opened, thus causing the contacts of the thermal time element relay to occupy their normal positions in which back-contact *a* is closed and front contact *b* is open. Stick relay TESR will accordingly be deenergized. Stick relays WSR and ESR will also be released due to the fact that their energizing circuits, which will be subsequently traced, are open. Control relay XR will be energized by a circuit which may be traced from the positive terminal B of battery LB, over front contact *c* of relay 2TR, front contact *b* of relay 3TR, front contact *b* of relay XTR, front contact *b* of relay 5TR, front contact *c* of relay 6TR, and the winding of relay XR to the negative terminal N of battery LB. Accordingly, crossing signal CS will be deenergized due to its obvious energizing circuit being open at back contact *a* of relay XR.

It will now be assumed that an eastbound train approaching from the left enters the stretch. As the train enters section 1T the wheels and axles of the train shunt relay 1TR causing it to release and thereby open its front contact *a*. This has no effect on the circuit which includes front contact *a* because this circuit is already open at other points. However, the utility of the opening of front contact *a* of relay 1TR will be made clear subsequently. When the train enters section 2T, the wheels and axles of the train will shunt relay 2TR causing it to release and thereby close an energizing circuit for relay ESR. This energizing circuit may be traced from positive terminal B of battery LB, over front contact *b* of relay 6TR, front contact *a* of relay 5TR, front contact *a* of relay 3TR, back contact *b* of relay 2TR, back contact *b* of relay TESR, back contact *a* of relay WSR, and the winding of relay ESR to negative terminal N of battery LB. Accordingly, relay ESR will pick up. The release of relay 2TR will also cause the previously traced energizing circuit for control relay XR to become opened. Relay XR will therefore release and close its back contact *a* which will cause the crossing signal CS to commence operating to thereby warn traffic of the approaching train.

When the train vacates section 1T and occupies only section 2T, relay TSR will become energized by a circuit which may be traced from positive terminal B of battery LB, over front contact *a* of relay 7TR, front contact *a* of relay 1TR, back contact *a* of relay 2TR, back contact *a* of thermal time element relay TE, and the winding of relay TSR to negative terminal N of battery LB. Accordingly, the thermal time element relay TE will become energized by a circuit which may be traced from positive terminal B of battery LB, over front contact *b* of relay TSR, back contact *a* of relay TESR, and the heater element of relay TE to negative terminal N of battery LB. Thermal time element relay TE may be of any of a number of conventional types of thermal time element relays well known in the art of railway signaling which, when energized for a predetermined time interval, will operate its contacts. Let it be assumed that the train does not occupy section 2T sufficiently long for the contacts of the thermal time element relay to be operated.

When the train enters section 3T the wheels and axles will shunt relay 3TR causing it to release and close a second energizing circuit for relay ESR. This circuit may be traced from positive terminal B of battery LB, over front contact *b* of relay 6TR, front contact *a* of relay 5TR, back contact *a* of relay 3TR, back contact *b* of relay TESR, back contact *a* of relay WSR, and the winding of relay ESR to negative terminal N of battery LB. Furthermore, the energizing circuit for control relay XR will now be open at front contact *b* of relay 3TR as well as front contact *c* of relay 2TR. Accordingly, when the train vacates section 2T and relay 2TR picks up, relay ESR will remain energized due to its second traced energizing circuit and crossing control relay XR will remain deenergized and the signal CS will continue to operate.

When the train enters section XT the wheels and axles of the train will shunt relay XTR causing it to thereby release. Accordingly, a first stick circuit will be established for relay ESR which may be traced from positive terminal B of battery LB, over back contact *a* of relay XTR, front contact *b* of relay ESR, and the winding of relay ESR to negative terminal N of battery LB. With the contacts of relay XTR released, the energizing circuit for control relay XR will now be opened at front contact *b* of relay XTR and the crossing signal will continue to operate.

Upon the train vacating section 3T and occupying section XT there will be not change in the circuit arrangement except that the contacts of relay 3TR will now be picked up, thereby opening the second traced energizing circuit for relay ESR. However, the first stick circuit for relay ESR will maintain relay ESR in its energized condition and its contacts will remain picked up.

When the train enters section 5T, the wheels and axles of the train will shunt relay 5TR, thereby causing relay 5TR to release. Accordingly, a second stick circuit for relay ESR will be established and this stick circuit may be traced from positive terminal B to battery LB, over front contact *b* of relay 2TR, front contact *a* of relay 3TR, back contact *a* of relay 5TR, back contact *c* of relay TESR, front contact *a* of relay ESR, and the winding of relay ESR to negative terminal N of battery LB. Furthermore, when relay 5TR releases, front contact *b* of relay 5TR, which is in the original energizing circuit for relay XR, will become open. This, however, will have no effect on relay XR since the original energizing circuit for relay XR will also be open at front contact *b* of relay XTR and, accordingly, the control relay XR will be released and the crossing signal CS will be operating.

When the train vacates section XT and occupies only section 5T, relay XTR will pick up, thereby closing its front contact *b* and establishing a second energizing circuit for relay XR which can be traced from positive terminal B of battery LB over front contact *c* of relay 2TR, front contact *b* of relay 3TR, front contact *b* of relay XTR, front contact *c* of relay ESR, and the winding of relay XR to negative terminal N of battery LB. Accordingly, the energizing circuit for crossing signal CS will become open at back contact *a* of relay XR and the crossing signal will cease operating. When

relay XTR picks up, the first stick circuit for relay ESR will also become open at back contact *a* of relay XTR. However, the second stick circuit for relay ESR will still be closed and relay ESR will remain energized, thereby bridging the open contact *b* of relay 5TR and energizing control relay XR in the manner just described.

When the train enters section 6T the wheels and axles of the train will shunt relay 6TR, thereby causing it to release. Accordingly, back contact *a* of relay 6TR will be closed and relay TSR will become energized by a circuit which may be traced from positive terminal B of battery LB, over front contact *a* of relay 7TR, front contact *a* of relay 1TR, back contact *a* of relay 6TR, back contact *a* of thermal time element relay TE, and the winding of relay TSR to negative terminal N of battery LB. Accordingly relay TSR will pick up and close the heretofore traced energizing circuit for the heater element of thermal time element relay TE. However, let it be assumed that the train will not occupy section 6T for a sufficiently long period for thermal time element relay TE to operate its contacts. With this assumption, the operation of the timing portion of the circuit has no effect on the remainder of the circuit.

Upon the release of relay 6TR, its front contact *c* will become open and thereby open the original energizing circuit for relay XR at a second point. However, with relay ESR picked up, front contact *c* of relay ESR will bridge the open front contact *c* of relay 6TR and relay XR will remain energized by the second traced energizing circuit for that relay. Accordingly, crossing signal CS will not operate.

Upon the train vacating section 5T and occupying only section 6T, relay 5TR will pick up and establish a third stick circuit for relay ESR. This third stick may be traced from positive terminal B of battery LB, over front contact *b* of relay 2TR, front contact *a* of relay 3TR, front contact *a* of relay 5TR, back contact *b* of relay 6TR, back contact *c* of relay TESR, front contact *a* of relay ESR, and the winding of relay ESR to negative terminal N of battery LB. During the time that relay 5TR is moving its contacts from their released to their picked up position, the second stick circuit for relay ESR will be opened and the third stick circuit of relay ESR will not yet be closed which results in relay ESR being momentarily deenergized. However, relay ESR has a slightly slow release characteristic which will keep it picked up while the contacts of relay 5TR are moving to their picked up position at which time the third stick circuit for relay ESR will be established to maintain the contacts of relay ESR picked up.

Upon a train entering section 7T, the wheels and axles of the train will shunt relay 7TR causing it to release. This will open the previously traced energizing circuit for relay TSR causing it to release and thereby deenergize the thermal time element relay TE. Since relay TE was not energized for a sufficiently long time to operate its contacts, the deenergization of relay TE will have no effect on the remainder of the apparatus. Upon the train vacating section 6T and occupying only section 7T, relay 6TR will pick up, thereby opening the third stick circuit for relay ESR causing it to release and thereby open the second energizing circuit for relay XR. However, upon the picking up of relay 6TR the original energizing circuit for relay XR will be reestablished and relay XR will remain picked up. Accordingly, crossing signal CS will not operate. When the train vacates section 7T, the track relay 7TR will pick up and all parts will then be restored to their normal condition in which they are shown in the drawing. It will be seen from the above description that the crossing signal will operate until the train has passed over the highway at which time the crossing signal will cease to operate due to the contacts of the stick relay bridging the contacts of the track relays of the receding sections in the stretch.

Let it now be assumed that an eastbound train moving through the stretch must stop for some reason in section 2T. When the train enters section 1T, the wheels and axles of the train will shunt relay 1TR causing it to release but this will have no effect upon the circuit arrangement for reasons already made clear in the previous description. When the train enters section 2T, the wheels and axles of the train will shunt relay 2TR causing it to release and after the train has vacated section 1T a circuit will be established for picking up relay TSR which circuit may be traced from positive terminal B of battery LB, over front contact *a* of relay 7TR, front contact *a* of relay 1TR, back contact *a* of relay 2TR, back contact *a* of thermal time element relay TE, and the winding of relay TSR to negative terminal N of battery LB. Accordingly, the heretofore traced energizing circuit for relay TE will be established upon the picking up of relay TSR. With the train remaining in section 2T for a period of time sufficiently long for the time element relay TE to operate its contacts, the energizing circuit for relay TSR will become opened at back contact *a* of the relay TE. However, relay TSR will remain picked up due to continued energization over a stick circuit which may be traced from positive terminal B of battery LB, over front contact *a* of relay 7TR, front contact *a* of relay 1TR, back contact *a* of relay 2TR, front contact *a* of relay TSR, and the winding of relay TSR to negative terminal N of battery LB. The closing of contact *b* of relay TE will establish an energizing circuit for relay TESR, which circuit may be traced from positive terminal B of battery LB, over front contact *b* of relay TE, and the winding of relay TESR to negative terminal N of battery LB. Accordingly, relay TESR will pick up and thereby open the previously traced energizing circuit for relay TE at back contact *a* of relay TESR, and close a stick circuit for relay TESR which may be traced from positive terminal B of battery LB, over front contact *b* of relay TSR, front contact *a* of relay TESR, and the winding of relay TESR to negative terminal N of battery LB. With thermal time element relay TE deenergized, its contacts will return to their normal positions and thereby open the energizing circuit for relay TESR and close the previously traced energizing circuit for relay TSR.

With relay TESR picked up, the previously traced energizing circuit for relay ESR will become open at back contact *b* of relay TESR and, accordingly, relay ESR will release. However, upon the picking up of relay TESR, front contact *c* of relay 2TR, which is open, will be bridged by front contact *d* of relay TESR and accordingly, an energizing circuit for relay XR will be established which will cause relay XR to pick up, thereby deenergizing the crossing signal CS. This energizing circuit for relay XR may be traced from positive terminal B of battery LB, over front contact *d* of relay TESR, front contact *b* of relay 3TR, front contact *b* of relay XTR, front contact *b* of relay 5TR, front contact *c* of relay 6TR, and front contact *e* of relay TESR in multiple, and the winding of relay XR to negative terminal N of battery LB.

After the train once again commences to move in its eastbound direction and enters section 3T, relay 3TR will release, opening the energizing circuit for relay XR which was just traced and thereby causing relay XR to release and once more energize crossing signal CS. Upon the train vacating section 2TR and just occupying section 3T, relay 2TR will pick up and open the energizing circuit for relay TSR at back contact *a* of relay 2TR, thereby causing relay TSR to release and open the stick circuit for relay TESR and cause it also to release. Upon relay TESR releasing, the second energizing circuit for relay ESR, which has already been traced, will become established and relay ESR will pick up. As the train moves through the remainder of the stretch, the apparatus will operate in a manner substantially identical to

the manner it operates when a train moves through the stretch without stopping in section 2T.

Because of the symmetry of the circuit arrangement, it should be obvious that trains making westbound movements continuously through the stretch of westbound movements involving a stop or slow-down in section 6T will cause the apparatus to operate in a manner substantially identical with that described for the eastbound movements.

It should be pointed out that sections 3T and 5T are sufficiently long to provide highway traffic with a minimum safe warning time assuming that the train is starting from a dead stop at some predetermined point in sections 2T or 6T, respectively. Sections 3T and 5T are included solely for the purpose of providing positive ringing after contact *c* of relay 2TR or 6TR has been bridged by contact *d* or *e* of relay TESR, respectively, upon the operation of that relay.

Let it now be assumed that a rail becomes broken in section 2T. Accordingly, relay 2TR will release and will stay released, and in a manner similar to that described for a train stopping in section 2T, relay TSR will pick up, thereby energizing relay TE which, when its contacts operate, will cause relay TESR to pick up. With the circuit arrangement in such a condition if a train subsequently enters section 1T, relay 1TR will release and thereby open the energizing circuit for relay TSR at front contact *a* of relay 1TR. Accordingly, relay TSR will release and thereby open the stick circuit for relay TESR at front contact *b* of relay TSR. This will cause relay TESR to release and as the train moves through the stretch the circuit arrangement will be in substantially the same condition as it is when a rail is not broken. Accordingly the movement through the stretch will be substantially the same as the movement of a train described heretofore in this description. Furthermore, with a rail broken in section 2T, if a train makes a westbound movement through the stretch, as it enters section 7T, the energizing circuit for relay TSR will become open at front contact *a* of relay 7TR, thereby causing relay TSR to release which in turn will cause relay TESR to release, thereby restoring the apparatus to its normal condition. Due to the symmetry of the circuit arrangement, it should be clear that the same protection is afforded for a broken rail in section 6T regardless of whether the subsequent train movement is eastbound or westbound. In previously proposed arrangements, this means for checking and resetting the apparatus was not provided and accordingly, a broken rail in either approach section could result in no warning of a train speeding toward a highway crossing being given to the highway traffic.

Because of the relative shortness of length of track sections 1T and 7T, it may be found more advantageous to use one of the many well known track instruments in conjunction with those sections rather than a conventional track circuit and it should be clear that my invention will operate just as well with such an arrangement. It should also be clear that where track circuits are used in my invention they may not only be direct current neutral track circuits, as shown in the drawing, but they may also be alternating current or coded track circuits. Furthermore, the thermal time element relay shown in the drawing can satisfactorily be replaced with some other well known type of time element means, such as that described and claimed in Letters Patent of the United States No. 1,966,965, granted to Branko Lazich and Harry E. Ashworth, on July 17, 1934, for Electrical Relays.

Although, as I have already pointed out, my invention is particularly useful in non-signaled territory, my invention may be used to good advantage in territory provided with wayside or cab signals, or both.

Although I have herein shown and described only one form of highway crossing protection control apparatus embodying my invention, it is to be understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination, a stretch of railway track divided into a first, second, third and fourth track sections through which traffic moves in the order named, said fourth track section being intersected by a highway, a highway crossing signal adjacent said intersection, means for energizing said highway crossing signal when any of said second, third or fourth sections are occupied, a first stick relay, a second stick relay, a time element relay adjusted to operate a contact when said time element relay has been energized for a predetermined time interval, an energizing circuit means for said first stick relay closed when said first section is unoccupied, said second section is occupied and said contact of said time element relay has not been operated; a stick circuit means for said first stick relay closed when said first section is unoccupied and said second section is occupied, circuit means for energizing said time element relay closed when said first stick relay is energized and said second stick relay is deenergized, circuit means for energizing said second stick relay closed when said time element relay has operated its contact, a stick circuit means for said second stick relay closed when said first stick relay is energized, and circuit means for deenergizing said highway crossing signal when said second section is solely occupied and said second stick relay is energized.

2. In combination, a stretch of railway track divided into a first, second, third, fourth, fifth, sixth and seventh track sections through which traffic may move in the order named or in the reverse order, said fourth section being intersected by a highway, a highway crossing signal adjacent said intersection, means for energizing said crossing signal when any of said second, third, fourth, fifth and sixth sections are occupied by a train approaching said intersection, a first stick relay, a second stick relay, a time element relay adjusted to operate a contact when said time element relay has been energized for a predetermined time interval, an energizing circuit for said first stick relay closed when said first and seventh sections are unoccupied, said second or sixth section is occupied and said contact of said time element relay has not been operated; a stick circuit means for said first stick relay closed when said first and seventh sections are unoccupied and said second or sixth section is occupied, an energizing circuit for said time element relay closed when said first stick relay is energized and said second stick relay is deenergized, an energizing circuit for said second stick relay closed when said time element relay has operated said contact, a stick circuit for said second stick relay closed when said first stick relay is energized, circuit means for deenergizing said crossing signal when said second stick relay is energized and said second or sixth section is solely occupied, and other circuit means for deenergizing said crossing signal when a receding train clears said fourth section.

3. In apparatus for controlling a highway crossing signal adjacent the intersection of a highway and a stretch of track over which traffic may move in both directions, said stretch being provided with a first approach track section on one side of the highway and a second approach section on the other side of the highway, said approach sections each being provided with a track circuit including a track relay, the combination comprising a first traffic responsive means having normal and actuated conditions and located in said stretch beyond the end of said first approach section remote from said highway, a second traffic responsive means having normal and actuated conditions and located in said stretch beyond the end of said second approach section remote from said highway, time element means having a first condition and a second condition to which it operates only when said time element means has been

energized for a predetermined time interval; means controlled by said first and second traffic responsive means and said track relays and effective only when said first and second traffic responsive means are in their normal condition and one of said track relays is deenergized for energizing said time element means, and ineffective when said traffic responsive means are in their actuated conditions first and second directional stick relays associated with said first and second approach sections, respectively, and means controlled by both said track relays and said time element means and effective only when said time element means is in said first condition for energizing each directional stick relay.

4. In apparatus for controlling a highway crossing signal adjacent the intersection of a highway and a stretch of railway track over which traffic may move in both directions, said stretch being provided with first and second track sections located on one side of said highway and third and fourth track sections located on the other side of said highway, the ends of said second and third sections remote from said highway being located at a distance from said highway approximately equal to the distance a train will travel in a given minimum safe warning time when traveling at a given maximum speed for said stretch, said first and fourth sections being located adjacent said remote ends of said second and third sections, respectively, and being of relatively short length, each of said track sections being provided with a track circuit including a track relay, time element means; a circuit including a front contact of the track relay associated with said fourth section, a front contact of the track relay associated with said first section, and a back contact of the track relay associated with said third section in multiple with a back contact of the track relay associated with said second section for energizing said time element means; first and second directional stick relays associated with said second and third track sections, respectively; a circuit including a front contact of said second track relay, a back contact of said third track relay and a contact closed unless said time element means has been energized for a predetermined time interval for energizing said first directional stick relay; and a circuit including a front contact of said third track relay, a back contact of said second track relay and a contact closed unless said time element means has been energized for said predetermined time interval for energizing said second directional stick relay.

5. In highway crossing protection control apparatus for a stretch of track intersected by a highway protected by a crossing signal, said stretch being divided into first and second sections in approach to said highway on one side thereof, a highway crossing section, and third and fourth sections in approach to said highway on the other side thereof, said second and third sections lying between said first and fourth sections, in combination, signal control means actuable to operative and inoperative conditions, means responsive to occupancy of said second and third sections for actuating said signal control means to its operative condition, timing means responsive to a fault condition in either of said second and third sections operatively connected to said signal control means to restore said control means to its inoperative condition after a predetermined time, directional means responsive to the sequence of occupancy of said second and third sections operatively connected to said signal control means to prevent actuation thereof to its operative position by the second of said second and third sections to be occupied, means controlled by said timing means for preventing the operation of said directional means, and means responsive to occupancy of said first and fourth sections for resetting said timing means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,097,827	Young	Nov. 2, 1937
2,379,209	Allen	June 26, 1945
2,628,306	McMahon	Feb. 10, 1953
2,664,499	Muse	Dec. 29, 1953
2,740,887	Lower	Apr. 3, 1956
2,760,054	Kemmerer	Aug. 21, 1956