April 25, 1944. T. B. HOLLIDAY 2,347,194

TRAFFIC CONTROL DEVICE

Filed Aug. 31, 1940 2 Sheets-Sheet 1

Fig. 1

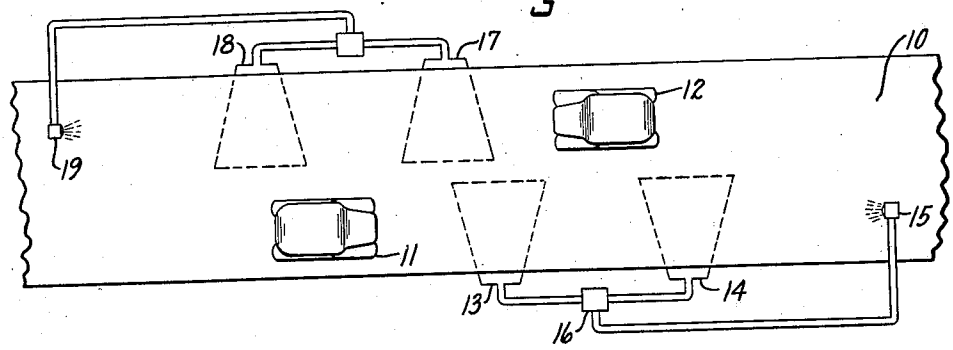


Fig. 2

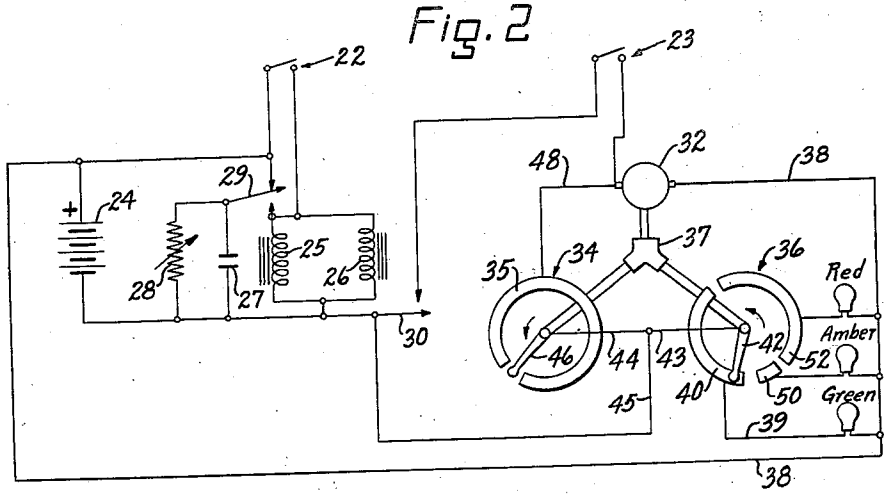
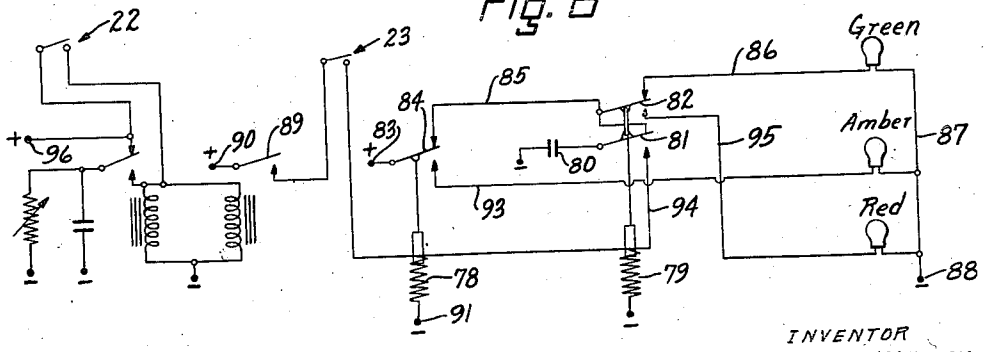


Fig. 6



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TRAFFIC CONTROL DEVICE

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Fig. 3

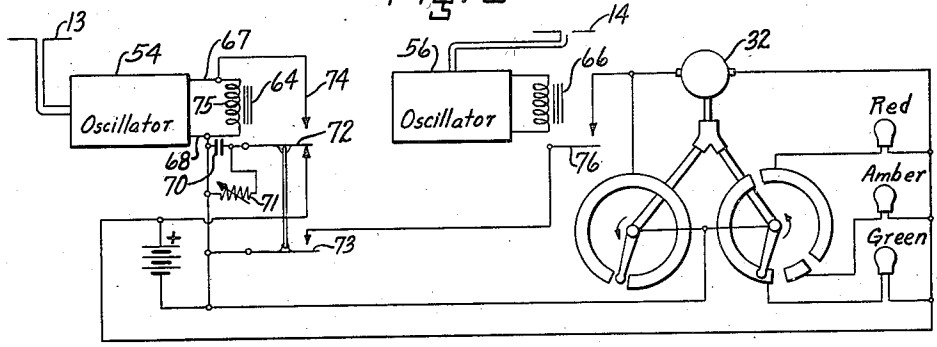


Fig. 4

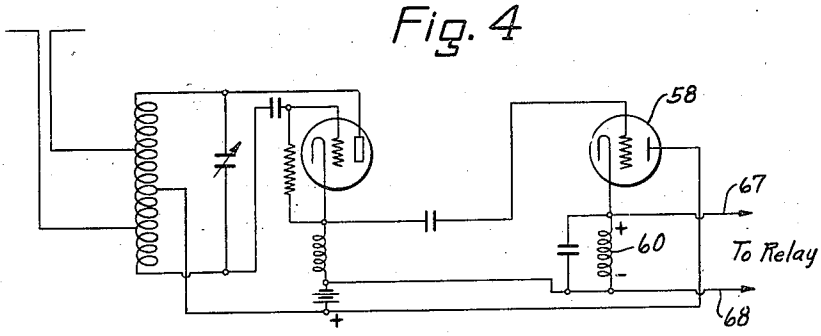


Fig. 5

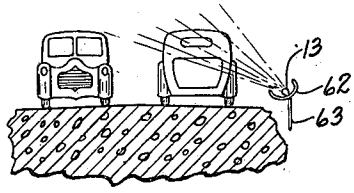
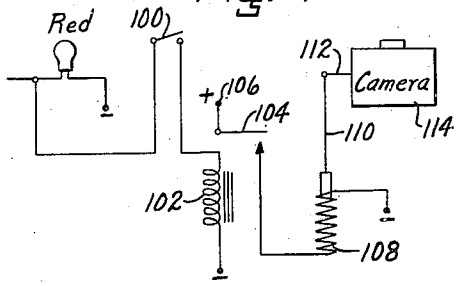


Fig. 7



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UNITED STATES PATENT OFFICE

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TRAFFIC CONTROL DEVICE

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Application August 31, 1940, Serial No. 354,985

6 Claims. (Cl. 177—337)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to traffic control apparatus and in particular to a traffic control signal operative in response to predetermined excessive speeds of vehicular traffic.

It is an object of the invention to provide means responsive to the passing of a vehicle travelling at a rate in excess of a predetermined value for actuating a signal device for indicating the speed of said vehicle.

It is a further object of the invention to provide a vehicular speed responsive device, as above described, which is operatively associated with a traffic signal so as to cause the traffic signal to consecutively progress from the "green" or "proceed" signal through the "amber" or "caution" signal, to the "red" or "stop" signal, and back again to "green."

It is still another object of the invention to provide a device of the above described type having operatively associated therewith means for reporting violations of the stop signal, or, if desired and feasible in operation, the actuation of more effective traffic control means, such as bars or gates, in response to violations by said vehicle of the stop signal.

It is another object of this invention to provide a novel means for determining the passing of two consecutive points by an object during an interval of time less than a predetermined amount.

It is still another object of this invention to provide novel means for actuation of a sequence of traffic signals in response to a given stimulus, such as a predetermined excessive speed.

The invention in general contemplates the provision of two spaced detectors sensitive to the passing of a vehicle or other object. Associated with the detectors is a timing device for determining the passing of the object between said two points during an interval of time less than a predetermined amount. The timing device includes a condenser associated with the first detector and arranged in a circuit so as to receive a charge, and employ said charge to hold a relay circuit closed for a predetermined interval of time. In the event the vehicle or other object crosses the point at which the second detector is located prior to the expiration of said predetermined interval, there is closed a circuit which will actuate a signal or other responsive means for whatever purpose it may be desired to employ same.

With these and incidental other objects in view, the invention includes certain novel features of construction and combinations of parts, the essential elements of which are set forth in appended claims and a preferred form or embodiment of which is hereinafter described with reference to the drawings which accompany and form a part of this specification.

In the drawings:

Fig. 1 is a diagrammatic view showing the general arrangement and plan of functioning of the invention.

Fig. 2 is a schematic circuit drawing of a simplified form of the invention.

Fig. 3 is a schematic circuit drawing of a preferred embodiment of the invention.

Fig. 4 is a circuit drawing of the oscillator used in Fig. 3.

Fig. 5 is a diagrammatic view of the arrangement of the di-pole antennae so as to cause the radio field to be intercepted only by cars on the side of the road in which the traffic is being regulated.

Fig. 6 is a schematic circuit diagram showing a modification of the invention wherein the time cycle of the lights is regulated by condenser action.

Fig. 7 is a schematic circuit diagram showing an apparatus responsive to a violation of a "stop" signal for photographing the offending vehicle.

Description

The general plan of the traffic control device is shown diagrammatically in Fig. 1, wherein reference numeral 10 designates a portion of a highway with automobiles 11 and 12 traveling in opposite directions. On the right side of the road as to automobile 11, are placed detectors 13 and 14, preferably spaced apart slightly more than the length of the automobile but not so far that a second moving vehicle would likely come within the field of the first detector before the first vehicle had entered the field of the second detector. A traffic control light 15 having a green, amber and red light, or other stop, caution and proceed signalling device, is suitably mounted in the highway in full view of automobile 11, but shielded against traffic coming in the opposite direction. Detectors 13 and 14 are connected to the timing device 16 which is connected with the traffic control light 15 and operates to turn the light from green, to amber, to red when the automobile 11 enters the

field of detector 14 in less than a predetermined time after entering the field of detector 13, and after holding the light red for a proper time, to return the light to green.

Similarly, detectors 17 and 18 operate to control traffic light 19 when vehicle 12 travels the distance between detectors 17 and 18 in less than the predetermined time.

As illustrated, detectors 13, 14, 17 and 18 are the di-pole antennae type used with ultra-high frequency oscillators, as are more specifically hereinafter described in connection with Figs. 4 and 5. They are adjusted and "screened" as shown in Fig. 5, so as to generate a radio field (shown in the dotted lines) which is effective for only one-half the width of the roadway.

Referring to Fig. 2, the invention as illustrated therein will be seen to comprise a pair of detectors 22 and 23 of the contact type spaced about four feet apart, or close enough for the front wheels to cross both contacts before the rear wheels reach the first detector. These detectors are connected in a timing circuit so as to actuate a signalling device and circuit when a vehicle intercepts the second detector 23 in less than a predetermined interval of time after intercepting the first detector 22.

A battery 24 supplies energy for both the timing circuit and the signalling device. The timing circuit consists of a pair of relays 25 and 26 in parallel connection, a condenser 27 and a variable resistance 28. The relays have spring actuated arms, or other means, for urging them normally open. The condenser and resistance are in parallel connection, and arranged so that the condenser is receiving a charge from the battery during inaction of the device. Upon the closing of the contact at the first detector 22, current flows through the relays 25 and 26, closing the arms 29 and 30. When arm 29 is closed, the circuit from the battery to the condenser is opened and a circuit is made through the arm from the condenser to the relays. In this way the condenser discharges through the relays and thereby causes the arms 29 and 30 to be held closed for a period of time corresponding to the time required for the condenser to discharge the energy stored therein to the point where the current flowing is no longer sufficient to hold the relay arms closed. The length of time which is required for the condenser to discharge can be varied by means of the variable resistance 28 in parallel arrangement with the condenser. By decreasing the resistance the time is decreased, and vice versa. The time is set at the value which will be required for an object or vehicle to traverse the distance from detector 22 to detector 23 at the greatest rate of speed considered proper or allowable.

When the vehicle passes contact 23, the circuit is closed from the battery 24 to the motor 32 in the signalling device circuit, provided the relay arm 30 is still closed. This means that if the vehicle has passed from detector 22 to detector 23 in less time than the time required for the condenser to discharge—which time equals a speed predetermined to be excessive—the signalling device will be put in operation because the arm 30 will still be held closed at the time when the vehicle passes the second detector 23. However, if the vehicle were traveling at a slower speed so that more time would have elapsed than that required for the condenser 27 to discharge, then the arm 30 would have opened and the contact of the second detector would be ineffective to close the circuit from the battery to the motor 32.

Considering now the signal device circuit, it will be seen to comprise the motor 32, a green, amber, and red light, and a pair of rotary switches 34 and 36 connected to the motor through a reduction gear 37. These rotary switches are of the well-known type having conducting arcuate segments and conducting switch arms. Rotary switch 36 serves to make up the respective circuits for the green, amber and red lights, and rotary switch 34 makes up the circuit for operation of the motor 32 during all but a small arc of the circle in which position the switch 34 is inoperative to supply current to the motor. In this position the motor can be actuated only by the circuit made up through relay arm 30 and the detector 23.

The operation of the signalling device circuit is as follows: Normally, and in the position shown, the motor and rotary switches are at rest and the circuit is made up from the battery to the green light through conductor 38 and from the green light back to the battery through conductor 39, switch segment 40, switch arm 42 and conductor 43—45. As above explained, no current is being supplied to the motor for these switches are at rest in the inoperative position of switch 34. When relay arm 30 is closed due to actuation by means of the first detector and then when the contact 23 at the second detector is closed while relay arm 30 still remains closed, a circuit is completed from the battery through the motor 32. This causes the motor to rotate, rotating both switch arms 42 and 46 counterclockwise, as illustrated. The segment 35 of switch 34 is so constructed that the momentary closing of contact 23 will cause the motor to rotate the switch sufficiently that the arm 46 will make contact with the segment 35. Thereafter, even though the circuit through relay arm 30 and contact 23 is opened, a closed circuit for the motor is provided through conductor 38, conductor 48, segment 35, switch arm 46, and conductor 44—45. Since both rotary switches operate in unison, the switch arms 42 and 46 will be rotated counterclockwise for the portion of the circumference represented by segment 35 of switch 34, at which point the switch arm 46 will again come to the open portion of the circle and open the circuit to the motor. During this same period of revolution, switch arm 42 of switch 36 successively makes contact with segment 50, opening the circuit through the green light and making a circuit through the amber light. Then contact is made with segment 52, opening the circuit through the amber light and making the circuit through the red light for a large portion of the revolution. The segments of the switches are so arranged that when the switch arm 46 of the motor controlling switch reaches the open portion, the switch arm 42 of the light cycle switch will come to rest on the extreme end of segment 40 making the circuit for the green light. It will be obvious that the length of time that the amber and red lights are on is governed by the length of the segments and the speed of rotation of the rotary switch arms. The segment 40 for the green light, as illustrated, is made approximately the size of the segment for the red light, so that in the event it was desired to space the detectors farther apart and they were so spaced that the wheels of one car might rest on one detector while the wheels of a second car were resting on the

relay arms 81 and 82 are still closed. This opens the circuit to the amber light and closes the circuit from terminal 83 to the red light through relay arm 84, conductor 85, relay arm 82 and conductor 95. When the condenser 80 has discharged to a point where its potential is equal to the potential value at which relay 79 drops out, the circuit to the red light is opened and the circuit to the green light is again completed.

It will be understood that a single source of current such as a battery might be used to operate the current for all three positive terminals 83, 90 and 96, and that all the negative terminals could be connected to the negative pole of the battery. In this case, the electrical characteristics of the lights would be the governing factor in the potential of the battery, and the relays and condensers would have to be selected with appropriate values to operate at the potential and current required for the lights. On the other hand, separate sources of potential could be supplied for each of the terminals 83, 90 and 96, in which case the values of the lights and relays would be governed with respect to the source of potential only which was energizing them.

It will be understood that in lieu of either the electrical contact type detector, or the oscillator antennae type detector, described in the foregoing modifications of the invention, that any satisfactory type of detector can be used, such as photoelectric cells, hydraulic or compressed air tubes, or mechanical means, and that the use of any suitable detector is to be considered as coming within the scope of this invention.

It may be desirable under certain conditions of operation and use of the invention, to associate with the traffic light or other traffic control indicating means, a further device for more effectively controlling the traffic, such as a bar or gate, or a device for recording an offending vehicle, such as a camera or a recordograph, or a violation reporting signal, which devices will be actuated by the act of the vehicle in violating the "stop" signal. This can be accomplish d by the use of a third detector located adjacent the proper line on the highway at which the vehicle should stop in response to the "stop" signal. The third detector may be any of the types described or mentioned heretofore, and will be arranged to complete an electrical circuit or other source of energy connection to the device to be operated, just as shown and described in connection with the operation of the traffic signalling devices in the modifications hereinbefore described. Action of the bar, gate, or camera, will be effected by offending vehicles only, by means of a contact which is in series connection between the source of energy and the device to be operated, and which contact is associated with the "stop" signal so that it may be closed only during energization of the stop signal. This contact functions much in the same manner as the first detector of Fig. 2, while the third detector used to cause actuation of the bar, gate, or recording or reporting means, functions in the manner of the second detector of Fig. 2.

A camera is useful in this arrangement because it can be used to photograph the passing vehicles which violate the "stop" signal, in such a position that the license number can be obtained, thereby affording the authorities information to aid in enforcing the law.

An application of the invention arranged to operate a camera is shown in Fig. 7, wherein a detector 100 is illustrated in parallel connection with the red light as of the modification shown in Fig. 6. In series with the detector is a relay 102. The relay arm 104 is connected to a positive potential 106 and adapted when closed by the action of a vehicle in closing the contact of detector 100 while the red light is energized to energize a relay 108 whose armature 110 is attached to the trigger mechanism 112 of an automatic reloading camera 114.

If there is sufficient power in the red light circuit to operate the camera trigger mechanism, it will be obvious that the relay arm 104 can be used directly to actuate the trigger and the relay 108 could be eliminated.

It will be understood that any of the other devices mentioned, or any desired device, may be substituted for the camera. One particularly useful application of this circuit in combination with a traffic signalling device, is that it may be connected to operate a bell or other attention commanding instrument when a red light is violated and thereby call the violation to the attention of a law enforcing officer.

Still another application of the invention is the use, in lieu of the traffic signalling device, of a signalling device such as a bell or light operated by the second detector and located at a point where a traffic officer is waiting. The officer, upon getting the signal that the speed limit is being violated, can note the vehicle which has passed the second detector, and immediately take action to apprehend the violator, being fortified with objective evidence of the speed violation.

While the form of mechanism herein shown and described is admirably adapted to fulfill the objects primarily stated, it is to be understood that it is not intended to confine the invention to the forms or embodiments herein disclosed, for it is susceptible of embodiment in various other forms, all coming within the scope of the claims which follow.

What is claimed is:

1. A signalling device having a plurality of signal indications adapted to be operated in a predetermined time interval sequence in response to a given stimulus, said device comprising a source of electrical energy for operating said signal indications, a condenser in circuit connection with said source of energy so as to be normally charged thereby, a plurality of relays adapted to be energized by said given stimulus, said relays having different operating current values and arranged so as to be operative to connect and disconnect said signal indications with said source of energy in said sequence, one of said relays being further effective to open the circuit from said potential to said condenser, and to close a circuit from said condenser to said relays, said condenser having sufficient capacity and said relays having constants such that the discharge of said condenser will maintain each of said relays closed for the interval of time from the initial energization thereof to the expiration of the time sequence of the indication being controlled by each said relay.

2. In a traffic control device, a traffic signal comprising a "proceed" signal indication, a "caution" signal indication, and a "stop" signal indication; a source of energy for actuating said signal indications; switch means for operatively connecting said energy to said signal indications in a predetermined sequence, said switch means comprising a pair of relays normally open and arranged in series to close a circuit in the open position of said relays to energize said "proceed"

other, as during a stop in traffic, and the cycle of the signalling device thereby repeat itself, the light would stay green long enough to enable traffic to get moving.

In this connection, it is to be noted that no confusion will result from the action of the two sets of wheels crossing the contactors. When the front wheels of the vehicle close the contact at detector 22 and then proceed on to detector 23—if this action has occurred in less than the predetermined time—the signalling device will be in operation when the rear wheels cross the contacts at detectors 22 and 23, since the time required for the cycle of operation of the lights is considerably greater than the time required for the complete passing of the vehicle past detectors 23 and 24, and therefore the rear wheels will have no effect on the operation of the device. On the other hand, in the event the front wheels crossed the contact at detector 23, after a greater interval than the predetermined time, they would not be effective to actuate the signalling device, as explained above. For the same reason, the rear wheels would function similarly.

The invention shown in Fig. 3 is similar to that shown in Fig. 2, except that in place of the contact type of detectors, ultra-high frequency oscillators 54 and 56 with di-pole antennae are used for the detectors 13 and 14. The oscillators are of the well-known type for producing a field of radio energy which is radiated through the di-pole antennae. These detectors are preferably spaced apart slightly more than the length of a vehicle, as described in connection with Fig. 1. There is no objection, as in the case of the contact type detectors, from the possibility of two cars coming to rest in a traffic stop and thus continuing to actuate the traffic signal, since the oscillator-antennae type detector functions only in response to the initial impulse generated as the metal object enters the field of radio energy. The circuit of one form of oscillator which may be used is shown in Fig. 4. When a metal object, such as a motor vehicle, intercepts a field of radio energy transmitted by the di-pole antennae, the metal object absorbs the energy and increases the power delivered by the oscillator to the field. This increase in power delivered causes an increase in plate current of the amplifying tube 58 of sufficient amount to cause a relay connected in shunt with an impedance 60 in the plate circuit of said tube to close, thereby causing the relay arm to function in the same manner as the contact switch 22 in Fig. 2.

In order to be responsive or sensitive to a car on the side of the road adjacent the radiator only, a reflector is placed behind the di-pole antennae in a conventional manner for limiting the field to a segment of a circle with the lower edge of the field above the usual height of a vehicle at the midpoint of the road. Such an arrangement is diagrammatically shown in Fig. 5 where 13 is the di-pole antennae and 62 is the reflector mounted on a stake 63.

The relays 64 and 66 shown connected to the oscillators 54 and 56 in Fig. 3 are connected at the points 67 and 68 of the oscillator circuit shown in Fig. 4. The lead 67 is positive with respect to the lead 68 because of the potential drop across the impedance 60. Condenser 70 and variable resistor 71 are arranged and function in exactly the same manner as shown in Fig. 2. Relay arm 72 is normally urged by a spring, or other means, to the open position, and completes a circuit from the battery to the condenser 70 during the period of inaction of the device. When a car passes the detector 13, the relay pulls arm 72 in, opening the circuit from the battery to the condenser and closing the circuit from the condenser through conductor 74 to the plus side of the relay winding 75, thus causing the condenser 70 to discharge through relay 64 for the period of time corresponding to the period required for the energy stored in the condenser to fall below the amount required to hold the arm closed. This relay is of the double throw type having a second arm 73 which makes up the circuit from the negative pole of the battery to the relay arm 76 during the time that the condenser 70 is discharging. If the vehicle passes the detector 14 while the relay arm 73 is still closed, relay arm 76 of relay 66, which is normally spring-urged to the open position, closes in response to the action of oscillator 56, and relay 66 completes the circuit from the battery to the motor 32 and back, thereby energizing the motor and initiating the cycle of operation of the lights as described in Fig. 2.

The modification of the invention shown in Fig. 6 is similar to that shown in Fig. 2 with respect to the timing circuit, except that instead of showing the return electrical paths, only plus and minus terminals are shown. This part of the circuit will not be again described because its arrangement and operation is believed to be obvious from the previous description. However, the signalling device circuit differs from that shown in Figs. 2 and 3 in that the light cycle from green to amber to red, and back to green, is governed by relay actuated switches and a condenser instead of by the motor and rotary switches described in the foregoing modifications. The signalling device circuit includes the green, amber and red lights, a pair of relays 78 and 79, and a condenser 80. Relay 78 is a single arm type and relay 79 is a double throw type having two arms 81 and 82. The relay arms are normally urged to the open position by means of springs. Further description of the circuit will be given in connection with the operation.

A circuit is normally made to the green light from the potential at terminal 83 through relay arm 84, conductor 85, relay arm 82, conductor 86, the light and conductor 87 to negative terminal 88. When the relay arm 89 is closed as a result of actuation by the first detector 22, the circuit is made from terminal 90 to the contactor 23, constituting the second detector. If this contact is actuated by the passing of the vehicle during the time that the relay arm 89 remains closed, the circuit is completed from the potential 90 to the negative terminals 91 and 92 through relay windings 78 and 79. This causes relay arms 84, 81 and 82 to pull in, thereby opening the circuit from the potential 83 to the green light and making up the circuit from potential 83 to the amber light through arm 84 and conductor 93. The circuit from the terminal 83 to the condenser 80 is opened at the same time and the circuit from the condenser through the relay windings is closed by means of relay arm 81 and conductor 94, thereby causing the condenser to discharge through the relay windings, serving to hold the relay arms closed for a period of time longer than that which would be normally caused by the temporary closing of the switch contactor 23. Relay 78 is adjusted to drop out at a higher voltage value than relay 79, so that arm 84 will make contact with conductor 85 during the time that

signal and to close a circuit from a source of potential to a condenser; circuit means responsive to a predetermined stimulus for momentarily energizing said relays to close same whereby said "proceed" signal circuit and said condenser charging circuit are opened and a circuit from said potential to the "caution" signal is closed through the relay first in series with the source of potential and a circuit from said condenser through said relays is made up, said first relay being of such constant that its armature opens at a potential value greater than the potential value at which the other relay opens and thereby opens the circuit from said potential to said "caution" signal and closes a circuit from said potential to said "stop" signal, and the other of said relays which makes up the condenser-to-relay circuit opening when said condenser has discharged to the hold-in potential value of said relay to thereby open said condenser-to-relay circuit and said potential-to-"stop" signal indication circuit and to re-establish in the open position of said relays said potential-to-condenser circuit and said potential-to-"proceed" signal indication circuit.

3. In a traffic control device, a traffic signal comprising a "proceed" signal indication, a "caution" signal indication, and a "stop" signal indication, a source of energy for actuating said signal indications, switch means for operatively connecting said energy to said indication means in a predetermined sequence, a motor for operating said switch means, a source of energy for said motor, a second switch means for connecting said source of energy to said motor during the portion of the cycle of operation of said signal indications corresponding to the cycle of operation for said "caution" and "stop" signal indications, and circuit means responsive to a predetermined stimulus while said traffic signal is indicating "proceed" to connect said motor with said source of energy through a third switch means for initiating the sequence of operation of said first-mentioned switch means.

4. In a highway traffic control device operative to provide a "stop" signal in response to predetermined excessive speeds of a traffic instrumentality, and being associated with a designated point in said highway beyond which said traffic instrumentality is forbidden to proceed by said "stop" signal, means responsive to a violation of said "stop" signal, comprising a detector arranged to be sensitive to the passing of said traffic instrumentality beyond the point forbidden by said signal, automatic self-loading camera trained on the view immediately beyond said forbidden point in said highway so as to record the identity of said traffic instrumentality, upon actuation thereof, a source of electrical energy, power means adapted to be operatively connected to said source of energy by said detector for actuating said camera, and means associated with said "stop" signal for rendering said detector effective to energize said power means during operation of said "stop" signal.

5. The combination with a traffic control device operative to provide a "stop" signal in response to predetermined excessive speeds of a traffic instrumentality, of a recording instrument for recording violations of said "stop" signal; detector means associated with said device responsive to a violation of said "stop" signal by such traffic instrumentality; and means actuable by the response of said detector means for initiating operation of said recording instrument

6. The combination with a traffic control device operative to provide a "stop" signal in response to predetermined excessive speeds of a traffic instrumentality, of a camera trained on the area which will be occupied by such traffic instrumentality at the point of violation of said "stop" signal; detector means associated with said device responsive to a violation of said "stop" signal by such traffic instrumentality; and means actuable by the response of said detector means for operating said camera so as to record the identity of said offending traffic instrumentality.

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