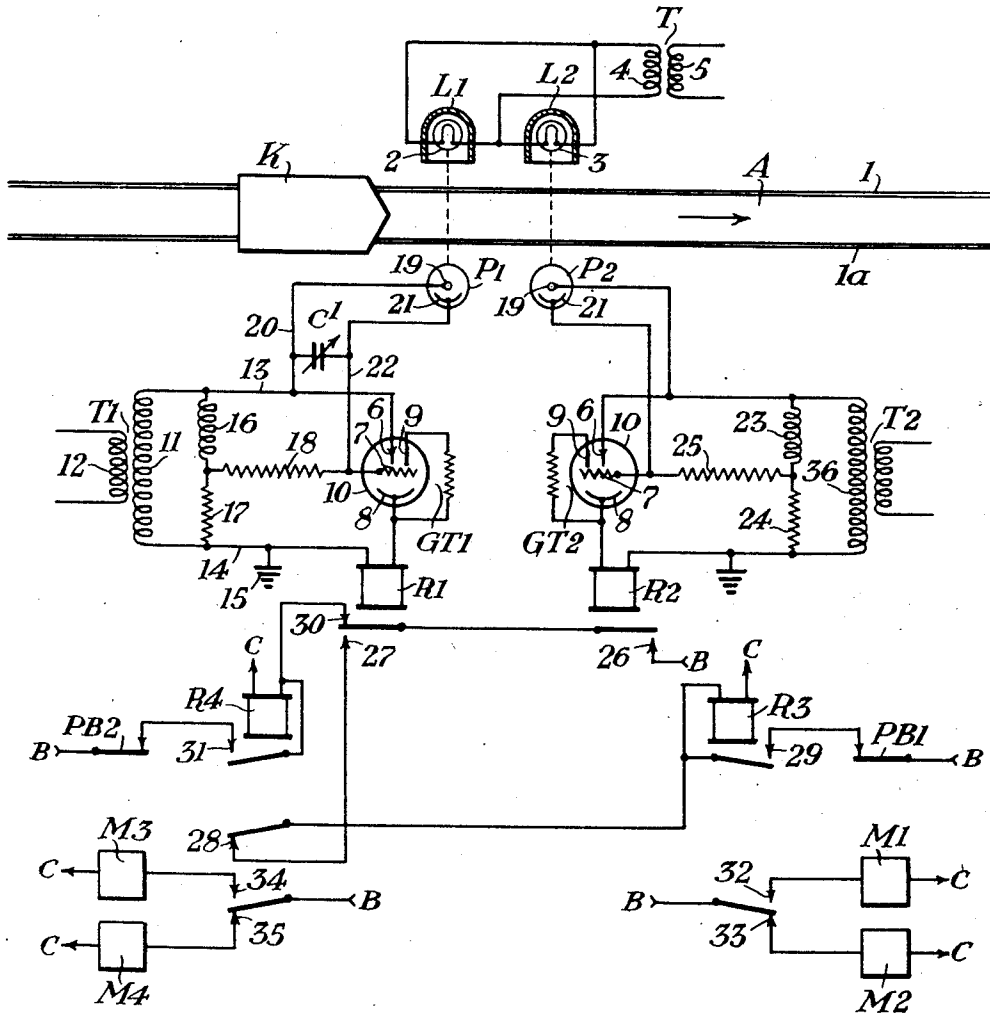


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J. W. LOGAN, JR
SPEED RESPONSIVE APPARATUS

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SPEED RESPONSIVE APPARATUS

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My invention relates to speed responsive apparatus, and more particularly to apparatus to detect whether the speed of a vehicle is greater than or less than a predetermined value. A feature of my present invention is the provision of novel and improved apparatus for causing operation of traffic governing mechanisms in accordance with the time required for a vehicle to pass over a given section of its path of travel, the time interval being adjustable. Other features and advantages of my invention will appear as the specification progresses.

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

The accompanying drawing is a diagrammatic view showing one form of apparatus embodying my invention which form detects whether or not a railway car passes over a given distance of track in greater than or less than a predetermined time interval. Such detection is used to control traffic governing mechanisms such as derails, switches, signals, car retarders, etc., with the result that the mechanisms are selectively controlled in accordance with whether or not the speed of a car is greater than or less than a given value.

Many applications for my invention will naturally suggest themselves to those skilled in the art, and it will be understood that I do not wish to limit myself to railways; the form of apparatus disclosed in the accompanying drawing will serve to illustrate the many places where my invention may be used.

Referring to the drawing, the reference characters 1 and 1a designate the traffic rails of a railway A over which traffic normally moves in the direction indicated by the arrow. Two sources of light L1 and L2 are disposed along the railway track each of which is adapted to direct a light beam across the traffic rails as indicated by the dotted lines. These light beams are arranged a predetermined distance apart and hence will be intercepted successively by a railway car moving along the track. The two light beams from sources L1 and L2 are preferably separated a distance less than the length of the intercepting silhouette of the shortest railway car. I shall assume in the following description that the two light beams are separated twenty feet apart in order to clarify the specification. However, other distances may be selected should it seem desirable to do so. The two light beams will preferably cross the track at a sufficient height above the top of the rails to clear

the heads of individuals walking along the track but will be intercepted by a railway car. These two light units L1 and L2 may take different forms and are preferably electric lamps mounted in suitable housings. The lamps 2 and 3 of the units L1 and L2, respectively, are constantly supplied with current from any convenient source, such as the secondary winding 4 of a transformer T, the primary winding 5 of which is connected with an alternating current generator not shown.

P1 and P2 are light sensitive devices adapted to receive the light beams projected from the light units L1 and L2, respectively. These light sensitive devices P1 and P2 may take different forms such, for example, as the well known photo-electric cell whose conduction depends upon illumination, or the well known selenium cell whose resistance depends upon illumination, or a photo-voltaic cell in which light produces an electromotive force. In the form here shown, P1 and P2 are photo-electric cells each comprising an anode 19, and a cathode 21 enclosed in a suitable envelope. Each of these photocells will, of course, comprise an enclosing tube which is open only at the end toward the cooperating light beam, in order to prevent the light sensitive element of the device from being influenced by light other than the associated light beam. When the potential of the anode 19 is rendered sufficiently positive with respect to the cathode 21 and the cell is illuminated, current is passed and in the event the current source is an alternating current then the current is rectified, current flowing only during the half cycle the anode is rendered positive. As will appear hereinafter, an alternating voltage is constantly impressed across the anode 19 and the cathode 21 of each of the light sensitive cells P1 and P2. Hence, it follows that under the normal illumination of the associated light unit, each cell passes current, and the flow of current is stopped when a car intercepts the associated light beam. Consequently, a car moving in the normal direction of traffic first intercepts the light beam from source L1 and the cell P1 is obscured and the flow of current therethrough is stopped. Before the rear of the car clears the light beam of unit L1, the head end of the car intercepts the light beam from the unit L2 and the cell P2 is also obscured and the flow of current therethrough is stopped. That is to say, the cells P1 and P2 are successively obscured and then concurrently obscured.

Two electric-discharge devices GT1 and GT2 are controlled by the photo-electric cells P1 and P2, respectively, in a manner to shortly appear.

These electric-discharge devices GT1 and GT2 may take different forms but preferably are cold cathode, grid-glow tubes. It will be understood, however, that other types of gas filled tubes, or the well known vacuum tube, may be used should it appear desirable to do so. In the form here shown, these electric-discharge devices GT1 and GT2 each comprises an anode 6, a cathode 8, a grid 7, and a grid-leak shield 9, enclosed in a suitable envelope 10 and which envelope contains a small amount of inert gas such, for example, as neon gas.

The grid-glow tubes GT1 and GT2 are each associated with a source of alternating current, an inductor, a resistor, a grid-leak resistor and a direct current neutral relay, which apparatus as a whole constitutes a sensitive relay device. Referring to the grid-glow tube GT1, for example, the top terminal of the secondary winding 11 of a transformer T1 is connected with the anode 6 by a wire 13, and the bottom terminal of the secondary winding 11 is connected with the cathode 8 over a wire 14, the winding of a direct current neutral relay R1 being inserted in the connection with the cathode. Preferably the wire 14 is grounded as indicated by the reference character 15. An inductor 16 and a resistor 17 are serially connected across the terminals of the secondary winding 11 in parallel with the anode-cathode path of tube GT1 and the winding of relay R1. A grid-leak resistor 18 is connected between the common terminal of inductor 16 and resistor 17 and the grid 7 of tube GT1.

As stated hereinbefore, the grid-glow tube GT1 is controlled by the photocell P1, and to this end the anode 19 of the cell P1 is connected with the wire 13 which interconnects the secondary winding 11 and the anode 6 of tube GT1 by a wire 20 and, the cathode 21 of cell P1 is connected with the grid 7 of tube GT1 by a wire 22. Across the anode 19 and the cathode 21 of cell P1 is connected a variable condenser C¹ to be referred to later, as will be readily understood by an inspection of the drawing.

It is clear from the foregoing description that the grid-glow tube GT1 is provided with an output circuit that includes its main electrodes 6 and 8, the source of alternating current, and the winding of the relay R1; and is also provided with a control circuit network which includes the inductor 16, resistor 17, grid leak 18, the source of alternating current and the control electrode 7, the photo-electric cell P1 and the condenser C¹ being associated with the control network.

The primary winding 12 of the transformer T1 is connected with any convenient source of alternating current not shown, and hence it follows that an alternating voltage is impressed upon both the anode 6 and the grid 7 of the grid-glow tube GT1, and is also impressed across the anode 19 and the cathode 21 of the photocell P1. The phase relation of the voltage impressed upon the grid 7 with respect to the voltage impressed upon the anode 6, and the potential of the grid 7 with respect to the anode 6 are both governed by the control circuit network. The transformer T1 is so proportioned that the voltage supplied by the secondary winding 11 is above the breakdown voltage of the cell P1 when that cell is illuminated, and thus with cell P1 illuminated, rectified current flows in the circuit comprising top terminal of secondary winding 11, wires 13 and 20, anode 19, the intervening space to the cathode 21, and thence by wire 22, resistors 18 and 17 to the lower terminal of the secondary wind-

ing 11. The voltage drop through the resistors 18 and 17 will be large in comparison with the voltage drop through the photocell P1 with the result that the grid 7 of the tube GT1 swings positive during each half cycle that current flows. Under this condition, the tube GT1 ionizes and a substantial rectifier current flows in the output circuit thereof, and the relay R1 is energized. When the photocell P1 is not illuminated, substantially no current flows therethrough and the potential of the grid 7 of tube GT1 swings negative and substantially no current flows in the output circuit of tube GT1. That is to say, the impedance of cell P1 when that cell is dark is materially greater than the impedance of the cell when illuminated, and this change in the impedance of cell P1 varies the impedance of the control network with the result that the voltage of grid 7 with respect to the voltage of anode 6 is varied. I have found that by the proper selection and proportioning of the parts associated with the grid-glow tube GT1 a substantial current will flow and the relay R1 will be picked up in response to illumination of the photocell P1, and the flow of current will be substantially stopped and the relay R1 deenergized when the light to the photocell P1 is intercepted. The variable condenser C¹ inserted across the electrodes of the photocell P1 becomes charged during the period that the cell is illuminated. When the cell is obscured the condenser C¹ discharges into the control network of the grid-glow tube GT1 and maintains the tube GT1 in the condition of passing current for a predetermined period of time, the period of time being proportional to the capacity of the condenser C¹. Consequently, the condenser C¹ is effective to establish a predetermined delay in the release of the relay R1 subsequent to the intercepting of the light beam to the photocell P1, the period of delay being in proportion to the capacity of the condenser. That is to say, without the condenser C¹ the tube GT1 immediately ceases to pass current and relay R1 immediately releases when the light beam to the cell P1 is intercepted. With the condenser C¹ inserted across the electrodes of the photocell, there is an interval between the time the light beam is intercepted and the time at which the grid-glow tube GT1 ceases to pass current and relay R1 releases. With the condenser C¹ made a variable condenser of any of the well known types, it is clear that different release periods for the relay R1 can readily be set up. The function of this slow release period provided for the relay R1 will appear when the operation of the apparatus is described.

The circuit elements, comprising inductor 23, resistor 24, grid-leak resistor 25, transformer T2, and relay R2 associated with the grid-glow tube GT2 are preferably duplicates of the corresponding elements associated with the tube GT1. The tube GT2 is provided with an output circuit which includes its main electrodes 6 and 8, winding of the relay R2, and the secondary winding 36 of the transformer T2. A first control network for tube GT2 includes its control electrode 7, the secondary winding 36, inductor 23, and resistors 24 and 25. Hence, the tube GT2 and its associated apparatus constitutes a second sensitive relay device. The photocell P2 has its two electrodes 19 and 21 connected with the anode 6 and grid 7 of the tube GT2, respectively, and constitutes a second control element for that tube. The parts associated with the tube GT2 are so proportioned and adjusted that with the cell P2 illuminated, the tube GT2 passes current between its anode 6 and

cathode 8 and the relay R2 is energized. When the cell P2 is dark, the tube GT2 ceases to pass current and the relay R2 is deenergized. In the case of the cell P2, however, no condenser similar to the condenser C¹ associated with the cell P1 is provided and hence the relay R2 is immediately released upon the intercepting of the light beam to the photocell P2.

Two stick relays R3 and R4 are controlled by the relays R1 and R2 for registering whether the time interval between the intercepting of the two light beams by a railway car is greater than or less than a predetermined time interval. Relay R3 is provided with a pickup circuit extending from the B terminal of any convenient source of current, such as a battery not shown, over back contact 26 of relay R2, back contact 27 of relay R1, back contact 28 of relay R4, winding of relay R3, and to the opposite terminal C of the same source of current. Relay R3 is also provided with a stick circuit extending from the B terminal of the current source over a manually controlled contact PB1, front contact 29 of this relay, and the winding of that relay to the C terminal of the current source. The relay R4 is provided with a pickup circuit that extends from the B terminal of the current source over back contact 26 of relay R2, front contact 30 of relay R1, winding of relay R4 and to the opposite battery terminal C. A stick circuit for relay R4 extends from the B terminal of the source of current over a manually controlled contact PB2, front contact 31 of relay R4, and the winding of that relay to the C battery terminal. It will be seen, therefore, that normally both relays R3 and R4 are deenergized, relay R3 is picked up when the relay R2 is released providing relays R1 and R4 have previously been released also, and relay R4 is picked up when relay R2 is released providing relay R1 is still retained energized. Relays R3 and R4 when once picked up are retained energized until released through the medium of the respective manually controlled contact.

Traffic governing mechanisms are controlled by the relays R3 and R4. As shown in the drawing, the relay R3 governs an operating circuit easily traced for a mechanism M1 and which includes its front contact 32, and governs an operating circuit for a second mechanism M2 which includes its back contact 33. In a like manner, the relay R4 governs an operating circuit for a mechanism M3 at its front contact 34 and a circuit for a second mechanism M4 at its back contact 35. These traffic governing mechanisms may be signals, switch operating mechanisms, car retarders, etc. The specific form of the mechanisms controlled by the apparatus of my invention forms no part of my present invention, and they are shown conventionally only in the drawing for the sake of simplicity.

I shall now describe the operation of the apparatus. At K is shown diagrammatically a railway car which I shall assume to be advancing in the normal direction of traffic. I shall further assume that condenser C¹ is set at a predetermined value. As soon as the head end of the car K intercepts the light beam from the unit L1, the photocell P1 will be obscured. The grid-glow tube GT1 will not, however, at once cease to pass current due to the influence of the condenser C¹, and hence relay R1 will not at once be released. In the meantime, the car K will advance and its head end will subsequently intercept the light beam from the unit L2 and the photocell P2 will be obscured. Immediately following the inter-

cepting of the light beam from unit L2, the relay R2 will be released. The time interval lapsing between the obscuring of the photocell P1 and the obscuring of the photocell P2 will, of course, depend upon the speed of the car, the distance between the two light beams being fixed at what I have previously assumed to be twenty feet. In the event the speed of the car is below a given value and the time lapsing between the intercepting of the two light beams is greater than the period of influence established by the predetermined value set up for the condenser C¹, the relay R1 will release ahead of relay R2, and hence when relay R2 is released, current will flow over the pickup circuit for the stick relay R3 and that relay will be energized. Relay R3 picked up will complete the operating circuit for the mechanism M1. Relay R3 once picked up will be retained energized over its own stick circuit until such time as the manually controlled contact PB1 is operated. As soon as the car K clears the light beams, the two relays R1 and R2 will be reenergized, and hence operation of the contact PB1 will restore the relay R3 to its normal position and reestablish the operating circuit for the mechanism M2. In the event the speed of the car is above the given value and the car intercepts the light beam from the unit L2 before the delay period established by the condenser C¹ has elapsed, the relay R2 will be released before relay R1. Under this condition, current will flow over the pickup circuit for the relay R4 and that relay will be energized. Relay R4, when picked up, establishes the operation circuit for the mechanism M3 to operate that mechanism. The stick circuit for the relay R4 retains this relay energized after the car has cleared the light beams and the relays R1 and R2 have both been reenergized. Subsequent operation of the manually controlled contact PB2 will restore relay R4 to its normal position and reestablish the circuit for the mechanism M4. It follows from the foregoing description that if the speed of the car K is below a given value, the relay R3 will be selected and the corresponding mechanisms M1 and M2 will be operated, and if the speed of the car is above the given value, relay R4 will be selected and the mechanisms M3 and M4 controlled. The normal condition of the mechanisms will be restored subsequently to the passing of the car through the medium of the manually controlled contacts PB1 and PB2. It is clear that condenser C¹ being adjustable, the apparatus can quickly and readily be set for different speeds.

Although I have herein shown and described but one arrangement of speed responsive apparatus embodying my invention, it is understood that the sensitive relay devices controlled by the photocells P1 and P2 may be used to automatically govern mechanisms in response to the movement of vehicles and objects other than a railway car.

Although I have herein shown and described only one form 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 traffic path, a vehicle adapted to travel along said traffic path, a traffic governing mechanism, a relay for governing the operation of said mechanism, a first and a second grid-glow tube, means for impressing alternating voltage on the anode and grid of each of said

tubes, a first and a second light sensitive unit connected across the anode and grid of said first and second tube respectively and effective to control the passage of current therethrough in response to illumination of the associated unit, two light beams disposed along the path a predetermined distance apart and adapted to normally illuminate said first and second light sensitive units respectively but to be successively intercepted by the vehicle moving along said path, a condenser connected across the anode and grid of said first tube and effective to continue the passage of current through said tube a predetermined time interval after the light beam to said first unit is intercepted, and means controlled jointly by said first and second tubes for controlling said relay.

2. In combination, a traffic path, a vehicle adapted to travel along said traffic path, a traffic governing mechanism, a relay governing the operation of said mechanism, a first and a second grid-glow tube, means for impressing alternating voltage on the anode and grid of each of said tubes, means connected with the anode and grid of each tube for controlling the grid voltage of the tube including a light sensitive unit and effective to establish passage of current through the tube in response to illumination of said unit, a first and a second light beam disposed along the path a predetermined distance apart and adapted to normally illuminate the light sensitive unit associated with said first and second tubes respectively but to be successively intercepted by the vehicle moving along said path, a condenser connected across the anode and grid of said first tube and effective to continue the passage of current through said tube a predetermined time interval after said first light beam is intercepted, and means controlled jointly by said first and second tubes for controlling said relay.

3. In combination, a traffic path, a vehicle adapted to travel along said path, a first and a second light sensitive unit disposed along said path a predetermined distance apart, two light beams disposed along said path and adapted to normally illuminate said two units respectively but to be successively intercepted by the vehicle moving along the path, a first and a second grid-glow tube, a first and a second circuit means associated with said first and second tube respectively and each effective to impress alternating voltage on the grid and anode of its respective tube, means to connect said first and second light sensitive unit with said first and second circuit means respectively to govern the grid voltage of the tube and effective to establish passage of current through the tube in response to illumination of the unit, a condenser connected with said first circuit means and adapted to be charged when said first unit is illuminated and to discharge when said unit is dark to retain said first tube in a condition to pass current a predetermined time interval, a first and a second relay controlled by said first and second tubes respectively, and a traffic governing mechanism controlled by said relays.

4. In combination, a mechanism to be operated, a relay for controlling the operation of said mechanism, means including an electric-discharge device having an anode, a cathode and a grid; a source of current; an output circuit for said electric-discharge device including said source of current, the anode, the cathode and said relay; a first control means including an inductor and a resistor serially connected across said current

source, and a grid leak connected between the common terminal of said inductor and resistor and the grid of said device; a second control means including a light sensitive cell and connected between the anode and grid of said device, said first and second control means effective to establish a flow of current in the output circuit in response to illumination of said cell, means including a condenser connected across said cell and adapted to charge the condenser when the cell is illuminated and to discharge said condenser into said first control means when the cell is dark, said means effective to maintain the flow of current in the output circuit a predetermined time interval after said cell is rendered dark, and a light beam adapted at times to illuminate said light sensitive cell.

5. In combination; a grid-glow electric-discharge device having an anode element, a cathode element and a control element; a source of electromotive force, means for constantly impressing the electromotive force across said anode and cathode, a first control means including a reactor and a resistor serially connected across said source and a grid-leak resistor connected between the common terminal of the reactor and resistor and said control element, said first control means effective to prevent the passage of current between said anode and cathode, a second control means connected across said anode and control element including a photocell effective to establish a flow of current between said anode and cathode in response to illumination of said photocell, a condenser connected in parallel with said photocell adapted to be charged when said cell is illuminated and to discharge into said first control means when said cell is obscured, said condenser effective to delay the first control means in stopping the flow of current between said anode and cathode a predetermined time interval, and an electroresponsive means energized by the current passed between said anode and cathode of the electric-discharge device.

6. In combination, a traffic path, a vehicle adapted to travel on said path, a first means including a source of current and a first electric-discharge device having main electrodes and a control electrode, a second means including a source of current and a second electric-discharge device having main electrodes and a control electrode, a first and a second relay; a first output circuit including the main electrodes of the first electric-discharge device, the associated current source and said first relay; a second output circuit including the main electrodes of the second electric-discharge device, the associated current source and the second relay; a first and a second light sensitive cell, a first control circuit including the first light sensitive cell and the control electrode of said first discharge device and effective to establish a flow of current in said first output circuit when said first cell is illuminated, a second control circuit including the second light sensitive cell and the control electrode of the second discharge device and effective to establish a current flow in the second output circuit when said second cell is illuminated, a first and a second light beam disposed along said traffic path a predetermined distance apart and adapted to normally illuminate said first and second light sensitive cells respectively but arranged to be successively intercepted by the vehicle moving along the path, a plurality of mechanisms controlled by said relays, and means including a condenser connected across said first cell and effective to

continue the established flow of current in the first output circuit a predetermined time interval after said first cell is obscured, whereby said mechanisms are selectively controlled in accordance with whether or not the speed of the vehicle is greater than or less than a given value.

7. In combination, a traffic path, a vehicle adapted to travel along said path, a plurality of traffic governing mechanisms, a first and a second relay for controlling said mechanisms, a first and a second light sensitive device effective to energize said first and second relays respectively when illuminated and to deenergize said relays when dark, a first and a second light beam disposed along said traffic path a predetermined distance apart but arranged to be successively intercepted by the vehicle moving along said path, said light beams adapted to normally illuminate the first and second light sensitive devices respectively, and a condenser connected across the first light sensitive device and effective to retain said first relay energized a predetermined time interval after the light beam to said first light sensitive device is intercepted, whereby said mechanisms are selectively controlled by said relays in accordance if whether or not the speed of the vehicle is greater than or less than a given value while it passes over said predetermined distance.

8. In combination, a traffic path, a vehicle adapted to travel along said path, a first light sensitive cell located along the path, a first means controlled by said first cell and including a first contact which is closed when the cell is illuminated and a second contact which is closed when

the cell is dark, a second light sensitive cell located along the path, a second means controlled by said second cell and including a contact which is closed only when the cell is dark, two stick relays R3 and R4; a pickup circuit for relay R3 including said contact of the second means, the second contact of said first means and a back contact of relay R4; a stick circuit for relay R3 including a first manually controlled contact; a pickup circuit for relay R4 including the contact of said second means and the first contact of said first means, a stick circuit for relay R4 including a second manually controlled contact, a plurality of mechanisms controlled by said stick relays, a first light beam disposed along said path and adapted to normally illuminate said first cell but arranged to be intercepted by the vehicle moving along the path, means including a condenser cooperating with said first cell and effective to retain the first contact of said first means closed a predetermined time interval after said cell is rendered dark, a second light beam disposed along the path a predetermined distance in advance of the first beam but arranged to be intercepted by the head end of the vehicle before the rear end of the vehicle clears the first beam and said second beam adapted to normally illuminate said second cell, whereby said relays R3 and R4 are selected in accordance with whether or not the speed of the vehicle is greater than or less than a predetermined value and are restored to their normal position by said manually controlled contacts.

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