May 8, 1934. J. W. LOGAN, JR 1,958,149

APPARATUS FOR THE CONTROL OF HIGHWAY CROSSING SIGNALS

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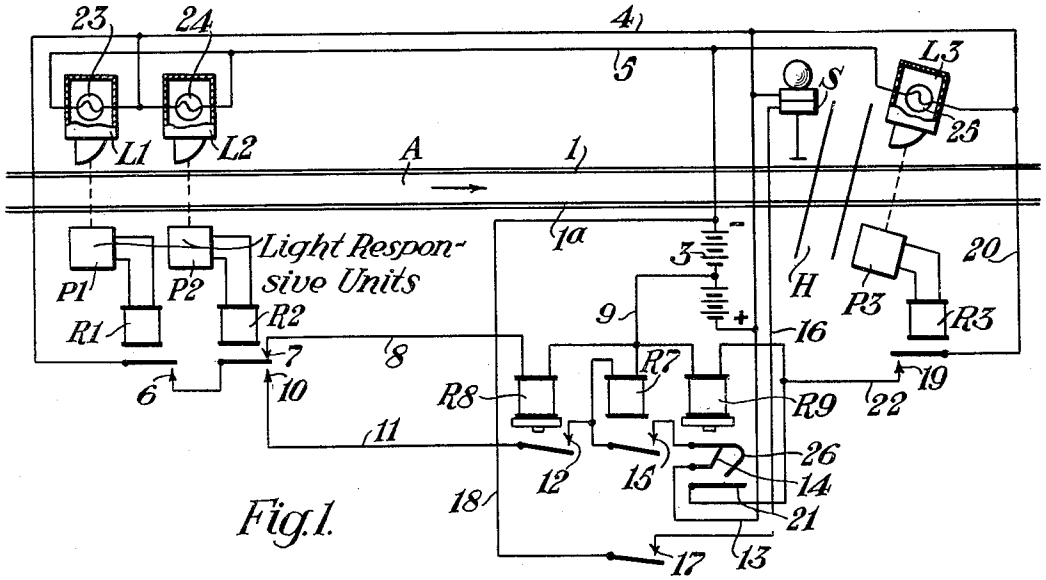


Fig. 1.

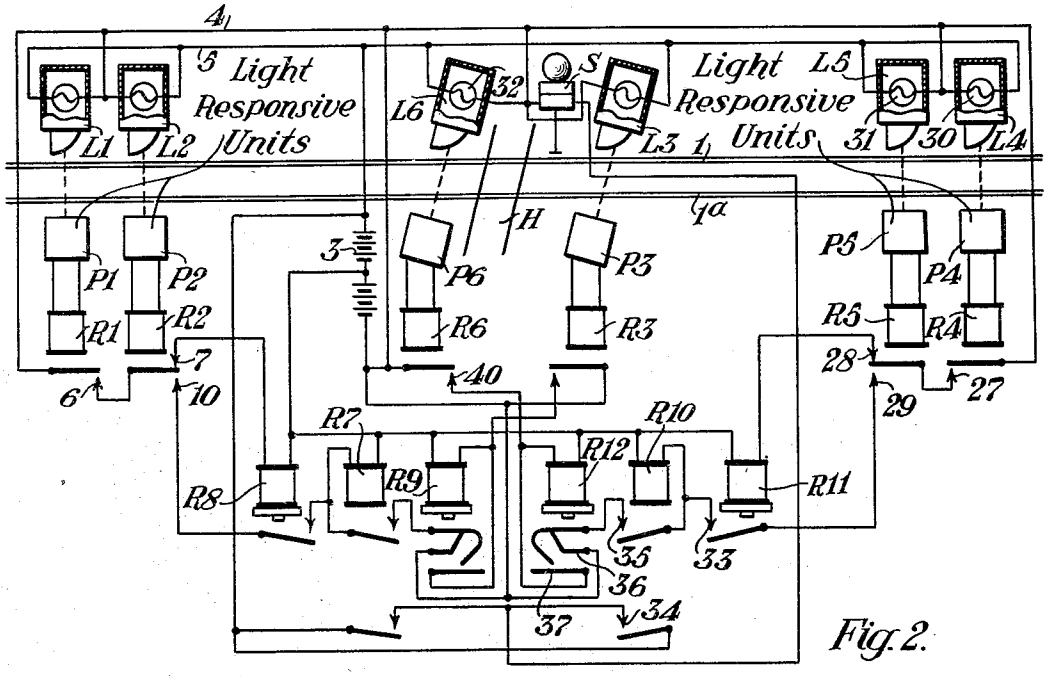


Fig. 2.

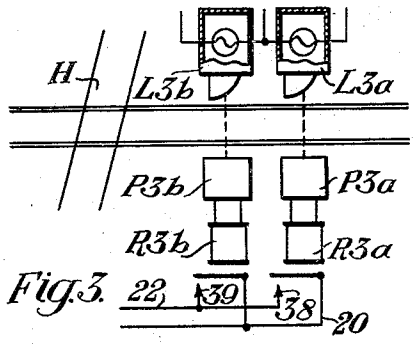


Fig. 3.

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APPARATUS FOR THE CONTROL OF HIGHWAY CROSSING SIGNALS

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9 Claims. (Cl. 246—125)

My invention relates to apparatus for the control of highway crossing signals, and has for an object the provision of apparatus controlled by a train approaching the highway for governing the operation of the highway crossing signals without the necessity for track circuits.

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

In the accompanying drawing, Fig. 1 is a diagrammatic view showing one form of apparatus embodying my invention, in which form protection is given for trains approaching the highway from one direction only. Fig. 2 is a diagrammatic view of a second form of apparatus embodying my invention, in which form protection is provided for trains approaching the highway from either direction. Fig. 3 is a diagrammatic view showing an alternate form of apparatus for stopping the operation of the highway crossing signal, and which apparatus also embodies my invention.

Similar reference characters refer to similar parts in each of the views.

Referring first to Fig. 1, the reference characters 1 and 1a designate the traffic rails of a railway track A over which traffic normally moves in the direction indicated by the arrow. These traffic rails are intersected by a highway H shown at the right-hand end of Fig. 1. At the intersection, there is located a highway crossing signal S. The signal S is indicated on the drawing by a symbol commonly used in the art to designate an audible highway crossing signal in the form of an electric bell. It will be understood, however, that my invention is not limited to any specific type of highway crossing signal, and any of the standard types may be used.

Located at the left of the highway H are two light units L1 and L2. These light units L1 and L2 are located at a distance from the highway sufficient to assure that when a train approaches the intersection, the signal S is operated for a period before the train reaches the highway long enough to properly warn the users of the highway. The two units L1 and L2 are preferably placed but a short distant apart, say for example, twenty feet and which distance is less than the length of a railway car. The light units L1 and L2 may take different forms and preferably are electrically lighted lamps enclosed in suitable weather proof housings. The lamps 23 and 24 of the units L1 and L2, respectively, are constantly supplied with current from a battery 3 over a pair of line wires 4 and 5 as will be readily understood by an inspection of Fig. 1. The two units L1 and L2 are each arranged to direct a light beam across the track rails as indicated by the dotted lines. Preferably these light beams will cross the traffic rails at a distance sufficiently high above the top of the rails so as to pass over the heads of individuals walking on the track, but so as to be intercepted by a railway car.

P1 and P2 are light responsive units adapted to receive light from the units L1 and L2, respectively. The light responsive units P1 and P2 may take different forms, and preferably are light responsive generators of electromotive force such, for example, as disclosed in the United States application for Letters Patent, Serial No. 248,852, filed January 23, 1928, by L. O. Grondahl and P. H. Geiger, for Light sensitive apparatus. It is deemed sufficient for the present application to say that when exposed to the light beams of the respective light units, the light responsive units P1 and P2 become generators of electromotive force, the energy supplied by each being sufficient to energize an associated relay to be referred to later. When the light beam from the associated light unit is shut off, the units P1 and P2 cease to supply electromotive force, or at least ceases to supply sufficient energy, and the associated relay is deenergized. It is to be understood, however, that I do not wish to limit myself to any specific form of light responsive unit, but the form here cited will serve to illustrate one form of such unit whereby a current flow sufficient to operate a relay is obtained in response to a directed light beam. The specific structure of these light responsive units forms no part of my present invention, and they are shown conventionally only in the drawing for the sake of simplicity. It is clear that the light responsive units P1 and P2 normally receive light from the respective light units L1 and L2, but are obscured successively by a car moving along the railway track. Being located, as stated above, only twenty feet apart, which is less than the length of a railway car, there is an interval when the units P1 and P2 are concurrently obscured by each passing car.

Two sensitive relays R1 and R2 are associated with the light responsive units P1 and P2, respectively. Relays R1 and R2 are each adapted to attract its armature and close a front contact when energized with the current supplied to its winding by the respective light responsive unit when that unit is exposed to the light beam from the corresponding light unit, and to release

its armature and close a back contact when the light beam is intercepted. Consequently, relays R1 and R2 are normally energized and are successively deenergized as a car advances along the railway, there being an interval for each car when both relays are deenergized.

To the right of the highway H is located a third light unit L3, the lamp 25 of which is constantly supplied with current from the battery 3 over the line wires 4 and 5 in parallel with the lamps 23 and 24 of the units L1 and L2. A light responsive unit P3, preferably similar to the units P1 and P2, is adapted to receive light from the light unit L3. The light unit L3 is preferably set to direct its light beams diagonally across the traffic rails as indicated by the dotted line in the drawing. The light unit L3 and the associated light responsive unit P3 are arranged close to the highway H so that the light beam is intercepted by the head end of a car moving in the normal direction of traffic just after it passes the intersection, and is cleared by the rear end of the car just as the car clears the intersection. The units L3 and P3 are located, of course, in a manner to assure that the light beam is not intercepted by vehicles or individuals using the highway. The diagonal arrangement of units L3 and P3 is to assure continuous interception of the light beam as long as a train of several cars is passing. If the light beam was directed at right angles across the track rails, it might flash across between the cars of a train. A relay R3, similar to relays R1 and R2, is controlled by the light responsive unit P3, and, hence, is energized when the unit P3 receives light and is deenergized when the light is intercepted.

The operation of the highway crossing signal S of Fig. 1 is governed by a relay R7 and its two associated relays R8 and R9 in the following manner. Assuming a car or train travelling in the normal direction of traffic approaches the highway H, it will first obscure the light responsive unit P1, and the relay R1 will be deenergized. Current will now flow from the positive terminal of the battery 3 over line wire 4, back contact 6 of relay R1, front contact 7 of relay R2, line wire 8, winding of relay R8 and wire 9 to a center terminal of battery 3, and the relay R8 will be picked up. The car on advancing a few feet will next obscure the light responsive unit P2, and relay R2 will also be deenergized. Current will now flow from the positive terminal of battery 3 over line wire 4, back contacts 6 and 10 of relays R1 and R2, respectively, line wire 11, front contact 12 of relay R8 inasmuch as relay R8 is slow releasing in character, winding of relay R7, and wire 9 to the center terminal of battery 3, and relay R7 will be picked up. Relay R7 once energized will be retained energized after the car has cleared the units P1 and P2 and the relays R1 and R2 are reenergized, by virtue of a stick circuit extending from the positive terminal of battery 3 over wire 13, back contact 14 of relay R9, transfer contact 26, front contact 15 of relay R7, winding of this relay and wire 9 to the center terminal of battery 3. Relay R7, when picked up, completes an operating circuit for the signal S and which circuit can be traced from the positive terminal of battery 3 over wire 4, winding of signal S, wire 16, front contact 17 of relay R7, and wire 18 to the negative terminal of battery 3.

Consequently, the car in approaching the intersection will successively obscure the units P1 and P2 in the order named, and will sequentially operate relays R1, R2 and R8 in a manner to cause relay R7 to be energized and the signal S to be set into operation. Relay R7 once picked up will be retained energized to continue the operation of signal S while the car approaches the intersection notwithstanding the relays R1 and R2 will be reenergized as soon as the car moves on to the right past the light responsive units P1 and P2.

When the head end of the car or train passes to the right of the highway H of Fig. 1, the light beam from the unit L3 will be intercepted and the relay R3 will be deenergized. Current will now flow from the positive terminal of battery 3 over wires 4 and 20, back contact 19 of relay R3, wire 22, winding of relay R9 and wire 9 to the central terminal of battery 3, and relay R9 will be picked up. Relay R9 on picking up will open the first traced stick circuit for the relay R7 at the back contact 14, and will at the same time close a second stick circuit for that relay at a front contact 21. Relay R7 will now be energized by current supplied from the battery 3 over the same circuit traced for the relay R9 up to the wire 22, thence over the front contact 21 of relay R9, transfer contact 26, front contact 15, winding of relay R7 and wire 9 to the center terminal of battery 3. Relay R9 being provided with continuity transfer contacts, the relay R7 will be retained energized during the period the relay R9 is picked up. It follows that the operation of signal S will be continued without interruption as long as the car or train intercepts the light beam from the unit L3. When the rear of the train or car passes to the right of the intersection and clears the light beam from unit L3, the relay R3 will be reenergized and the back contact 19 will be opened with the result that both relays R9 and R7 will be deenergized and the operation of the signal S will be stopped. It will be recalled that the units L3 and P3 are arranged diagonally with respect to the traffic rails to assure that the light beam from the unit L3 will not pass between cars of a train which might result in the relay R3 being momentarily energized to deenergize the relays R9 and R7 and stop the operation of signal S. Relay R9 is slow releasing in character and hence relay R7 will release and open its stick circuit at its own front contact 15 before the relay R9 releases, and the reestablishing of the first traced stick circuit for relay R7 will be avoided.

It is clear from the foregoing description that normally signal S is silent and is set into operation as a car successively obscures the units P1 and P2 to operate the relays R1 and R2 in a predetermined sequence. The signal S, once set into operation, continues to warn the highway users until the rear of the car or train has passed beyond the intersection.

A train moving against traffic in Fig. 1 will obscure the light responsive unit P3 and deenergize the relay R3 to pick up the relay R9 but the relay R7, however, will not be energized and the signal S will not be operated. A train moving from the right to the left past the two units P2 and P1 will cause relay R2 to be deenergized first. Relay R2 being down before relay R1 will be deenergized, neither the relay R8 nor the relay R7 will be picked up, and hence the signal S will not be set into operation. That is to say, the sequence in which relays R2 and R1 will be operated in response to a train moving against traffic will

not be effective to energize relay R7 and set the signal S into operation.

Referring now to Fig. 2, protection is provided for a train approaching the highway in either direction. The light units L1, L2 and L3, together with their respective light responsive units P1, P2 and P3 are located with respect to the highway H, similar to that of Fig. 1. The light responsive units P1, P2 and P3 control the relays R1, R2 and R3, respectively, and these relays, in turn, govern signal controlling relays R7, R8 and R9, in the same manner as in Fig. 1, and hence provide operation of the signal S in response to a car or train moving from the left to the right over the intersection in the same manner as already described in connection with Fig. 1. Furthermore, this apparatus associated with traffic moving from the left to the right is ineffective to operate the signal S when a car moves from the right to the left in the same manner as described for Fig. 1.

Light units L4 and L5 are located to the right of the highway H a distance sufficient to assure that when a train approaches the intersection from the right, the signal S is operated for a period before the train reaches the highway long enough to properly warn the highway users. The units L4 and L5 are located with respect to each other in the same manner as the units L1 and L2, that is, they are located approximately twenty feet apart. The lamps 30 and 31 of the units L4 and L5, respectively, are continuously supplied with current from battery 3 over the line wires 4 and 5 as will be readily understood by an inspection of Fig. 2. The light responsive units P4 and P5 normally receive light from the respective units L4 and L5 and control the relays R4 and R5, respectively. It follows that both relays R4 and R5 are normally energized and are deenergized successively in the order named when a car moving from the right to the left obscures the units P4 and P5. Located just to the left of the highway H is a light unit L6, the lamp 32 of which is constantly supplied with current from the battery 3. A light responsive unit P6 receives light from the unit L6 preferably diagonally across the traffic rails as indicated by the dotted line and controls a relay R6.

A set of signal controlling relays R10, R11 and R12 is associated with traffic moving from the right to the left, and these signal controlling relays R10, R11 and R12 are controlled by a predetermined sequential operation of the relays R4, R5 and R6, in a manner similar to that described for relays R7, R8 and R9.

The operation of the apparatus of Fig. 2 associated with traffic moving from the right to the left is similar in all respects to the operation of the apparatus associated with traffic moving from the left to the right, and which operation, as pointed out above, is the same as described for the apparatus of Fig. 1. It is deemed sufficient, therefore, to but briefly repeat the operation of the apparatus of Fig. 2 in connection with a car moving from the right to the left. A car approaching the intersection from the right will first obscure the light responsive unit P4, and the relay R4 will be deenergized. Current will now be supplied to the relay R11 over a circuit including the back contact 27 of relay R4 and a front contact 28 of the relay R5. The car advancing to obscure the light responsive unit P5 will cause relay R5 to be deenergized and current will then be supplied to the relay R10 over the back contacts 27 and 29 of relays R4 and R5, respectively, and the front contact 33 of the relay R11, the relay R11 being slow releasing in character. The relay R10 controls at its front contact 34 the operating circuit for the signal S, and hence the signal S will be set into operation upon the energizing of the relay R10. Relay R10 once picked up will be retained energized first by a stick circuit which includes its own front contact 35 and a back contact 36 of the relay R12. When the car has advanced to the left of the highway H and obscured the light responsive unit P6, the relay R6 will be deenergized and current will be supplied to the relay R12 over the back contact 40 of relay R6 and that relay will be picked up. With relay R12 picked up, the relay R10 will be retained energized over a second stick circuit easily traced and which includes the front contact 37 of the relay R12. When the car has advanced past the highway and cleared the light responsive unit P6, the relay R6 will be reenergized and the control relays R10 and R12 will both be deenergized, and the operation of the signal S will be stopped. The order in which the relays R6, R5 and R4 will be operated by a car moving from the left to the right will be ineffective to control the relays R10, R11 and R12, similar to the manner a car moving from the right to the left is ineffective to control the relays R7, R8 and R9 as already described.

The light beam from the unit L3, used for stopping the operation of highway crossing signal S, is shown as a single light beam directed diagonally across the traffic rails. The purpose of this diagonal arrangement is to assure continuous interception of the light beam for a train of several cars; if the light beam was directed at right angles across the traffic rails, it might flash across between the cars. An alternate form of apparatus for stopping the operation of the highway crossing signal is shown in Fig. 3. Two light units L3*a* and L3*b* are located about fifteen feet apart, that is, located apart a distance less than a car length but greater than the opening between the tops of coupled cars, and are arranged to direct their respective light beams at right angles across the traffic rails to the associated light responsive units P3*a* and P3*b*, respectively. The two units P3*a* and P3*b* control the two relays R3*a* and P3*b*, respectively. The energizing circuit for the control relay R9, which governs the stopping of the operations of the signal S is established through either the back contact 38 of relay R3*a* or through the back contact 39 of the relay R3*b*. It is clear, therefore, that even should one of the light beams from the units L3*a* and L3*b* pass between the cars of a train with the result that the associated relay is picked up momentarily, the energizing circuit of relay R9 is retained over the back contact of the other relay.

Apparatus such as here disclosed is simple and reliable, and provides automatic operation of highway crossing signals without the use of track circuits, whereby rail motor cars which are too light to reliably operate track circuits, or which can not operate track circuits without special equipment because of the use of rubber tired wheels, are effective as they approach a highway intersection, to govern the operation of a highway crossing signal.

Although I have herein shown and described only three forms of apparatus embodying my invention, it is 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 highway crossing signal adjacent the intersection, a first and a second light beam disposed along said stretch a given distance apart but arranged to be concurrently intercepted by a car approaching the intersection in a given direction, a third light beam disposed along said stretch and arranged to be intercepted by a car moving away from the intersection in said given direction; a first, a second and a third contact controlled by said first, second and third light beams respectively, and each contact adapted to assume one position when influenced by the respective light beam and to assume a second position when the light beam is intercepted; a relay, an operating circuit for said signal including a front contact of said relay, a pickup circuit for said relay including said first and second contacts in their second positions, a stick circuit means for said relay, and means controlled by said third contact in its second position for governing said stick circuit means.

2. In combination, a stretch of railway track intersected by a highway, a highway crossing signal adjacent the intersection, a first and a second light beam adapted to be successively and concurrently intercepted by a car approaching said intersection; a first, a second and a third relay; means to energize the first relay in response to a car intercepting the first light beam only, means controlled by the first relay when energized to energize the second relay in response to a car concurrently intercepting both the first and second light beams, an operating circuit effective when said second relay is energized to operate the signal, a first stick circuit for the second relay including a back contact of the third relay, a third light beam adapted to be intercepted by a car moving away from the intersection, means controlled by the third light beam when intercepted for energizing the third relay, and a second stick circuit for the second relay including a front contact of the third relay whereby operation of said signal is started in response to the successive intercepting of the first and second light beams by a car and is continued until the car intercepts and clears the third light beam.

3. In combination, a stretch of railway track intersected by a highway, a highway crossing signal adjacent the intersection, three sources of light disposed along the railway, three light responsive units P1, P2 and P3 normally receiving light from said three sources respectively but arranged that units P1 and P2 are successively obscured by a train approaching the intersection and unit P3 is obscured by the train moving away from the intersection; a first, a second and a third relay, means controlled by unit P1 when obscured to energize the first relay, means controlled by the first relay when energized and units P1 and P2 when concurrently obscured to energize the second relay, an operating circuit effective when the second relay is energized to operate the signal, a first stick circuit for said second relay including a back contact of the third relay, means controlled by unit P3 when obscured to energize the third relay, and a second stick circuit for the second relay including a front contact of the third relay, whereby operation of said signal is started in response to the successive obscuring of units P1 and P2 and is continued until unit P3 is obscured and cleared.

4. In combination, a stretch of railway track intersected by a highway, a highway crossing signal adjacent the intersection, two sources of light disposed along the stretch, two light responsive units P1 and P2 normally receiving light from said two sources respectively but arranged to be successively obscured in the order named by a car approaching the intersection in a given direction; a first, a second and a third relay; a pickup circuit for the first relay including a contact controlled by unit P1 when obscured and a contact controlled by unit P2 when receiving light, a pickup circuit for the second relay including a front contact of the first relay and a contact controlled by unit P2 when obscured, a stick circuit for said second relay including a back contact of the third relay, means controlled by a car when moving away from said intersection in said given direction for energizing said third relay, and an operating circuit for rendering said signal active including a front contact of said second relay.

5. In combination, a stretch of railway track intersected by a highway, a highway crossing signal adjacent said intersection, two sources of light disposed along the stretch, two light responsive generators of electric current normally receiving light from said two sources respectively for energizing two relays R1 and R2 respectively but arranged to be successively obscured by a car approaching the intersection when travelling in a given direction for successively deenergizing said relays; a first, a second and a third normally deenergized control relay; a pickup circuit for said first control relay including a front contact of relay R2 and a back contact of relay R1, a pickup circuit for the second control relay including a back contact of each of the relays R1 and R2 and a front contact of said first control relay, a stick circuit for said second control relay including a back contact of the third control relay, an operating circuit for said signal including a front contact of said second control relay, a contact governed by a train moving away from the intersection when traveling in said given direction, and a pickup circuit for said third control relay including said last-mentioned contact.

6. In combination, a stretch of railway track intersected by a highway, a highway crossing signal adjacent the intersection, two sources of light disposed along the stretch, two light responsive generators of electric current P1 and P2 normally receiving light from said two sources respectively but arranged to be successively obscured in the order named by a car approaching the intersection when traveling in a given direction, two relays R1 and R2 normally energized by generators P1 and P2 respectively, and deenergized when the respective generator is obscured, a first and a second control relay, an operating circuit for said signal including a front contact of said second control relay, a pickup circuit for the first control relay including a back contact of relay R1 and a front contact of relay R2, and a pickup circuit for said second control relay including a back contact of each of the relays R1 and R2 and a front contact of the first control relay, whereby said signal is set into operation in response to a car successively obscuring P1 and P2 when traveling in said given direction only.

7. In combination, a stretch of railway track intersected by a highway, a highway crossing signal adjacent said intersection, a first, a second and a third relay; a pickup circuit for said first relay including a first and a second traffic controlled contact; a pickup circuit for said second

relay including said first traffic controlled contact, a third traffic controlled contact and a front contact of said first relay; a first stick circuit for the second relay including a back contact of said third relay, a second stick circuit for the second relay including a front contact of the third relay and a fourth traffic controlled contact, an operating circuit for the signal including a front contact of said second relay, a pickup circuit for said third relay including said fourth traffic controlled contact; means controlled by a car approaching the intersection in a given direction to successively control said first, second and third traffic controlled contacts to successively energize said first and second relay for starting operation of said signal; and means controlled by the car moving away from the intersection in said given direction to control said fourth traffic controlled contact to energize said third relay and subsequently stop the operation of said signal.

8. In combination, a stretch of railway track, three sources of light disposed along the stretch; three light responsive units P1, P2 and P3 normally receiving light from said three sources respectively but arranged that units P1 and P2 are successively and concurrently obscured and unit P3 subsequently obscured by a car moving along the track in a given direction; a first and a second slow acting relay, a quick acting relay, a pick-up circuit for the first slow acting relay including a contact controlled by unit P1 when obscured and a contact controlled by unit P2 when receiving light, a pickup circuit for the quick acting relay including a front contact of the first slow acting relay and a contact controlled by unit P2 when obscured, a first stick circuit for said quick acting relay including a back contact of said second slow acting relay, a pickup circuit for said second slow acting relay including a contact controlled by unit P3 when obscured, a second stick circuit for said quick acting relay including a front contact of the second slow acting relay and a contact controlled by unit P3 when obscured, a mechanism, and an operating circuit for said mechanism including a front contact of the quick acting relay, whereby said mechanism is controlled from the time a car obscures units P1 and P2 until it obscures and clears unit P3 when moving in said given direction and is unaffected by a car moving in the opposite direction.

9. In combination, a stretch of railway track intersected by a highway, a highway crossing signal adjacent the intersection, two sources of light L1 and L2 disposed along the stretch to the left of the intersection, two sources of light L4 and L5 disposed along the stretch to the right of the intersection, two light responsive units P1 and P2 normally receiving light from the sources L1 and L2 respectively but arranged to be successively obscured in the order named by a car approaching the intersection from the left, two light responsive units P4 and P5 normally receiving light from the sources L4 and L5 respectively but arranged to be successively obscured in the order named by a car approaching the intersection from the right, a first, a second and a third relay; a pickup circuit for the first relay including a contact controlled by unit P1 when obscured and a contact controlled by unit P2 when receiving light, a pick-up circuit for the second relay including a front contact of the first relay and a contact controlled by unit P2 when obscured, a stick circuit for said second relay including a back contact of the third relay; a fourth, a fifth and a sixth relay; a pickup circuit for said fourth relay including a contact controlled by unit P4 when obscured and a contact controlled by unit P5 when receiving light, a pickup circuit for the fifth relay including a front contact of the fourth relay and a contact controlled by unit P4 when obscured, a stick circuit for the fifth relay including a back contact of the sixth relay, an operating circuit for said signal including a front contact of the second relay or a front contact of the fifth relay, means controlled by a car when moving to the right away from the intersection for energizing said third relay, and means controlled by a car when moving to the left away from the intersection for energizing said sixth relay.

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