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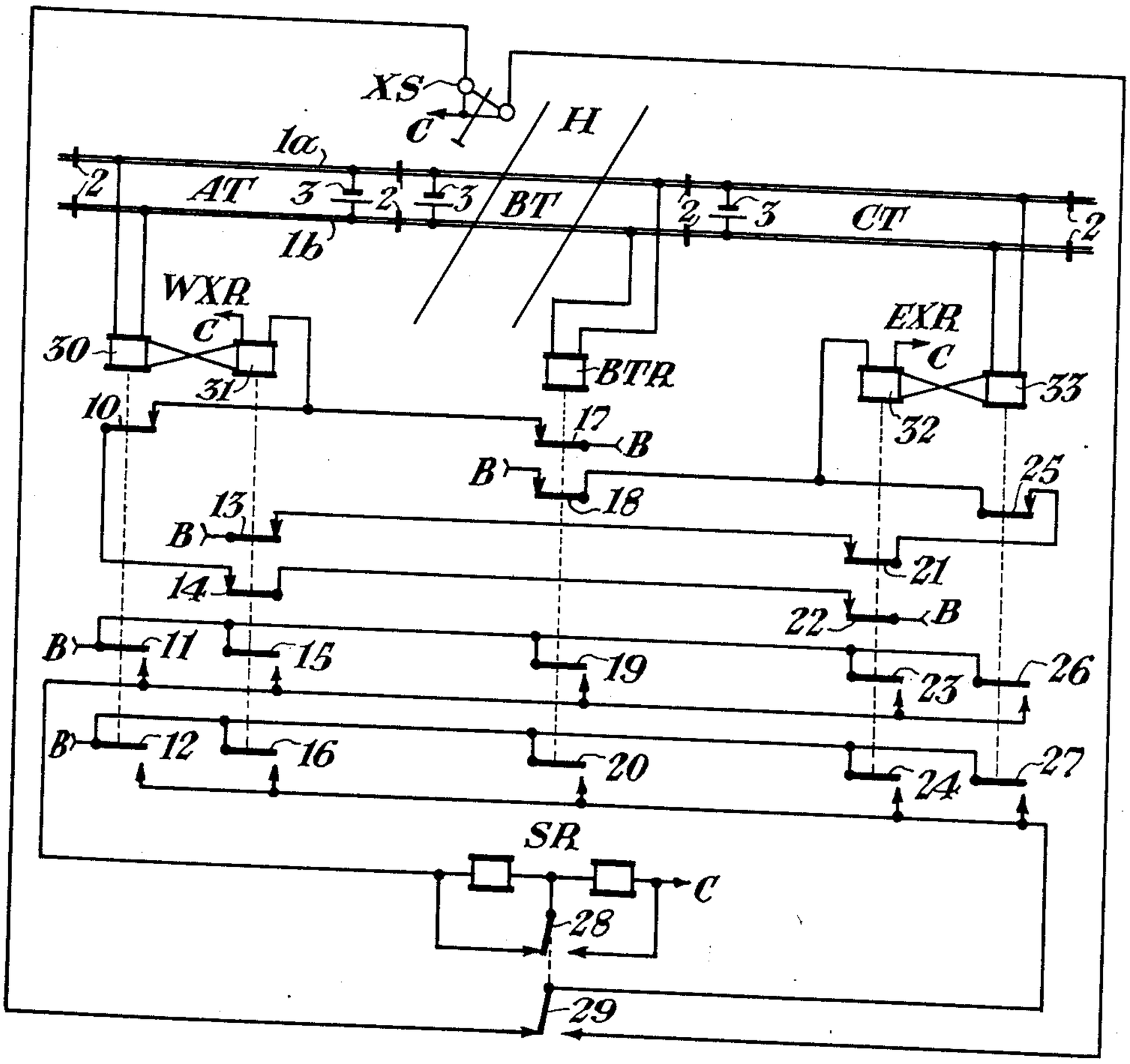

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HIGHWAY CROSSING SIGNAL CONTROL SYSTEM

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5 Claims. (Cl. 246—130)

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My invention relates to a highway crossing signal control system of the type adapted to provide protection for both directions of railroad traffic on a stretch of single track. More particularly my invention relates to a system of the above described type which is arranged to provide for proper operation should the track become shunted by a highway vehicle at the crossing.

A highway crossing signal control system automatically initiates operation of a highway crossing signal when a train approaches an intersection, and customarily discontinues such operation only when the train has cleared the crossing. On a stretch of single track intersected by a highway, protection of this type must be provided for both directions of railroad traffic if trains are to move over the track in either direction. Where track circuits are employed, it is usual in such cases to provide a crossing section which includes the intersection and two approach sections located one on each side of the intersection adjoining the crossing section. Apparatus is then provided to initiate operation of the signals when a train travelling toward the intersection in either direction enters an approach section, and to terminate operation when the train vacates the crossing section.

One form of apparatus that has been proposed heretofore for accomplishing this result contemplates the use of an interlocking relay to control the signals, and a track circuit including a track relay for each track section to control said interlocking relay. The interlocking relay has two windings each provided with an armature, and an interlocking mechanism which on the release of either armature latches up the other armature to prevent it from closing its back contacts if it should release before the first armature is picked up. The system is arranged to provide for the deenergization of one winding of this interlocking relay when the track relay of one approach section is released, for the deenergization of the other winding when the track relay of the other approach section is released, and for the deenergization of both windings when the track relay of the crossing section is released. The desired protection is then obtained by controlling the signals over back contacts of the interlocking relay such that the signals are set into operation whenever one armature of the interlocking relay has closed its back contacts.

Although apparatus of the above described type will normally function in the desired manner, any system so arranged incorporates an inherent difficulty in that proper operation of the signals may be interfered with when the track circuit of the crossing section is shunted by a crawler type tractor or similar vehicle moving across the tracks. That is, when the track circuit of the crossing section is shunted through the metallic treads and body of the vehicle both windings of the interlocking relay are deenergized and it is indeterminate as to which of the armatures shall close its back contacts and which shall be latched up. Although the signals will operate under these conditions whichever armature is closed, if the back contacts controlled by the armature of one approach section should close and a train then enters the other approach section, the signals will cease to operate when the highway vehicle ceases to shunt the rails of the crossing section and will not operate as the train proceeds through the intersection.

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It is an object of my invention to provide a novel and improved highway crossing signal control system of the type described which will function to establish proper operation even though a highway vehicle shunts the rails at the crossing.

Another object of my invention is the provision of a novel and improved highway crossing signal control system of the type described which utilizes two interlocking relays and incorporates means for maintaining the windings of each energized when the track section at the crossing is shunted by a vehicle moving across the tracks.

Other important objects and characteristic features of my invention will become apparent from the following description.

In attaining the above mentioned and other objects of my invention, I provide two interlocking relays and a track relay to control the operation of the signals. One winding of one interlocking relay is connected across the rails of one approach section and one winding of the other interlocking relay is connected across the rails of the other approach section. The track relay is connected across the rails of the crossing section. The other windings of the interlocking relays are jointly controlled over contacts of the track relay and over contacts of the interlocking relays such that these windings are maintained energized when the track circuit of the crossing section is shunted by a vehicle moving across the tracks, but are deenergized when the track relay is released during normal operation by the presence of a train in the crossing section.

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

The accompanying drawing is a diagrammatic view of one form of apparatus embodying my invention.

Referring now to the drawing, the reference characters *1a* and *1b* designate the rails of a given stretch of track over which traffic may move in either direction and which as shown is intersected at grade by a highway H. A highway crossing signal designated by the reference char-

acter XS which may take any one of a number of suitable forms but which is represented as the flashing light type in the drawing, is located adjacent the intersection. The signal is controlled by an operating relay SR which may be of the flasher relay type illustrated in the drawing.

The flasher relay SR is characterized by the provision of two coils permanently connected in series, an armature mounted for attraction to either coil, and contacts operated between extreme right and left-hand positions depending upon the position of the armature. One contact 28 in its right-hand position establishes a shunt path around the right-hand coil of the relay, and in its left-hand position establishes a shunt on the left-hand coil. When the relay is deenergized the armature is biased to one of its extreme positions, for example, the left-hand position as shown in the drawing to assure a starting action so that when the relay is energized, the right-hand winding is first effective to create a flux which attracts the armature to its right-hand position and contact 28 thereupon shunts the right-hand coil, whereupon the left-hand coil operates to attract the armature and the armature is alternately operated between its two extreme positions. The armature carries another contact 29 through which energy is supplied to the signal lamps. A relay of this type is shown, for example, in Letters Patent of the United States Reissue No. 17,252, dated April 2, 1929, to C. S. Snavely and W. B. Wells.

The track rails 1*a* and 1*b* are divided by insulated joints 2 into an approach section AT located on one side of the crossing, a crossing section BT including the crossing and an approach section CT on the other side of the crossing. Each such section is provided with a track circuit including a track battery 3. The track circuits for sections AT and CT include windings 30 and 33, respectively, of interlocking relays WXR and EXR. The track circuit for section BT includes the winding of a track relay BTR.

Interlocking relays WXR and EXR are each characterized by the provision of a mechanical locking arrangement which for relay WXR is controlled by the armatures of windings 30 and 31 and for relay EXR is controlled by the armatures of windings 32 and 33. When both armatures of either relay are picked up, the release of one will latch up the other permitting its front contacts to open, but preventing its back contacts from closing if it should release before the first armature has picked up. Thus, taking relay WXR as an example, if winding 30 is the first to be released, its front contact 10 will open and its back contacts 11 and 12 will close, but the armature of winding 31 will be latched up so that when winding 31 subsequently becomes deenergized with winding 30 still released, its front contacts 13 and 14 will open but its back contacts 15 and 16 will be prevented from closing. A relay of this type is shown, for example, in Letters Patent of the United States No. 1,799,629, granted April 7, 1931, to W. K. Lockhart and T. J. O'Meara.

As previously mentioned, winding 30 of relay WXR and winding 33 of relay EXR are respectively connected in circuit with the rails of sections AT and CT and these two windings therefore are controlled by traffic in the respective approach sections. The other winding 31 of relay WXR has a pick-up circuit governed by relay BTR which may be traced from terminal B of a suitable source of current, such as a battery not shown, through front contact 17 of relay BTR and winding 31 to the other terminal C of the same source of current, and it has a stick circuit extending from terminal B through front contact 22 of winding 32, front contact 14 of winding 31, front contact 10 of winding 30 and winding 31 to terminal C. Winding 32 of interlocking relay EXR is similarly provided with a pick-up circuit controlled by front contact 18 of relay BTR and with a stick circuit which includes its own front contact 21, a front contact 25 of winding 33 and a front contact 13 of winding 31. Windings 31 and 32 are controlled by these circuits so that during normal operation, that is, when a train approaches the intersection through an approach section both windings will be released when a train enters the crossing section but will remain energized when a highway vehicle shunts the rails at the crossing and the sections are otherwise vacant.

Flasher relay SR is energized and set into operation over an obvious circuit which may be completed at back contact 11 of winding 30, back contact 15 of winding 31, back contact 19 of relay BTR, back contact 23 of winding 32 or back contact 26 of winding 33. The signals are energized and set into operation over an obvious circuit which may be completed at back contact 12 of winding 30, back contact 16 of winding 31, back contact 20 of relay BTR, back contact 24 of winding 32 or back contact 27 of winding 33.

The approach sections AT and CT located on opposite sides of the intersection each extend a distance equal to that which would be traversed in twenty seconds by a train operating at the highest authorized speed for the stretch. The crossing signals are set into operation, as will be made clear hereinafter, when a train approaching the intersection from either direction enters either section AT or section CT. As a result, the crossing signals are set into operation not less than 20 seconds before a train moving at the maximum authorized speed reaches the intersection. The crossing section which adjoins both approach sections merely spans the crossing and is relatively short with respect to the lengths of sections AT or CT.

The apparatus embodying my invention is illustrated in the drawing in the normal condition that obtains when the sections are unoccupied. In this condition of the apparatus both windings of each interlocking relay are energized and track relay BTR is picked up. As a result flasher relay SR is deenergized and the signal is disconnected from the source of power.

When an eastbound train, that is a train operating from left to right as viewed in the drawing enters section AT, the shunting action of its wheels and axles deprives winding 30 of interlocking relay WXR of current. Front contact 10 opens and back contacts 11 and 12 close in response. Back contact 11 closes to complete the obvious energizing circuit for flasher relay SR previously mentioned and relay SR responds by alternately operating its contact 29 first to one position and then to another to cause the two lamps of signals XS to be energized alternately, one over a circuit which extends from terminal B over back contact 12 of winding 30 and contact 29 of flasher relay SR in its left-hand position through the filament of one lamp of signal XS to terminal C, and the other over a circuit which extends from terminal B over back contact 12 of winding 30 and contact 29 of flasher relay SR in its right-hand position through the filament of the other lamp of sig-

nal XS to terminal C. Front contact 10 of winding 30 prepares for the deenergization of winding 31 of interlocking relay WXR by opening the previously traced stick circuit which includes front contact 22 of winding 32, front contact 14 of winding 31 and front contact 10 of winding 30.

When the train enters section BT it causes the release of track relay BTR. Its back contacts 19 and 20 close and its front contacts 17 and 18 open and as a result energizing circuits are completed for the signals and the flasher relay over back contacts 19 and 20 which circuits maintain the signals in operation as explained hereinafter when the train vacates section AT and back contacts 11 and 12 of winding 30 open. Front contact 17 opens the previously traced pick-up circuit for winding 31 of interlocking relay WXR extending from terminal B over front contact 17 of relay BTR through winding 31 to terminal C. Winding 31 then releases and its front contacts 13 and 14 open. Its back contacts 15 and 16 are latched up by the interlocking mechanism of relay WXR preventing them from closing.

The opening of front contact 14 of winding 31 serves no immediate purpose, however, it holds open the stick circuit previously traced for winding 31 which extends over front contact 10 when the train vacates section AT and contact 10 closes as explained hereinafter. Front contact 13 of winding 31 opens the previously mentioned stick circuit for winding 32 of interlocking relay EXR extending from terminal B over front contact 13 of winding 31, front contact 21 of winding 32 and front contact 25 of winding 33 through winding 32 to terminal C. With front contact 18 of relay BTR open, the previously traced pick-up circuit for winding 32 is now open and that winding releases opening its front contacts 21 and 22 and closing its back contacts 23 and 24. The opening of front contacts 21 and 22 performs no useful function for eastbound traffic, but in the case of westbound traffic these contacts perform a function similar to that of front contacts 13 and 14 of winding 31. When back contacts 23 and 24 close energizing circuits are completed over these contacts for the flasher relay and the signal, which circuits maintain the signal in operation when the train vacates section BT and back contacts 19 and 20 of relay BTR open as explained hereinafter.

When the train enters section CT winding 33 of interlocking relay EXR releases opening its front contact 25. Contact 25 performs no useful function in the case of eastbound traffic, but it performs a function similar to that of front contact 10 of winding 30 for westbound traffic. Back contacts 26 and 27 do not close when winding 33 releases but are maintained in a latched up position instead by the interlocking mechanism of relay EXR.

As the train vacates section AT, winding 30 of interlocking relay WXR picks up. Front contact 10 closes and back contacts 11 and 12 open. Although the energizing circuits for the signals and the flasher relay which extend over back contacts 11 and 12 are opened, alternate circuit paths exist over back contacts 19 and 20 of relay BTR and back contacts 23 and 24 of winding 32, and the signals continue to operate. When front contact 10 closes it prepares the stick circuit for winding 31 of interlocking relay WXR.

As the train vacates section BT relay BTR

picks up to close its front contacts 17 and 18 and open its back contacts 19 and 20 connected respectively in the obvious circuits for relay SR and signal XS. Although back contacts 19 and 20 open, back contacts 23 and 24 of winding 32 remain closed and the signal continues to operate. When front contact 17 of relay BTR closes it completes the previously mentioned pick-up circuit for winding 31 of interlocking relay WXR which circuit extends from terminal B over front contact 17 of relay BTR through winding 31 to terminal C. Winding 31 picks up to close its front contacts 13 and 14 and to bring its back contacts 15 and 16 from their latched up position to their energized position. When front contact 18 of relay BTR closes it completes the previously traced pick-up circuit for winding 32 of interlocking relay EXR which extends from terminal B over front contact 18 of relay BTR through winding 32 to terminal C. Winding 32 picks up to close its front contacts 21 and 22 and to open its back contacts 23 and 24. When back contacts 23 and 24 open they disconnect the flasher relay and the signal from the source of power and the signal ceases to operate. Front contact 21 closing prepares the stick circuit for winding 32 of interlocking relay EXR. Front contact 22, when it closes completes the previously traced stick circuit for winding 31 of interlocking relay WXR which includes front contact 22 of winding 32, front contact 14 of winding 31 and front contact 10 of winding 30.

When the train vacates section CT winding 33 of interlocking relay EXR picks up. Its front contact 25 closes completing the stick circuit for winding 32 which circuit extends from terminal B over front contact 13 of winding 31, front contact 21 of winding 32 and front contact 25 of winding 33 through winding 32 to terminal C. When winding 33 picks up it brings back contacts 26 and 27 from their latched up position into their energized position. The apparatus has now resumed its normal condition, that is, the condition that it normally obtains when each of the track sections is vacant.

The equipment operates in a substantially corresponding manner for westbound traffic as it does for eastbound traffic, and a detailed description of its operation for westbound traffic is therefore believed unnecessary.

It follows from the foregoing description of the operation of the apparatus shown in the drawing that my invention is effective to maintain proper operation of the signal although a train enters an approach section during the time that a vehicle moving across the tracks shunts the track circuit of the crossing section.

If a crawler type tractor or similar vehicle shunts the track circuit at the crossing, track relay BTR will release. Its front contacts 17 and 18 will open and its back contacts 19 and 20 will close. When back contacts 19 and 20 close the signals are set into operation. Interlocking relays WXR and EXR are unaffected by the release of relay BTR for one winding of each is maintained energized over the track circuit with which it is associated, and the other winding is maintained energized over its own stick circuit. If an eastbound train should enter section AT then, winding 30 of interlocking relay WXR will release opening its front contact 10 and closing its back contacts 11 and 12 as in normal operation. When the highway vehicle ceases to shunt the track circuit at the crossing relay BTR picks up closing its front contacts 17 and 18 and open-

ing its back contacts 19 and 20. The signal is then operated over back contacts 11 and 12 of winding 30 and the normal mode of operation already described obtains as the train proceeds through the various track sections. Similarly, the equipment will operate in a substantially corresponding manner should a westbound train enter section CT while the track circuit at the crossing is shunted by a highway vehicle moving across the tracks.

Although I have illustrated and described only one form of highway crossing signal control system embodying the features of 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 intersected by a highway, a middle section including the crossing, a first and a second approach section located one on each side of the crossing, a signal for said intersection, a track relay, a track circuit including said track relay for said middle section, a first and a second interlocking relay, a first winding for said first interlocking relay controlled by the presence of a train on said first approach section, a second winding for said first interlocking relay jointly controlled by said track relay and by said second interlocking relay, a first winding for said second interlocking relay controlled by the presence of a train on said second approach section, a second winding for said second interlocking relay jointly controlled by said track relay and said first interlocking relay, and circuit means responsive to the operation of said interlocking relays and said track relay to control the operation of said signal.

2. In combination, a stretch of railway track intersected by a highway, a first, a second and a third section in said track stretch with said first and said third sections located on opposite sides of the crossing, and with said second section including the crossing, a signal for said intersection, a track circuit for said second section, a track relay included in said track circuit, an interlocking relay for said first section, an interlocking relay for said third section, a first winding for the interlocking relay of said first section controlled by the presence of a train in said first section, a first winding for the interlocking relay of said third section controlled by the presence of a train in said third section, a second winding for the interlocking relay of the first section, a second winding for the interlocking relay of said third section, circuit means jointly controlled by said track relay and by the first winding of each interlocking relay to control the second winding of that interlocking relay, and other circuit means responsive to the operation of said interlocking relays and said track relay to control the operation of said signal.

3. In combination, a stretch of railway track intersected by a highway, a first, a second and a third section in said track stretch with said first and said third sections located on opposite sides of the crossing, and with said second section extending over the crossing, a signal for said intersection, a track circuit for said second section, a track relay included in said track circuit, an interlocking relay for said first section, an interlocking relay for said third section, a first winding for the interlocking relay of the first section controlled by the presence of a train in said first

section, a first winding for the interlocking relay of the third section controlled by the presence of a train in said third section, a second winding for the interlocking relay of the first section, a second winding for the interlocking relay of the third section, a control circuit for the second winding of the interlocking relay of the first section extending over a front contact of said track relay, a control circuit for the second winding of the interlocking relay of the third section extending over a front contact of said track relay, a stick circuit for the second winding of the interlocking relay of the first section extending over a front contact of the second winding of the interlocking relay of the third section, a front contact of the second winding of the interlocking relay of the first section and a front contact of the first winding of the interlocking relay of the first section; a stick circuit for the second winding of the interlocking relay of the third section extending over a front contact of the second winding of the interlocking relay of the first section, a front contact of the second winding of the interlocking relay of the third section and a front contact of the first winding of the interlocking relay of the third section; and circuit means responsive to the operation of said interlocking relay and said track relay to control the operation of said signal.

4. A highway crossing signal control system for a stretch of single track railway intersected at grade by a highway and divided into three successive adjoining track sections the middle one of which includes the intersection, said system including a highway crossing signal at said intersection, a track relay, a track circuit including said track relay for said middle section, interlocking relay means having first and second windings, means for controlling said first windings of said interlocking relay means by traffic on the two outer track sections, a pickup circuit for each of said second windings each controlled by said track relay, a stick circuit for each of said second windings each controlled by the other second winding, and circuit means responsive to the operation of said interlocking relay means and said track relay to control the operation of said signal.

5. A highway crossing signal control system for a stretch of single track railway intersected at grade by a highway and divided into three successive adjoining track sections the middle one of which includes the intersection, said system including a highway crossing signal at said intersection, a track relay, a track circuit including said track relay for said middle section, two interlocking relays one for each outer track section and each having a first and a second winding, means for controlling the first winding of each interlocking relay by traffic in its respective outer track section, means for controlling said highway crossing signal by said track relay and said first windings of said interlocking relays, a pickup circuit for each said second winding controlled by a front contact of said track relay, and a stick circuit for each said second winding governed by the first winding of that interlocking relay and the second winding of the other interlocking relay.

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