

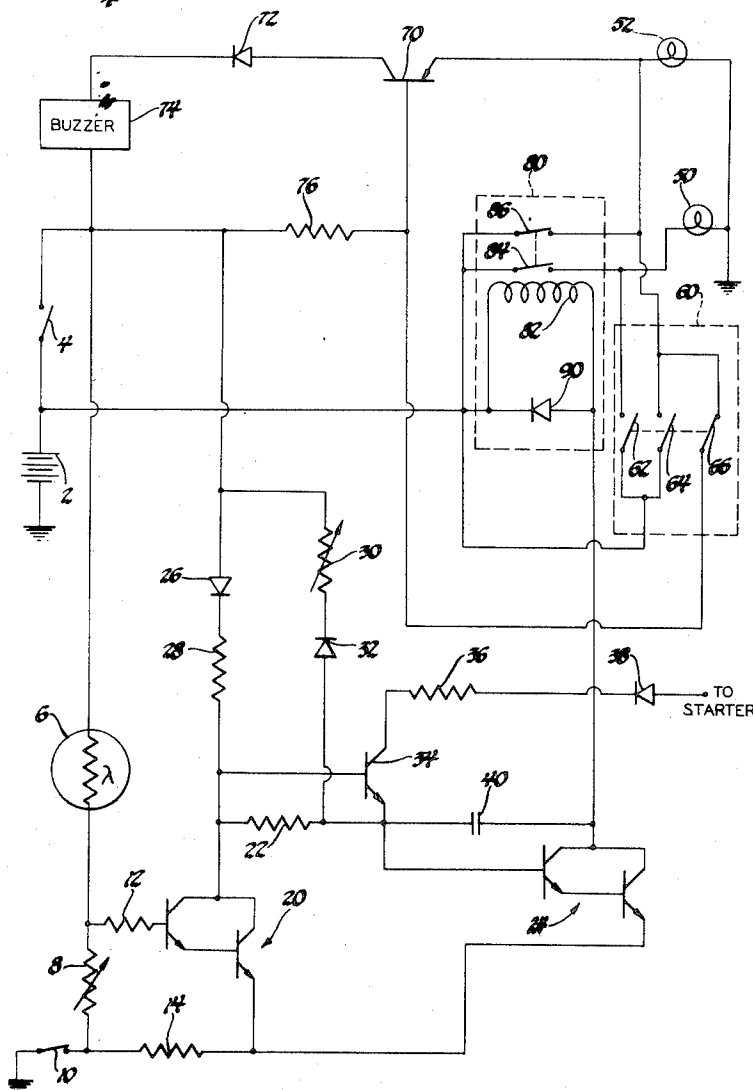
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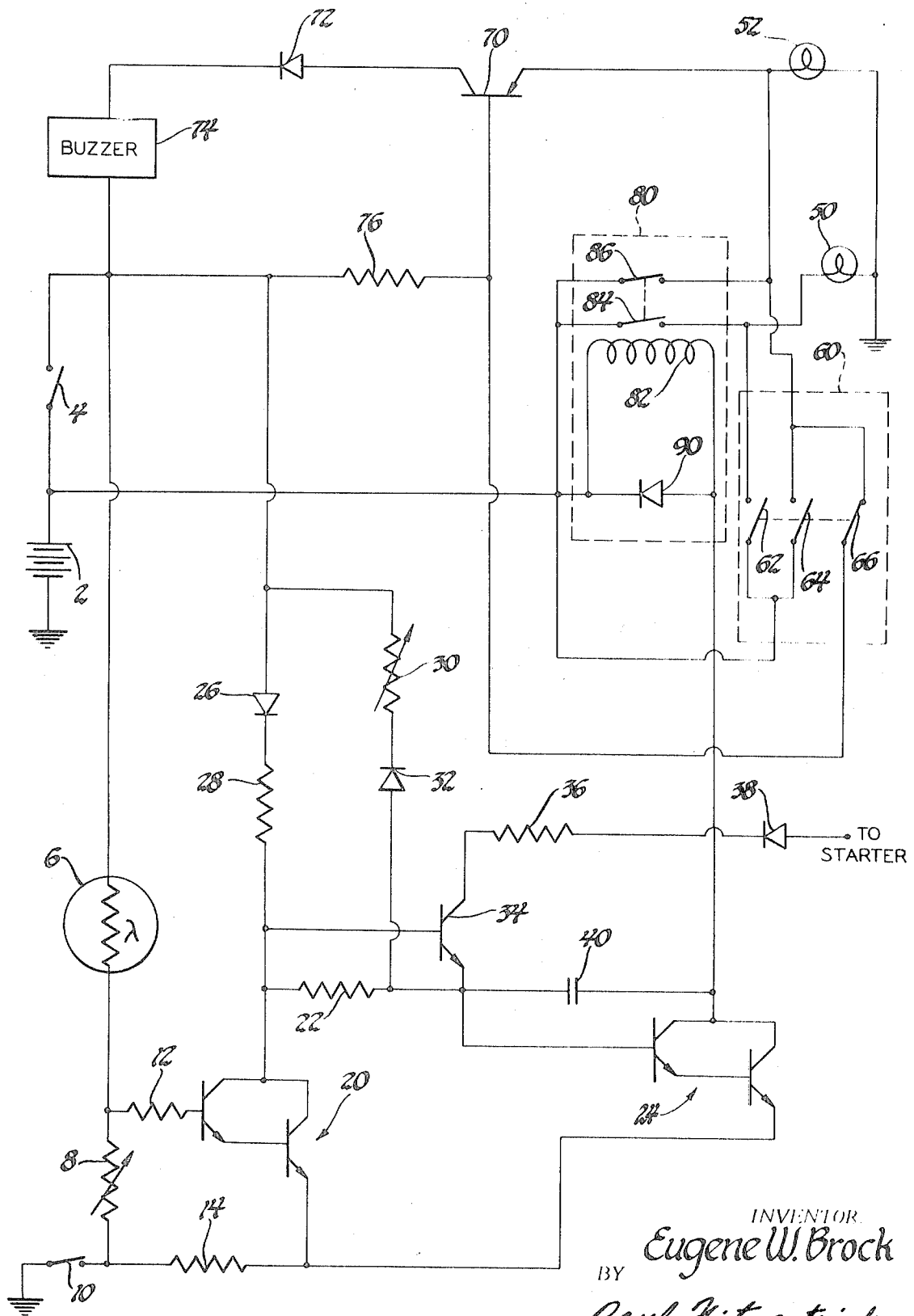
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[54] **HEADLAMP CONTROL MEANS WITH TIME DELAY**
4 Claims, 1 Drawing Fig.

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315/134, 315/159
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H05b 37/02
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134, 159

ABSTRACT: A vehicle lamp control system which, with the ignition switch closed, automatically energizes the lamps after a first time delay in darkness and deenergizes the lamps after a second time delay in light and, in darkness, automatically deenergizes the lamps after a third time delay when the ignition switch is opened and energizes the lamps after a fourth time delay when the ignition switch is closed. The time delay circuit consists of a capacitor and a plural number of resistors. The lamp switching circuit also controls the time delay circuit by connecting a different resistor with the capacitor in an RC timing circuit to produce each time delay.





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HEADLAMP CONTROL MEANS WITH TIME DELAY

This invention relates to light-sensitive control means and more particularly to light-sensitive control means for automotive lighting systems which incorporate a time delay section to maintain the lighting system energized for a predetermined adjustable time period after the ignition circuit of the vehicle upon which it is mounted has been switched off.

Light-sensitive control systems on automotive vehicles often contain elements to introduce a time delay to the energization of deenergization of the headlamps. This time delay prevents undesirable switching caused by momentary changes in ambient light conditions such as would result from the approaching high-beam headlamps of another vehicle at night or a shade-producing bridge or short tunnel during the day. The time delay element is generally an RC timing circuit which consists of a capacitor charged or discharged through a resistor to produce a delay in the change of electrical potential at some point in the lamp switching circuit. Some vehicles with light-sensitive control systems for their headlamps also possess means to hold their headlamps in the energized state in darkness for a fixed period of time after the vehicle ignition switch has been opened. The time delay means here also uses a capacitor charged or discharged through a resistor. Since separate time delay periods have often been desired for headlamp energization, headlamp deenergization and headlamp deenergization after the opening of the ignition switch, up to this time at least two capacitors have been used to produce the three required time delay periods. However, since both the cost and size of transistors have been greatly decreased in recent years, a capacitor large enough to be used in a time delay circuit is now a bulky and comparatively expensive component.

My improved headlamp control system requires only one capacitor to produce the three separate time delay periods mentioned above. It makes use of the headlamp switching components themselves to connect one of three or four separate resistances in series with the capacitor during switching.

It is an object of this invention to provide a new and improved headlamp control system.

It is another object of this invention to provide a novel headlamp control system providing light-sensitive vehicle lamp energization with a first time delay, light-sensitive deenergization with a second time delay and ignition voltage sensitive deenergization with a third time delay.

It is a further object of this invention to provide such a circuit using one capacitor to produce the three different delay periods.

The FIGURE is a circuit diagram of a headlamp control system for vehicle lighting circuits embodying my invention.

Referring now to the FIGURE, my system obtains electrical power from the standard vehicle battery 2, which provides electrical current at a substantially constant voltage. One side of the vehicle battery is grounded, and the other is connected to the vehicle ignition switch 4. The side of the ignition switch not connected to the battery will be called the ignition side of the ignition switch; and to it is connected the vehicle's ignition system, which is not shown in the figure. From the ignition side of the ignition switch, a light-sensitive cell 6, a variable resistor 8 and on/off switch 10 are connected in series to ground. The light-sensitive cell 6 is a device whose resistance varies inversely with the amount of light to which it is exposed; and it is mounted upon the vehicle in such a manner that it is exposed to the ambient light in the immediate vicinity of the vehicle. In conjunction with battery 2, the light-sensitive cell 6 and the variable resistor 8 form a voltage divider, the midpoint of which is connected through resistor 12 to the base electrode of transistor switch 20. Transistor switch 20 can be two transistors connected in Darlington configuration, but here it is a single semiconductor device having electrical characteristics of a Darlington connected transistor pair. The collector of transistor switch 20 is connected through resistor 22 to the base of transistor switch 24, which is identical to transistor switch 20. The emitters of transistor switches 20 and 24 are

both connected through resistor 14 and on/off switch 10 to ground. From the ignition side of the ignition switch, a diode 26 and a resistor 28 are connected in series with the collector of transistor switch 20. Also, from the ignition side of the ignition switch, a variable resistor 30 and a diode 32 are connected in series to the base of transistor switch 24. To the collector of the transistor switch 20 is connected the base of transistor 34. Transistor 34 has its emitter connected to the base of transistor switch 24 and its collector connected through resistor 36 and diode 38 to the vehicle starter. Across the base-collector junction of transistor switch 24 is connected capacitor 40.

The vehicle has mounted on it headlamps which are represented in the figure by headlamp 50. The vehicle also has mounted on it tail lamps which are represented in the figure by tail lamp 52. The vehicle has a manual headlamp switch 60 which includes ganged switch arms 62, 64 and 66. Power is supplied to the headlamps 50 and the tail lamps 52 from the battery 2 through switch arms 62 and 64, respectively, when they are closed. Switch arm 66, however, is closed only when switch arm 62 and 64 are opened; and it connects tail lamp 52 to the base of the transistor 70. Transistor 70 has its emitter connected to the tail lamp 52 and its collector connected through diode 72 and a buzzer 74 to the ignition side of the ignition switch 4. Resistor 76 connects the ignition side of the ignition switch 4 to the base of transistor 70.

The circuit contains a power relay 80 which includes a coil 82 connected between the battery 2 and the collector of transistor switch 24 and also includes armatures 84 and 86, which supply power from the battery 2 to headlamp 50 and tail lamp 52, respectively, when closed. Connected from the battery 2 to the collector of transistor switch 24, in parallel with relay coil 82, is a diode 90.

Now the operation of the circuit will be described. When the driver wishes to operate the vehicle he first closes the ignition switch 4. Battery voltage is now supplied to the voltage divider formed by light sensitive cell 6 and variable resistor 8 and to the collectors of transistor switches 20 and 24. Assuming the light sensitive cell 6 to be initially in high ambient light, its resistance will be low; and the voltage at the base of transistor switch 20 will thus be high enough to drive transistor switch 20 on into saturation. Since resistor 14 is very small compared with resistor 28, the emitter of transistor switch 20, and thus its collector also will be held at a value just above ground potential. Since no current can flow at this time through the reverse-biased diode 32, there will be no voltage drop across resistor 22, and the low voltage at the base of transistor switch 24 will bias that transistor switch in the off condition. Therefore no current will flow through relay coil 82; armatures 84 and 86 will remain open; and the headlamp 50 and tail lamp 52 will remain deenergized unless energized by the manual headlamp switch 60.

If the ambient light level around the vehicle is reduced, the resistance of the light-sensitive cell 6 increases and the voltage on the base of transistor switch 20 decreases. If this action is continued, the cutoff point of transistor switch 20 is eventually reached. Transistor switch 20 attempts to cut off; and the rising collector voltage of transistor 20 tends to turn transistor switch 24 on. Regenerative feedback occurs in the form of increased current from the transistor switch 24 through resistor 14, which reinforces the turnoff action of transistor switch 20 and tries to cause an abrupt change of state in the two transistor switches 20 and 24. However, capacitor 40 and resistors 22 and 28 form an RC timing circuit to delay the switching of transistor switch 24. The presence of capacitor 40 across the base-collector junction of transistor switch 24 prevents the complete switching of transistor switch 24 until the capacitor 40 can discharge through diode 26 and resistors 22 and 28. Diodes 32 prevents current flow through variable resistor 30. The gradually increasing current through transistor switch 24 also flows through coil 82 and at some point causes the ganged armatures 84 and 86 to be closed and energize the headlamp 50 and tail lamp 52, respectively. Since

the resistance of resistor 28 is much larger than resistance of resistor 22, it is resistor 28, in conjunction with capacitor 40, that determined the length of the time delay period for headlamp energization.

If the ambient light striking the light-sensitive cell 6 is now increased, the resistance of light-sensitive cell 6 is diminished; and the voltage at the base of transistor 20 increases. At some point transistor switch 20 will begin to conduct, and its collector voltage will start to fall. This will cause the base voltage of transistor switch 24 to fall toward cutoff. As transistor switch 20 begins to conduct while transistor switch 24 is still conducting, the current through resistor 14 will once again increase, and transistor switch 24 will be driven even harder toward cutoff. However, before the switching can be completed, the capacitor 40 must now be charged through resistor 22, transistor switch 20 and resistor 14. As the current through transistor switch 24, and thus through relay coil 82, gradually decreases, a point will be reached at which ganged armatures 84 and 86 open and deenergize headlamp 50 and tail lamp 52 respectively. Since the resistance of resistor 22 is much larger than the resistance of resistor 14, it is resistor 22 which, in conjunction with capacitor 40, forms an RC timing circuit to determine the length of the time delay period for headlamp deenergization.

Now assume that the photocell is in darkness, and the headlamp 50 and the tail lamp 52 are energized through the relay 80. Assume further that the driver has reached his destination and is ready to leave his vehicle. When he opens the ignition switch 4, the ignition side of the ignition switch 4 will be grounded through the vehicle accessories. Transistor switch 24 can now no longer obtain base current through resistor 22. In addition, transistor switch 20 is electrically removed from the circuit. However, transistor 24 continues to conduct while the capacitor 40 is charged through a circuit comprising relay coil 82, battery 2, ground, the ignition side of the ignition switch 4, variable resistor 30 and diode 32, which is now forward biased. Diode 26 is now reverse biased so no current flows through resistors 28 or 22. As the current through relay coil 82 gradually decreases, at some point the ganged armatures 84 and 86 open and deenergize headlamp 50 and tail lamp 52. Variable resistor 30, which may be mounted on the dashboard of the vehicle for convenient driver adjustment, and capacitor 40 form another RC timing circuit which determines the third time delay period.

Finally, assume that the driver is starting his vehicle in darkness. He first closes the ignition switch, which supplies battery potential to the base of transistor 34. He then activates the starter, which supplies the necessary voltage and current through resistor 36 to the collector of transistor 34 to drive transistor 34 into saturation. Since resistor 36 is comparatively small, capacitor 40 discharges rapidly through transistor 34 and resistor 36 while the starter is activated, rather than more slowly through resistors 22 and 28. Thus when the vehicle's starter is activated in darkness, capacitor 40 and resistor 36 form an RC timing circuit with a very short time delay and headlamp 50 and tail lamp 52 are energized almost immediately.

Another feature of the system will now be described. The on/off switch 10 enables the driver of the vehicle to disable the automatic switching portion of the system. With the on/off switch 10 open, only the manual headlamp switch 60 will energize the headlamp 50 and tail lamp 52. It may happen that the driver while using the manual headlamp switch, will forget to open the switch and deenergize his headlamp and tail lamp when he leaves his vehicle. Even if the driver notices that the headlamps are on, he may think that there is nothing wrong, since he may have forgotten that the on/off switch 10 is in the open position and that therefore the headlamps will not be turned off automatically after a delay. Therefore, an audible warning circuit is included which will produce an alarm when the manual headlamp switch is left closed and the ignition switch is opened. Transistor 70 is a PNP transistor with its emitter connected to the ungrounded side of the tail lamp 52,

so that it receives emitter bias whenever the tail lamp is energized. The collector of transistor 70 is grounded through diode 72, buzzer 74 and the vehicle accessories when the ignition switch 4 is opened. With these conditions prevailing, the transistor 70 will conduct when its base is grounded. With the manual headlamp switch 60 in the off position, the closed switch arm 66 supplies emitter bias directly to the base of transistor 70 and prevents its conduction. However, if headlamp switch 60 is in the on position, with switch arms 62 and 64 closed, switch arm 66 will be open; and the base of transistor 70 will be grounded through resistor 76 and the vehicle accessories. Transistor 70 will then conduct and supply power to the audible warning buzzer 74. This happens only when the manual headlamp switch 60 is left in the on position and the ignition switch 4 is opened.

My system contains several more features which enhance its usefulness. The time delay periods for headlamp energization and deenergization are constant regardless of the incremental change in ambient light affecting the light sensitive cell 6, since capacitor 40 is not charged or discharged through light-sensitive cell 6 in any of the switching operations. Variable resistor 8 provides means for adjusting the circuit to switch at the desired ambient light intensity. Diode 90 protects transistor switch 24 from voltage transients induced in the relay coil 82; diode 72 protects transistor 70 from ignition voltage when the ignition switch is closed; and diode 38 prevents current flow from the system to the vehicle starter.

It will be recognized by one skilled in the art that I have invented a new and useful headlamp control system. The precise circuit elements and configurations described above are for disclosure purposes only and they are not meant to restrict the scope of the claims which follow.

What is claimed is:

1. A vehicle lamp control system comprising, in combination, vehicle lamps, an electric power source, a vehicle ignition switch, lamp switch means effective to control the supply of power from the power source to the vehicle lamps, light-sensitive switch means responsive to ambient light while the ignition switch is closed to control the lamp switch means to cause the vehicle lamps to be energized in darkness and deenergized in light, a capacitor and a plurality of resistors; the lamp switch means being effective to connect the capacitor and a first resistor in a first RC timing circuit to delay energization of the vehicle lamps and to connect the capacitor and a second resistor in a second RC timing circuit delay deenergization to the vehicle lamps; the lamp switch means also being responsive to the opening of the ignition switch to cause the vehicle lamps to be deenergized and effective to connect the capacitor and a third resistor in a third RC timing circuit to delay deenergization of the vehicle lamps.

2. A vehicle lamp control system comprising, in combination, vehicle lamps, an electric power source, a vehicle ignition switch, lamp switch means effective to control the supply of power from the power source to the vehicle lamps, light-sensitive switch means responsive to ambient light while the ignition switch is closed to control the lamp switch means to cause the vehicle lamps to be energized in darkness and deenergized in light, a capacitor and a plurality of resistors; the lamp switch means being effective to connect the capacitor and a first resistor in a first RC timing circuit to delay energization of the vehicle lamps and to connect the capacitor and a second resistor in a second RC timing circuit to delay deenergization of the vehicle lamps; the lamp switch means also being responsive to ignition switch voltage while the light-sensitive switch means senses darkness to control the lamp switch means to cause the vehicle lamps to be energized when the ignition switch is closed and deenergized when the ignition switch is opened; the lamp switch means being effective to connect the capacitor and a third resistor in a third RC timing circuit to delay energization of the vehicle lamps and to connect the capacitor and a fourth resistor in a fourth RC timing circuit to delay deenergization of the vehicle lamps.

3. A vehicle lamp control system comprising, in combination, vehicle lamps, an electric power source, a vehicle ignition system, lamp switch means effective to control the supply of power from the power source to the vehicle lamps and light-sensitive switch means responsive to ambient light when the ignition switch is closed to control the lamp switch means to cause the vehicle lamps to be energized in darkness and deenergized in light, the lamp switch means including time delay means, said time delay means including a capacitor and first, second and third resistances, the lamp switch means also controlling the time delay means to connect a first circuit to discharge the capacitor through the first resistance to produce a time delay in vehicle lamp energization and a second circuit to charge the capacitor from the power source through the second resistance to produce a time delay in vehicle lamp deenergization; the lamp switch means also being sensitive to the opening of the ignition switch to cause the vehicle lamps to be deenergized and to connect a third circuit to charge the capacitor from the power source through a third resistance to produce a time delay in vehicle lamp deenergization.

4. A vehicle lamp control system comprising, in combination, vehicle lamps, and electric power source, a vehicle ignition system, lamp switch means effective to control the supply of power from the power source to the vehicle lamps and light-

sensitive switch means responsive the ambient light when the ignition switch is closed to control the lamp switch means to cause the vehicle lamps to be energized in darkness and deenergized in light, the lamp switch means including time delay means, said time delay means including a capacitor and first, second, third and fourth resistances, the lamp switch means also controlling the time delay means to connect a first circuit to discharge the capacitor through the first resistance to produce a time delay in vehicle lamp energization and a second circuit to charge the capacitor from the power source through the second resistance to produce a time delay in vehicle lamp deenergization; the lamp switch means also being sensitive to ignition switch voltage while the light-sensitive switch means senses darkness to control the lamp switch means to cause the vehicle lamps to be energized when the ignition switch is closed and deenergized when the ignition switch is open, the lamp switch means being effective to control the time delay means to connect a third circuit to discharge the capacitor through the third resistance to produce a time delay in vehicle lamp energization and a fourth circuit to charge the capacitor from the power source through the fourth resistance to produce a time delay in vehicle lamp deenergization.

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