United States Patent

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[54] **VEHICLE LIGHT CONTROL AND WARNING INDICATOR SYSTEM**
16 Claims, 4 Drawing Figs.

[52] U.S. Cl. 340/52, 315/82
[51] Int. Cl. B60q 1/02
[50] Field of Search ..... 340/52, 52 D; 315/77, 80, 82, 84

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ABSTRACT: An automatic lamp disconnecting system for vehicle lighting systems having a lamp energizing circuit including a normally open relay switch in series with a manual lamp control switch. Magnetic means for closing the relay switch is energized through the vehicle ignition switch and through a separate holding circuit comprising, in series connection, the relay switch, the lamp control switch, and a normally closed thermal time delay switch which has a heating element responsive to energization of the vehicle lamp only when the ignition switch is opened to effect opening of said time delay switch a predetermined time after opening of the ignition switch.

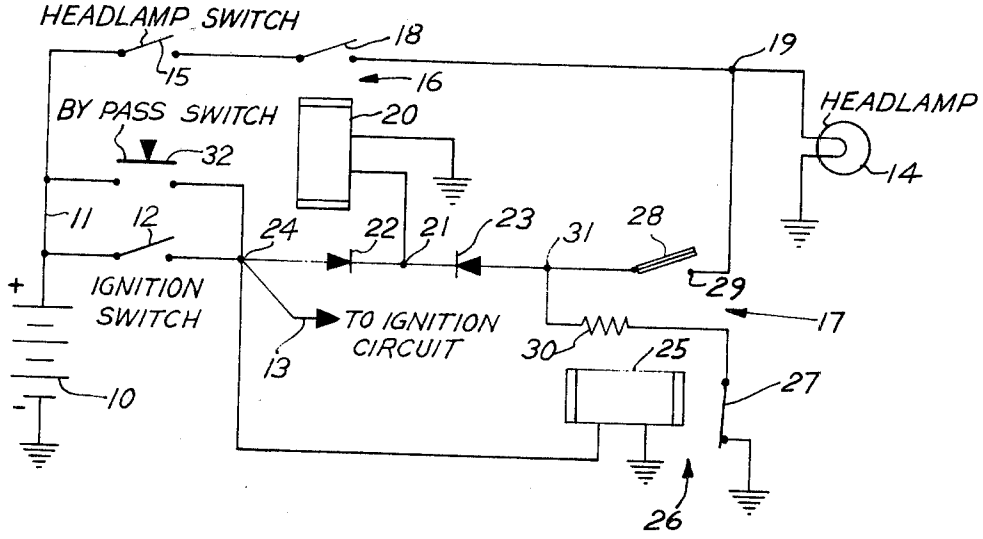

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Fig. 1

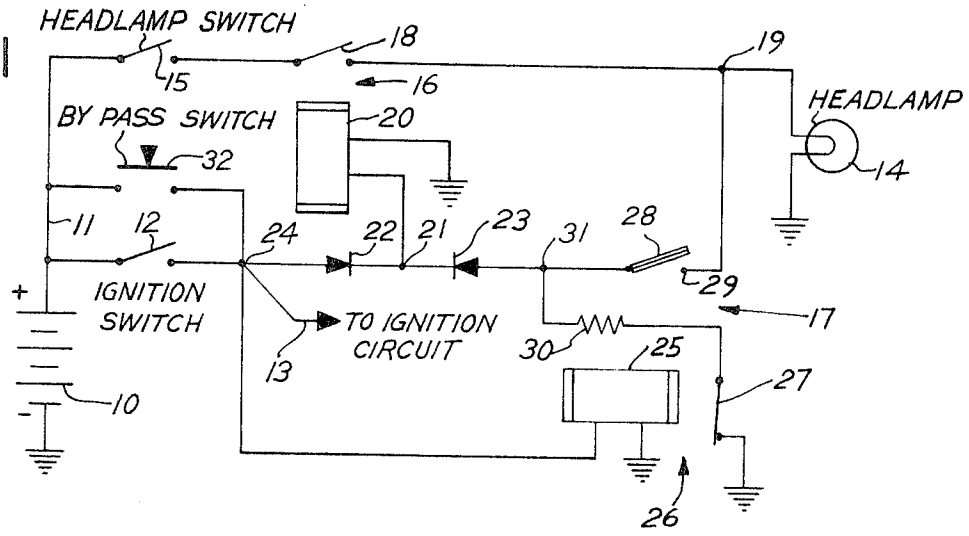


Fig. 2

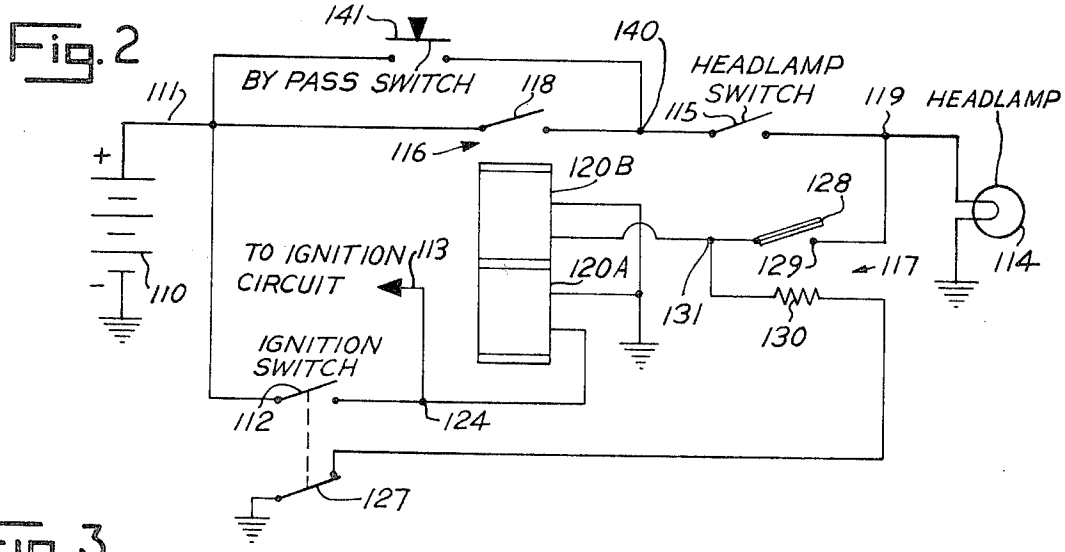
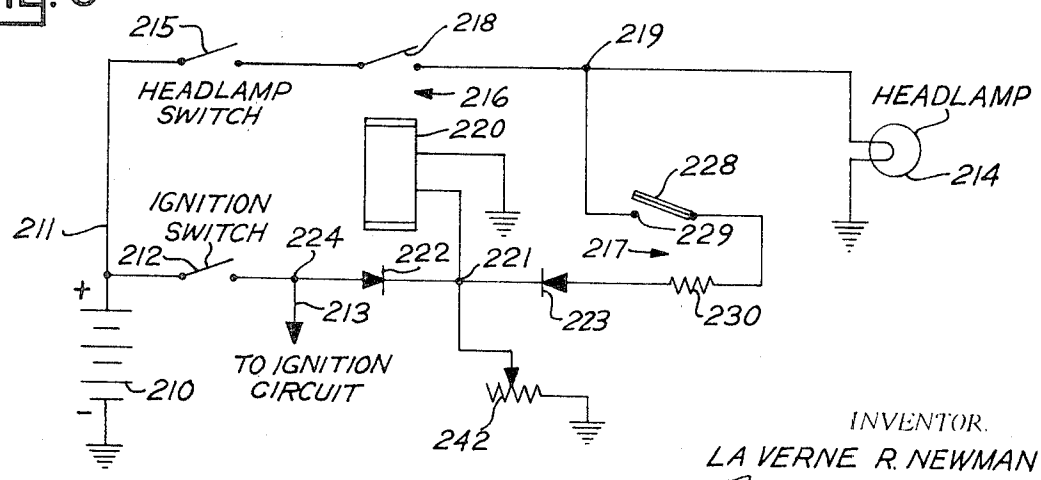


Fig. 3



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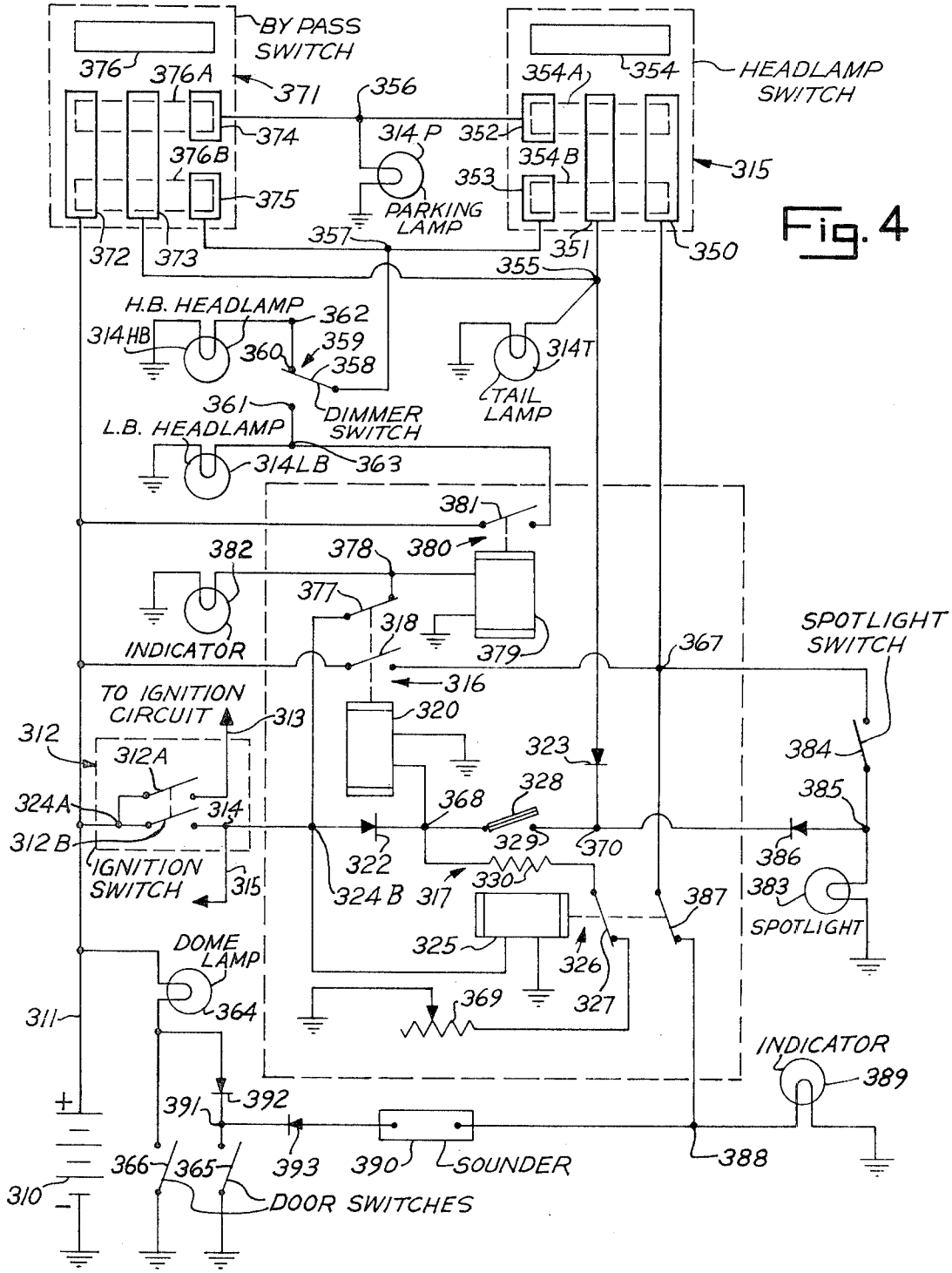

Fig. 4

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the ignition system has been turned off by the ignition switch 12. The normally open contacts 18 of the relay 16 are connected in the energizing circuit of the lamp 14 between the stationary contact of the control switch 15 and the terminal 19 of the lamp 14. The coil 20 of the relay 16 is grounded at one end and at the other end is connected to the junction point 21 of two unidirectional conducting elements or diodes 22 and 23. The other side of the diode 22 is connected to the ignition switch 12 at its junction point 24 with the ignition circuit supply conductor 13. Also connected to the junction point 24 is one end of the coil 25 of an auxiliary electromagnetic relay 26 which has normally closed contacts 27. The other end of the relay coil 25 is grounded as is the stationary contact of the relay contacts 27. The time delay switch 17 is depicted as a thermally actuated device comprising a movable contact 28 in the form of a bimetal strip, a stationary contact 29 normally engaged by the movable contact 28, and a heating element or resistance winding 30 which is in a heat transferring relation with the movable contact 28. The heating element 30 is connected at one end to the movable contact of the relay contacts 27 and at the other end to a junction point 31, which in turn, is connected to the movable contact 28 and to one side of the diode 23. The stationary contact 29 of the time delay switch 17 is connected to the lamp 14 at terminal 19.

In operation, the closing of the ignition switch 12 will energize the relay coil 25, thereby opening the relay contacts 27. At the same time, the relay coil 20 is energized from the battery 10 through a first relay energizing circuit composed of the supply line 11, ignition switch 12, diode 22, and coil 20 to ground. Energization of the coil 20 causes the relay contacts 18 to close. If the control switch 15 is closed, the illuminating lamp 14 is energized through a lamp energizing circuit composed of the control switch 15 and the relay contacts 18. By operating the control switch 15, the lamp 14 may be turned on and off as desired. Although the lamp 14 is connected to the junction point 21 by the diode 23 and the contacts 28 and 29 of the time delay switch 17, the blocking action of the diode 23 prevents energization of the lamp 14 through the ignition switch 12 and the diode 22. It will also be apparent that the opened relay contacts 27 prevent energization of the heating element 30 whenever the ignition switch 12 is closed.

When the control switch 15 is left closed after turning off the ignition switch 12, the coil 20 of the main relay 16 will remain energized through a second relay energizing circuit extending from the battery 10 through the supply line 11, the control switch 15, relay contacts 18, terminal 19, contacts 28 and 29, junction point 31, diode 23, junction point 21, and relay coil 20 to ground. Thus, the lamp 14 will remain energized until either the control switch 15 or the relay contacts 18 are opened. As the diode 22 blocks any current flow from the junction point 21 to the junction point 24, the ignition system and the coil 25 of the auxiliary relay 26 will be deenergized when the ignition switch 12 is opened. The relay contacts 27 close upon deenergization of the coil 25 to energize the heating element 30 of the time delay switch 17 from the battery 10 in a circuit comprising the supply line 11, control switch 15, relay contacts 18, terminal 19, contacts 28 and 29, junction point 31, heating element 30, and relay contacts 27 to ground. The current flow through the heating element 30 causes the heating element to heat the movable contact 28. After a predetermined time interval, the movable contact 28 is sufficiently heated to disengage from the contact 29. Upon opening of the contacts 28 and 29, the second energizing circuit of the relay coil 20 is interrupted to cause the relay contacts 18 to open thereby energizing the lamp 14 and the time delay switch 17. The lamp 14, the time delay switch 17, and the relay coil 20 will remain deenergized until the ignition switch is closed even though the contact 28 upon cooling again engages the contact 29 since relay contacts 18, which have now been opened, prevent the reinitiation of current flow from the battery 10 to the contacts 28 and 29. Thus, no current will be drawn by any part of the light control system in its inactive condition.

If desired, the light control system shown in FIG. 1 may be provided with a manually operated bypass switch 32 to permit operation of the lamp 14 without using the ignition switch 12. The switch 32 may be connected between the supply line 11 and the junction point 24 in shunt with the ignition switch 12. It will be obvious that if the switch 32 is closed the relay coil 20 will be energized to permit energization of the lamp 14 through the control switch 15 and the relay contacts 18. When the switch 32 is only momentarily closed, the lamp 14 will be automatically deenergized after a predetermined time interval. If the switch 32 is maintained closed, the lamp 14 will remain energized as long as the control switch 15 is not opened.

DESCRIPTION OF SECOND PREFERRED EMBODIMENT

FIG. 2 illustrates another embodiment of the invention wherein components similar to corresponding components of the FIG. 1 circuit are identified by the same reference numerals with the prefix 1. In this embodiment, the relay 26 of the FIG. 1 embodiment has been eliminated by the substitution for the relay contacts 27 of an auxiliary switch 127 associated with the ignition switch 112. The switch 127 is controlled in such manner that when the ignition switch 112 is closed, the switch 127 will be opened. Also a relay 116 with dual-coil electromagnetic actuating means has been substituted for the single coil relay 16 and the two diodes 22 and 23 of the FIG. 1 embodiment. The magnetic structure of the relay 116 includes two coils 120A and 120B which are arranged and connected so that when either is individually or simultaneously energized they will actuate the relay contacts 118 to a closed position.

As shown in FIG. 2, the energizing circuit for the illuminating lamp 114 extends from the battery 110 through the supply line 111, relay contacts 118, junction point 140, control switch 115, terminal 119, and lamp 114 to ground. One end of the relay coil 120A is grounded while the other end is connected at the junction point 124 with the ignition switch 112 and the ignition circuit supply conductor 113. One end of the relay coil 120B is grounded while the other end is connected to the lamp terminal 119 through the junction point 131 and the contacts 128 and 129 of the time delay switch 117. The heating element 130 of the time delay switch 117 is connected at one end to the junction point 131 and at the other end to the stationary contact of the auxiliary switch 127 which has its movable contact grounded.

The operation of the second embodiment is generally the same as described in connection with the first embodiment. The closing of the ignition switch 112 opens its associated switch 127 while at the same time the relay coil 120A is energized to cause closing of the relay contacts 118. The illuminating lamp 114 may then be energized as desired by closing the control switch 115. The relay coil 120B will also be energized in a second relay energizing circuit through the contacts 128 and 129 of the time delay switch 117 whenever the illuminating lamp 114 is energized, but the opened switch 127 prevents energization of the heating element 130.

If the control switch 115 is left closed after the ignition switch 112 has been opened, the relay coil 120B will remain energized through a holding circuit extending from the battery 110 through the relay contacts 118, the control switch 115, and the contacts 128 and 129 of the time delay switch 117. However, the closing of the auxiliary switch 127 upon opening of the ignition switch 112 permits the heating element 130 to become energized. After a predetermined interval, the movable contact 128 is sufficiently heated to disengage from the contact 129. The opening of the contacts 128 and 129 deenergizes the relay coil 120B which permits the relay contacts 118 to open thereby deenergizing the lamp 114.

The light control system shown in FIG. 2 includes a manually operated bypass switch 141 connected between the supply line 111 and the junction point 140. It will be obvious that the lamp 114 may be energized through the control

VEHICLE LIGHT CONTROL AND WARNING INDICATOR SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to automotive vehicle light control systems and more particularly to improved time delay control systems which will automatically deenergize the illuminating lamps of an automotive vehicle after a predetermined time delay in the event the lamps have been left energized when the ignition switch is turned off.

Heretofore, various time delay control systems for automatically disconnecting vehicle lighting systems have been proposed to provide temporary lighting for a driver parking his vehicle in an unlighted area or to prevent excessive discharge of the vehicle battery when the lighting system is inadvertently left energized. In one prior art control system disclosed in the Jerome C. Meyer U.S. Pat. No. 2,606,626, issued Aug. 12, 1952, a thermal time delay switch controlled by a switch associated with the driver's seat disconnects the vehicle lamps when the driver leaves his seat. Other systems such as disclosed in the William Poznik U.S. Pat. No. 2,669,664, issued Feb. 16, 1954, employ a thermostatic switch responsive to the temperature of the vehicle engine to deenergize the lighting system upon cooling of the vehicle engine. Still other prior control systems such as disclosed in the Paul C. Crum U.S. Pat. No. 2,751,507, issued June 19, 1956, require the replacement of the usual headlight control switch with a specially constructed self-opening switch with detent means controlled by a time delay device.

Several prior patents have proposed control systems in which a thermal time delay switch has its heating element controlled by the ignition switch to deenergize the headlamps a predetermined length of time after the ignition switch is turned off. Such a system shown in the William H. Long U.S. Pat. No. 2,793,301, issued May 21, 1957, is not entirely satisfactory since the heating element remains energized after the lighting circuit has been deenergized. This disadvantage is obviated by providing the time delay switch with a detent or latch for mechanically maintaining the time delay switch in its open or operated position as shown, for example, in the Irving D. Shapiro U.S. Pat. No. 2,806,980, issued Sept. 17, 1957. However, the latter type of system requires installation of the time delay switch in a location readily accessible to the vehicle driver since the delay switch must be manually reset after its operation.

Accordingly, an improved lamp control system constructed in accordance with the principles of my invention, is inexpensive, convenient and safely operated. The operation of such system is completely automatic and any manual resetting or actuation of ancillary switches or other mechanisms is obviated. Moreover, a system employing the principles of my invention, may be readily adapted to existing headlight circuits without the necessity of replacing the headlight control switch with an elaborate mechanical switch. Also, once the headlights have been automatically deenergized no current flow obtains in any portion of the system which might result in the continued discharge of the battery over an extended period of time. The control system of this invention is also easily and inexpensively adapted for automatic deenergization of an accessory such as a spotlight and the lighting system may be operated when the ignition switch is in the off position.

SUMMARY OF THE INVENTION

In a principal aspect of the present invention, there is provided an improved time delay control system for a vehicle illuminating lamp comprising normally open relay contacts and the vehicle lamp control switch connected in series in the lamp energizing circuit. Electromagnetic actuating means for the normally open relay contacts are connected to the vehicle battery through a first relay energizing circuit including the vehicle ignition switch and through a second relay energizing circuit including in series connection the normally open relay contacts, the lamp control switch and a normally closed time

delay switch. The relay actuating means thus may be initially energized by closing of the ignition switch but will be maintained energized independently of the ignition switch by the second relay energizing circuit. The electrical operating winding of the time delay switch is connected to the vehicle battery through a circuit including the second relay energizing circuit which is arranged to energize the operating winding in response to opening of the ignition switch. The operating winding is thus responsive to energization of the second relay energizing circuit only when the ignition switch is turned off to effect opening of the time delay switch a predetermined length of time after opening of the ignition switch. The time delay switch when opened interrupts the second relay energizing circuit to deenergize both the relay actuating means and the operating winding of the time delay switch. Although the lamp control switch remains closed, the relay actuating means cannot be reenergized until the ignition switch is again closed thereby maintaining the illuminating lamp and all operating elements of the control system deenergized. Preferably, the time delay switch is of the bimetal operated type having a heating element while the first and second relay energizing circuits include unidirectional conducting elements such as diodes to prevent current flow from one relay energizing circuit to the other. These and other features and advantages may be more fully understood in the detailed description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

In the course of this description, reference will frequently be made to the attached drawings in which:

FIG. 1 is an electrical schematic diagram of an embodiment of the invention.

FIG. 2 is an electrical schematic diagram of an alternate embodiment of the invention.

FIG. 3 is an electrical schematic diagram of another embodiment of the invention.

FIG. 4 is an electrical schematic diagram of an additional embodiment of the invention.

DESCRIPTION OF THE FIRST PREFERRED EMBODIMENT

Referring now to the drawings, and more particularly to FIG. 1, thereof, there is shown one embodiment of the invention which illustrates its basic principles and operation. As shown in FIG. 1, the novel vehicle light control system is adapted for use with a conventional automotive electrical system including a battery 10 or other direct current source of electrical energy having a grounded negative terminal and a positive terminal connected to a main supply line 11, an ignition switch 12 connected between the supply line 11 and an ignition supply conductor 13 for the ignition system of an internal combustion engine, a grounded illuminating lamp 14, and a manually operated lamp control switch 15 with one side connected to the supply line 11. The ignition switch 12 may be of the key-operated type usually provided in automotive vehicles to control the ignition, starting and accessory circuits. Although identified as an ignition switch 12 connected to an ignition supply conductor, it will be apparent that the switch 12 may also be the accessory portion of an ignition switch in which case the conductor 13 would be the accessory supply conductor. It will also be apparent that the switch 12 may be the operation controlling switch for vehicle driving prime movers other than internal combustion engines. The lamp 14 is representative of one or more of the exterior illuminating lamps such as headlamps, parking lamps, and tail lamps found in the usual vehicle lighting system. The control switch 15 is shown as a single pole, single throw switch but may be a conventional three-position light switch of the push-pull type.

In accordance with this invention as embodied in FIG. 1, there is provided a main electromagnetic relay 16 and a time delay switch 17 for automatically interrupting the energizing circuit of the lamp 14 at a predetermined time interval after

switch 115 whenever the bypass switch 141 is closed. The bypass switch 141 thus functions to provide a shunt circuit for the illuminating lamp 114 in case a component of the light control system should fail. Of course, a bypass switch could also be connected directly across the ignition switch 112 as shown in the embodiment of FIG. 1.

DESCRIPTION OF THIRD PREFERRED EMBODIMENT

FIG. 3 illustrates still another embodiment of the invention wherein components similar to corresponding components of the FIG. 1 circuit are identified by the same reference numerals with the prefix 2.

In this embodiment, the heating element 230 of the time delay switch 217 has a low resistance value and is connected between the movable contact 228 and the diode 223 in series with the coil 220 of the main relay 216. No auxiliary switch such as the relay switch 27 of FIG. 1 or the switch 127 of FIG. 2 is necessary in this embodiment.

As shown in FIG. 3, the energizing circuit for the illuminating lamp 214 extends from the battery 210 through the supply line 211, control switch 215, relay contacts 218, terminal 219 and lamp 214 to ground. The coil 220 of the relay 216 is grounded at one end and at the other end is connected to the junction point 221 of two diodes 222 and 223. The other side of the diode 222 is connected at the junction point 224 with the ignition switch 212 and the ignition circuit supply conductor 213. The other side of the diode 223 is connected by the heating element 230 and the contacts 228 and 229 of the time delay switch to the terminal 219.

In operation of the third embodiment, the closing of the ignition switch 212 will energize the relay coil 220 through the diode 222 thereby resulting in the closing of the relay contacts 218. The diode 223 blocks any current flow to the heating element 230 and the illuminating lamp 214 through the ignition switch 212 but the illuminating lamp 214 may be energized as desired by closing the control switch 215. No substantial current will flow through the heating element 230 from the terminal 219 while the ignition switch 212 remains closed because the voltage at terminal 219 is substantially equal to that at the junction point 221.

If the control switch 215 is left closed after the ignition switch 212 has been opened, the relay coil 220 will remain energized through a second relay energizing circuit extending from the battery 210 through the control switch 215, the relay contacts 218, terminal 219, the contacts 229 and 228, the heating element 230 and the diode 223. The current flow in this holding circuit through the heating element 230 causes the heating element to heat the movable contact 228. After a predetermined interval of time, the movable contact 228 is sufficiently heated to disengage from the contact 229. The opening of the contacts 228 and 229 deenergizes the relay coil 220 which permits the relay contacts 218 to open and thereby deenergize the lamp 214.

An adjustable variable resistor 242 may be connected in parallel with the relay coil 220 at the junction point 221, to provide for adjustment of the time interval in which the time delay switch 217 opens its contacts. It will be apparent that a change in the resistance value of the resistor 242 will change the current flow through the heating element 230 of the time delay switch 217 and hence the period of time delay.

DESCRIPTION OF FOURTH PREFERRED EMBODIMENT

FIG. 4 illustrates an additional embodiment of the invention wherein components similar to corresponding components of the FIG. 1 circuit are identified by the same reference numerals with the prefix 3. In this embodiment, the usual lighting system for automotive vehicles is illustrated as including grounded high beam headlamps 314HB, grounded low beam headlamps 314LB, grounded parking lamps 314P, and grounded tail lamps 314T. Selective energization of these illuminating lamps is controlled by a conventional manually operated lamp control switch 315. The control switch 315 includes a supply stationary contact and terminal 350, a tail lamp stationary contact and terminal 351, a parking lamp stationary contact and terminal 352, and a stationary headlamp contact and terminal 353, as well as a movable contact bridging member 354. In the illustrated full line or "off" position of the bridging member 354, the latter is disengaged from the stationary contacts. In the "parking lamps on" position of the bridging member 354 as indicated by the dotted lines 354A, the bridging member 354 connects the tail lamp contact 351 and the parking lamp contact 352 to the supply contact 350. In the "headlamps on" position of the bridging member 354 as indicated by the dotted lines 354B, the bridging member 354 connects the tail lamp contact 351 and the headlamp contact 353 to the supply contact 350. The tail light contact 351 and the parking light contact 352 are connected, respectively, to the terminal 355 of the tail lamp 314T and the terminal 356 of the parking light 314P. The headlamp contact 353 is connected at the junction point 357 to the movable contact 358 of the usual foot operated dimmer switch 359. The dimmer switch 359 may be the conventional ratchet type of switch in which the movable contact 358 alternately engages the stationary contacts 360 and 361 and remains in its last actuated position until moved to the opposite contact. The stationary contact 360 and 361 are connected, respectively, to the terminal 362 of the headlamp 314HB and the terminal 363 of the headlamp 314LB. The vehicle electrical system is also shown as including a battery 310 having a grounded negative terminal and a positive terminal connected to a main supply 311. The main supply line 311 is connected to a junction point 324A which, in turn, is connected to a double circuit ignition switch 312 having contacts 312A and 312B mechanically linked to each other. When the double circuit ignition switch is closed, both of its contacts are simultaneously closed and current flow is provided from junction 324A to ignition supply conductor 313 through contact 312A and current flow is also established from junction 324A to junction 324B through contact 312B. Upon closing the double circuit ignition switch 312 and its contact 312B, current flow is also provided from junction 324A through the contact 312B to junction 314 and thence to the accessory conductor 315. An interior-mounted courtesy or dome lamp 364 is also connected to main supply line 311 and two door-actuated switches 365 and 366 are connected between the dome lamp 364 and ground. When at least one of the vehicle doors is open, at least one of the door-actuated switches 365 or 366 is closed to energize the lamp 364.

In accordance with one feature of this invention, there are provided two electromagnetic relays 316 and 326 and a time delay switch 317 for automatically deenergizing the lamps of the exterior lighting system at a predetermined time interval after the ignition switch 312 has been turned off with any lamps of the lighting system energized. The normally open contacts 318 of the main relay 316 are connected in the energizing circuit of the lighting system between the supply line 311 and a junction point 367 which is connected to the supply contact 350 of the control switch 315. The coil 320 of the main relay 316 is grounded at one end and is connected at the other end to the junction point 368 of a diode 322 and the movable contact 328 of the time delay switch 317. The other side of the diode 322 is connected to the ignition switch 312 and the ignition circuit supply conductor 313 at the junction points 324A and 324B. Also connected to the junction point 324B is one end of the coil 325 of the auxiliary relay 326 which has its other end grounded. The stationary contact of the normally closed contacts 327 of the relay 326 is connected to ground through an adjustable variable resistor 369. The heating element 330 which is in a heat transferring relation with the bimetallic movable contact 328 is connected between the movable contact of the relay contacts 327 and the junction point 368. A diode 323 is connected at one side of the terminal 355 of the tail lamp 314T and is connected at its other side to the stationary contact 329 of the time delay switch 317 at the junction point 370.

The fourth embodiment of the invention thus far described operates in substantially the same manner as does the first embodiment. The closing of the ignition switch **312** will energize the relay coil **325** thereby opening the relay contacts **327**. At the same time, the relay coil **320** is energized through the ignition switch **312** and the diode **322** to cause closing of the relay contacts **318**. Although the tail lamp **314T** is connected to the junction point **368** by the diode **323** and the normally closed contacts **328** and **329** of the time delay switch **317**, the lamp is not energized through this circuit because of the blocking action of the diode **323**. The heating element **330** also is not energized since the opened relay contacts **327** prevent energization of the heating element **330** whenever the ignition switch **312** is closed.

After closing of the ignition switch **312**, the illuminating lamps may be energized as desired. If the bridging member **354** of the control switch **315** is moved to the "parking lamps on" position indicated at **354A**, the parking lamp **314P** and the tail lamp **314T** will be energized since the lamp energizing circuit to the supply contact **350** of the control switch **315** will be completed through the supply line **311**, relay contacts **318**, and the junction point **367**. Similarly, the headlamps **314LB** and **314HB** may be selectively energized through the dimmer switch **359** when the bridging member **354** of the control switch **315** is moved to the "headlamps on" position indicated at **354B**.

If the bridging member **354** of the control switch **315** remains in either of its operated positions **354A** or **354B** after opening of the ignition switch **312**, the relay coil **320** will remain energized through a holding circuit extending from the battery **310** through the supply conductor **311**, relay contacts **318**, junction point **367**, supply contact **350** of the control switch **315**, terminal **355**, diode **323**, junction point **370**, contacts **329** and **328** of the time delay switch **317**, and junction point **368**. The diode **322** blocks any current flow from this second relay energizing circuit to the ignition circuit supply conductor **313** and to the coil **325** of the auxiliary relay **326**. The relay coil **325** is thus deenergized upon opening of the ignition switch **312** and the relay contacts **327** close to energize the heating element **330** of the time delay switch **317**. After a predetermined time interval adjustably set by the variable resistor **369**, the movable contact **328** is sufficiently heated by the heating element **330** to disengage from the contact **329**. The opening of the contacts **328** and **329** deenergize the relay coil **320** which in turn causes the relay contacts **318** to open. The opening of the relay contacts **318** interrupts the lamp energizing circuit to the control switch **315** thereby deenergizing the illuminating lamps. The illuminating lamps, the time delay switch **317**, and the relay coil **320** will remain deenergized until the ignition switch **312** is closed again.

The light control system shown in FIG. **4** further includes a manually operated bypass switch **371** generally similar in construction to that of the control switch **315**. The bypass switch **371** comprises a stationary supply contact **372** connected to the battery **310** by the supply conductor **311**, a stationary tail lamp contact **373** connected to the terminal **355** of the tail lamp **314T**, a stationary parking lamp contact **374** connected to the terminal **356** of the parking lamp **314P**, a stationary headlamp contact **375** connected to the junction point **357**, and a movable bridging member **376**. In the illustrated full line or "off" position of the bridging member **376**, the latter is disengaged from the stationary contacts. In the "parking lamps on" position of the bridging member **376** as indicated by the dotted lines **376A**, the bridging member **376** connects the tail lamp contact **373** and the parking lamp contact **374** to the supply contact **372**. In the "headlamp on" position of the bridging member **376** as indicated by the dotted lines **376B**, the bridging member **376** connects the tail lamp contact **373** and the headlamp contact **375** to the supply contact **372**. In the event a component of the light control system should fail, the bridging contact member **376** of the bypass switch **371** may be shifted to either of its "on" positions to provide direct energization of the illuminating lamps. The bypass switch **371** also may be used to energize the headlamps without use of the ignition switch **312**.

In accordance with another feature of the invention, the light control system shown in FIG. **4** includes means for automatically energizing the low beam headlamp **314LB** in the event the relay **316** fails to close its contacts **318** when the ignition switch **312** is closed. For this purpose, the main relay **316** is provided with the normally closed contacts **377** which are opened when the relay coil **320** is energized. The movable contact of the contacts **377** is connected to the junction point **324B** while the stationary contact is connected at the junction point **378** with one end of the coil **379** of a safety relay **380** which is grounded at the other end. The normally open contacts **381** of the safety relay **380** are connected between the supply line **311** and the terminal **363** of the low beam headlamp **314LB**. In normal operation of the light control system as described above, the relay contacts **377** will be opened whenever the relay coil **320** is energized. Thus, the relay coil **379** will not be energized from the supply line **311** through the ignition switch **312**. If, however, due to a failure of the relay **316** the relay coil **320** fails to open the contacts **377** when the ignition switch **312** is closed, the relay coil **379** will be energized through the ignition switch **312** and the relay contacts **377**. The energization of the relay coil **379** causes the relay contacts **381** to close thereby energizing the low beam headlamp **314LB** directly from the supply conductor **311** as long as the ignition switch **312** remains closed. A pilot light **382** or other indicator may be connected to the junction point **378** in parallel with the relay coil **379** to warn the vehicle driver of the failure of the relay **316**.

A spotlight **383** or other accessory with its control switch **384** may be used with the light control system shown in FIG. **4**. The accessory control switch **384** is connected between the junction point **367** and the terminal **385** of the spotlight **383** while the terminal **385** is connected by a unidirectional conducting element or diode to the junction point **370**. The diode **386** is connected to block current flow from the junction point **370** to the spotlight terminal **385** and to permit current flow in the opposite direction. It is apparent the spotlight **383** may be energized when both the relay switch **318** and the accessory control switch **384** are closed following closing of the ignition switch **312**. If the accessory control switch **384** is left closed after the ignition switch **312** has been opened, the relay coil **320** will remain energized through a circuit extending from the battery **310** through the relay contacts **318**, the accessory control switch **384**, diode **386**, and contacts **329** and **328** of the time delay switch **317**. The heating element **330** of the time delay switch **317** is also energized through this same circuit and after a predetermined time causes the opening of the contacts **328** and **329** to deenergize the relay coil **320**. Thus, the spotlight **383** is automatically controlled by the light control system of FIG. **4** in the same manner as are the illuminating lamps.

If desired, the light control system shown in FIG. **4** may also be provided with means for giving a warning signal when an operator of the vehicle leaves the vehicle while the illuminating lamps are left energized. For this purpose, the auxiliary relay **326** may be provided with normally closed contacts **387** connected between the junction point **367** and the terminal **388** of a pilot light **389** or other electric warning indicator device. Another electric warning device such as a sounder **390** may be connected between the terminal **388** and the terminal **391** of the door switch **365** which is preferably associated with the vehicle door on the operator's side. If, after the ignition switch is opened, the relay coil **320** remains energized due to one or both of the control switches **315** and **384** being closed, the pilot light **389** will be energized through the relay contacts **318** and **387**. If the door switch **365** now is closed by opening of the vehicle doors, the sounder **390** will also be energized. A unidirectional conducting element or diode **392** may be connected between the dome lamp **364** and the terminal **391** to prevent energization of the sounder **390** through any door switch other than the switch **365**. Also, a unidirectional con-

ducting element or diode **393** is connected between the terminal **391** and the sounder **390** to prevent reverse current flow through the sounder **390** and pilot light **389** from the power supply line **311** via the dome lamp **364** when contacts **387** are open.

It is to be understood that the foregoing embodiments are merely illustrative of the application of the principles of the invention. Various modifications may be made to these embodiments without departing from the true spirit of the invention.

I claim:

1. An automatic lamp disconnecting system for an automotive vehicle electrical system having

a source of electrical energy,

a prime mover controlling system for a vehicle driving prime mover including a prime mover controlling switch connected between the source of electrical energy and a prime mover operating circuit,

and a lighting system including an exterior illuminating lamp and a control switch for controlling the flow of current from the source of electrical energy to the illuminating lamp,

wherein the improvement comprises:

a relay having normally open contacts and electromagnetic actuating means operative when energized from said source to close said normally open contacts;

a lamp energizing circuit between said lamp and said source including said normally open contacts and said control switch in series connection;

a first relay energizing circuit connecting said relay actuating means to said source through said prime mover controlling switch for energizing said actuating means to close said relay contacts upon closing of the prime mover controlling switch;

a second relay energizing circuit independent of said prime mover controlling switch to maintain the actuating means of said relay energized following opening of the prime mover controlling switch, said second relay energizing circuit connecting the actuating means of said relay to said source and including said relay contacts and said control switch in series connection;

a normally closed time delay switch connected in said second energizing circuit for automatically deenergizing the actuating means of said relay, if energized, a predetermined time after opening of prime mover controlling switch;

and operating means for the time delay switch connected to said second relay energizing circuit and responsive to energization of said second relay energizing circuit only when said prime mover controlling switch is opened to effect opening of said time delay switch a predetermined time after opening of the prime mover controlling switch.

2. The improvement set forth in claim **1** wherein said time delay switch is of the thermally actuated type including a movable bimetal operated contact and an electric heating element.

3. An automatic lamp disconnecting system for an automotive vehicle electrical system having

a source of direct current electrical energy,

a prime mover controlling system for a vehicle driving prime mover including a prime mover controlling switch connected between the source of electrical energy and a prime mover operating circuit,

and a lighting system including an exterior illuminating lamp and a control switch for controlling the flow of current from the source of electrical energy to the illuminating lamp,

wherein the improvement comprises:

a relay having normally open contacts and electromagnetic actuating means operative when energized from said source to close said normally open contacts;

a lamp energizing circuit between said lamp and said source including said normally open contacts of the relay and said control switch in series connection;

a first relay energizing circuit connecting the actuating means of said relay to said source through said prime mover controlling switch;

a normally closed time delay switch provided with an operating winding and means to open the delay switch after a predetermined period of energization of the operating winding;

a second relay energizing circuit connecting the actuating means of said relay to said source independently of said prime mover controlling switch, and including in series connection said relay contacts, said control switch and said delay switch;

a normally closed auxiliary switch controlled by said prime mover controlling switch and arranged to open in response to closing of said prime mover controlling switch;

and an operating winding energizing circuit connecting the operating winding of said delay switch to said source, and including in series connection said relay contacts, said control switch, said delay switch, said operating winding and said auxiliary switch.

4. The improvement as set forth in claim **3** wherein said time delay switch is of the thermally actuated type including a bimetal operated contact and said operating winding is a heating element in a heat transferring relation with the bimetal operated contact.

5. The improvement as set forth in claim **3** wherein said time delay switch is of the thermally actuated type including a movable bimetal operated contact and said operating winding is a heating element in a heat transferring relation with the bimetal-operated contact, said operating winding energizing circuit including a variable resistance in series with said heating element for adjustably regulating the current flow therethrough and hence the period of time delay.

6. The improvement as set forth in claim **3** wherein said electromagnetic actuating means includes a magnetic structure having a single coil connected to said source by each of said first and second relay energizing circuits; said first relay energizing circuit including a first unidirectional conducting element connected in series with said prime mover controlling switch; said first unidirectional conducting element being poled in a direction to prevent current flow from said source through said second relay energizing circuit to said prime mover operating circuit; and said second relay energizing circuit including a second unidirectional conducting element connected in series with said delay switch; said second unidirectional conducting element being poled in a direction to prevent current flow from said source through said first relay energizing circuit to said illuminating lamp.

7. The improvement as set forth in claim **3** wherein said electromagnetic actuating means includes a magnetic structure having a first coil connected to said source by said first relay energizing circuit, and a second coil connected to said source by said second relay energizing circuit, either coil when energized operating to close said relay contacts.

8. The improvement as set forth in claim **3** including a normally open bypass switch connected in parallel circuit with said normally open contacts of the relay, said bypass switch being manually operated for energization of said illuminating lamp independently of said relay contacts.

9. The improvement as set forth in claim **3** including a normally open bypass switch connected in parallel circuit with said prime mover controlling switch, said bypass switch being manually operated for energization of said electromagnetic actuating means independently of said prime mover controlling switch.

10. An automatic lamp disconnecting system for an automotive vehicle electrical system having

a source of direct current electrical energy,

a prime mover controlling system for a vehicle driving prime mover including prime mover controlling switch connected between the source of electrical energy and a prime mover operating circuit,

and a lighting system including a headlamp, a tail lamp and a manually operated multiple position control switch with supply, headlamp and tail lamp terminals for controlling the flow of current from the source of electrical energy to the headlamp and tail lamp, said multiple position control switch having an off position in which said supply terminal is disconnected from the other terminals and an on position in which said supply terminal is connected to said headlamp and tail lamp terminals,

wherein the improvement comprises:

a main relay having a set of normally open contacts and electromagnetic actuating means including a coil operative when energized from said source to close said normally open contacts;

a lamp energizing circuit connecting said headlamp and tail lamp to said source through said multiple position control switch including the normally open contacts of said main relay connected between said source and the supply terminal of said multiple position control switch, said lamp energizing circuit further including conductors connecting said headlamp and said tail lamp, respectively, to said headlamp and tail lamp terminals of the multiple position control switch;

a thermal time delay device including a heating element and a normally closed, bimetal-operated delay switch arranged to open after a predetermined period of energization of said heating element;

a first relay energizing circuit connecting the coil of said main relay to said source through said prime mover controlling switch;

a second relay energizing circuit connecting the coil of said main relay to said source through said multiple position control switch and the normally open contacts of said main relay and including said delay switch connected between the coil of said main relay and said tail lamp terminal of the control switch;

said first relay energizing circuit including a first unidirectional conducting element connected in series with said prime mover controlling switch and said coil of the main relay to prevent current flow from said source through said second relay energizing circuit to said ignition circuit;

said second relay energizing circuit including a second unidirectional conducting element connected in series with said delay switch and said coil of the main relay to prevent current flow from said source through said first relay energizing circuit to said tail lamp terminal of the multiple position control switch;

an auxiliary relay having a set of normally closed contacts and electromagnetic means including a coil operative when energized from said source to open said normally closed contacts;

a circuit for energizing the coil of said auxiliary relay from said source including a conductor connecting said coil of the auxiliary relay to said prime mover controlling switch in parallel circuit with said prime mover operating circuit;

and a heating element energizing circuit connecting said heating element to said source through said delay switch, said multiple position control switch, and the normally open contacts of said main relay and including said normally closed contacts of the auxiliary relay.

11. The improvement as set forth in claim **10** wherein said heating element energizing circuit includes a variable resistance in series with said heating element for adjustably regulating the current flow therethrough and hence the period of time delay.

12. The improvement as set forth in claim **10** including a normally open bypass switch connected between said source and said headlamp terminal of the multiple position control switch, said bypass switch being manually operated for energization of said headlamp independently of the normally open contacts of said main relay.

13. The improvement as set forth in claim **10** wherein said main relay includes a set of normally closed contacts opened in response to energization of the coil of said main relay, safety relay means having switch means operative when said safety relay means are energized to connect said headlamp directly to said source, and means for connecting said safety relay means to said source including in series connection said prime mover controlling switch and the normally closed contacts of said main relay.

14. The improvement as set forth in claim **10** wherein said auxiliary relay includes a second set of normally closed contacts, an electric warning indicator, and a warning indicator energizing circuit connecting said warning indicator to said source through said normally open contacts of the main relay, said second set of normally closed contacts and the supply terminal of said multiple position control switch.

15. The improvement as set forth in claim **14** wherein said warning indicator energizing circuit includes, in series connection with said warning indicator, a normally open door-actuated switch which is closed upon opening a vehicle door.

16. The improvement as set forth in claim **10** further including an auxiliary lamp, a manually operated auxiliary lamp control switch with supply and auxiliary lamp terminals for controlling the flow of current from the source of electrical energy to the auxiliary lamp, an auxiliary lamp energizing circuit connecting said auxiliary lamp control switch in series with said normally open contacts and said second relay energizing circuit, said auxiliary lamp energizing circuit including a third unidirectional conducting element connected in series with said delay switch and said auxiliary lamp control switch to prevent current flow from said source through said delay switch to said auxiliary lamp.