

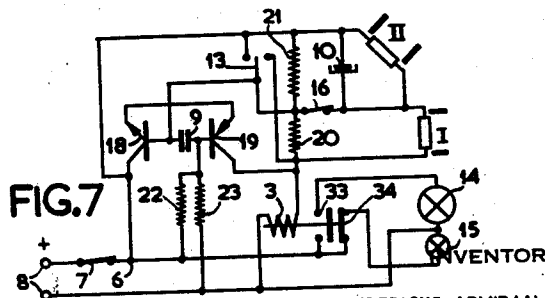
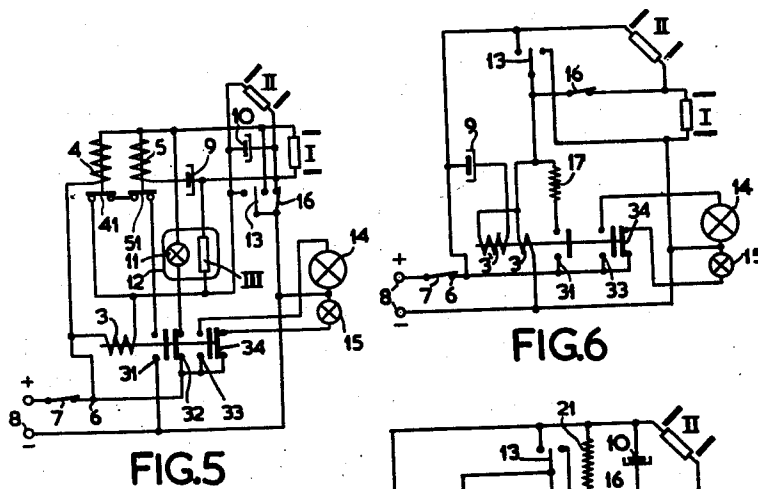
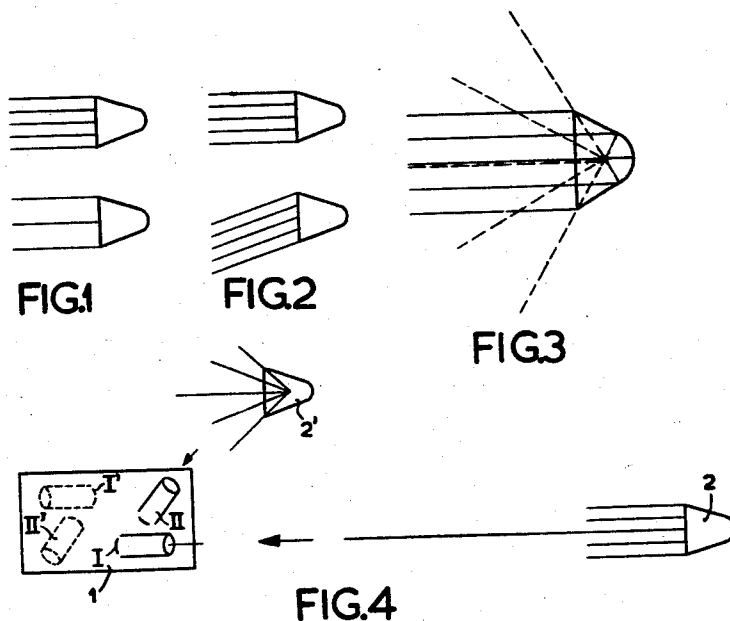
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SWITCHING DEVICE CONTROLLABLE BY A LIGHT SOURCE

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SWITCHING DEVICE CONTROLLABLE BY A LIGHT SOURCE

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This invention relates to switching devices controllable by a light source and intended more particularly for automatically dimming the headlights of a car, when the light source moves in a determined direction towards and past the switching device and radiates light in the direction of its movement.

Such switching devices have previously been described in French Patent Nos. 1,035,492 and 1,071,113. The last-mentioned patent relates to an improved construction of a known form of such devices. However, the switching device according to said patent is adapted to American conditions and has the disadvantage that, if an oncoming car dims its headlights first, the headlights of the vehicle equipped with the switching device are dimmed much too late. That is, the lights are dimmed only when the dimmed headlights of the oncoming car, as a result of the decreased distance, have become sufficiently strong to render the switching device operative.

In one known arrangement, the headlights of vehicles are dimmed merely by decreasing the amount of light, so that according to European conceptions the amount of light radiated forwards and horizontally is still too large.

In another known arrangement, the amount of light radiated is usually not decreased to a considerable extent, but the radiation of the headlights is directed downwards, so that the road is even better illuminated at a short distance in front of the vehicle, but the light beams cannot directly strike the eyes of the driver of an oncoming car.

These conditions are shown diagrammatically in Figures 1 and 2 of the accompanying drawing (headlight above and dimlight below).

In a well known form, the switching device comprises a very sensitive, forwards directed photo-electric cell with multiplier, and an amplifier controlling a relay. When the headlights of the vehicle comprising this device are dimmed, the relay closes an additional contact, resulting in the amplification of the amplifier and the sensitivity of the device being increased to an extent such that, upon dimming of the headlights of the oncoming car, the device remains in the "dimlight position" until the vehicle has finally passed. In order to accurately guarantee switching over to "headlight," the sensitivity of the device is gradually reduced with a suitably chosen electric time-constant.

If dimming is effected according to the above first described system, for example by reducing the radiated amount of light, to one quarter, the prior switching devices dim the headlights of a vehicle at a certain distance A of an oncoming car if the headlights of the last-mentioned vehicle are not dimmed first, and approximately at a distance A/2 if these headlights are dimmed first. If dimming is effected in accordance with the above second described system, such switching devices are not operative at all or are operated only at a very small distance of an oncoming car in the second case.

The switching device according to French Patent No.

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1,035,492 is not adapted for the above-noted beam lowering systems.

In this device, the switching over to dimlight is intentionally delayed, which may have the result that it does not switch over again to "headlight" if the headlights of the oncoming car are dimmed in their turn. Switching over to "head-light" is brought about by a light pulse which is thrown via a mirror onto the photo-electric cell by a spotlight arranged especially at the back of the passing vehicle and radiating light laterally against the vehicle comprising the switching device. A condition for this automatic switch-over to "headlight" is thus the standardized equipment of all motor vehicles with an addition spotlight, hitherto unusual and radiating sideways.

In the switching device according to the present invention, switching-over is effected by action of the light from the headlights of a passing vehicle upon a second photo-electric cell, which light, as shown in Figures 3 and 4, is radiated directly to the side, that is not concentrated into a beam. With ordinary photo-electric cells, a complicated amplifying equipment is thus required and the device is therefore a little more complicated and more expensive than switching devices of known type. When using very sensitive photo-electric cells, more particularly photo-conducting cells, for example cells of cadmium sulphide with activating additions, this equipment becomes much cheaper and simpler since the whole amplifying equipment together with a direct voltage converter for the supply thereof may be dispensed with.

The switching device according to the present invention comprises by a first light-sensitive cell arranged to be illuminated by the light source when still fairly remote, a second light-sensitive cell arranged to be temporarily illuminated by the light source moving past the switching device, and a switching relay which is controlled by the photo-cells in accordance with their respective illuminations and in a manner such that the relay assumes a first stable position when the first cell is illuminated and a second stable position when the second cell is illuminated and the first cell is not illuminated.

Due to the fact that the switching relay is stable in either position, that is, it is held automatically in either position until a new switching command is received, the dimming of the headlights of a vehicle moving towards the switching device cannot bring about premature switching over. Preferably, means are even provided by which the switching relay is also brought into its first position by an abrupt strong decrease of the illumination of the first cell, so that, if the headlights of a vehicle moving towards the switching device are dimmed, before the switching relay has assumed its first position, this dimming causes the switching relay to be switched over to its first position. The accompanying drawing illustrates the described dimming systems and the conditions of illumination when a vehicle approaches and passes and shows the circuit diagrams of three different embodiments of the switching device according to the invention.

Fig. 1 illustrates one known arrangement for dimming headlights;

Fig. 2 illustrates another known arrangement for dimming headlights;

Fig. 3 shows the reflected beam of rays and the direct non-concentrated radiation,

Fig. 4 is a schematic diagram of an embodiment of the switching device of the present invention, showing the arrangement of the two photo-electric cells, with respect to the headlights of a vehicle moving towards and past it;

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Fig. 5 is a schematic circuit diagram of an embodiment of the switching device of the present invention;

Fig. 6 is a schematic circuit diagram of another embodiment of the switching device of the present invention; and

Fig. 7 is a schematic circuit diagram of still another embodiment of the switching device of the present invention.

In Fig. 4, a switching device according to the invention is represented diagrammatically by a rectangle 1. The main application of this device resides in the automatic dimming of the headlights of a motor vehicle. However, it may be used for many other purposes, for example for the automatic control at night of traffic signals at complicated and dangerous crossings which are manned in day-time.

If the switching device is incorporated in a motor vehicle, it comprises a first photo-electric cell I, which is directed forwards and arranged on this vehicle so that it is illuminated, by the headlights 2 of other vehicles coming from the opposite direction. It also comprises a second photo-electric cell II which is directed approximately horizontally and obliquely forwards, that is, towards the side of the road on which a crossing vehicle must pass according to the traffic rules. This cell is thus temporarily illuminated by the non-concentrated light radiated by the lamps of the headlights 2' of a vehicle passing in the opposite direction.

If the switching device is used for the automatic control of traffic signals, it may be arranged on a traffic column, for example at the center of a crossing. Let us consider, for example, the case of a crossing between motor roads in which the road from the left to the right and conversely is a major road with respect to the other road extending from above to below and conversely (Fig. 4). The traffic column 1 is equipped not only with the photo-electric cells I and II, but also with a second set of photo-electric cells I' and II' (shown in dotted lines). Each set of photo-electric cells supervises the main road in a given direction. When a vehicle approaches from the right hand side, the photo-electric cell I, for example, switches a switching relay into its first position and as soon as this vehicle passes the traffic column 1, photo-electric cell II gives the command to change over to the second position. In the first position, the switching relay switches on red stoplights and in the second position yellow flicker-lights. Both the red and the yellow lights are arranged so that they are clearly visible from vehicles driving in both directions on the subordinate road, but are invisible from the major road. The photo-electric cells I and I' and II and II' may be connected in parallel, but it is preferable to utilize two switching devices having separate associated switching relays, the contacts of these relays being connected together that the red lights are "on" when the one or the other of these relays occupies its first position or when both relays occupy their first positions.

The embodiment shown in Fig. 5 comprises, in addition to the photo-electric cells I and II, a switching relay 3, a second relay 4 and a comparatively sensitive auxiliary relay 5. The winding of switching relay 3 is connected at one end to a point 6 which is connected through a main switch 7, for example through the lighting switch of a motor vehicle, to the positive terminal of a direct-voltage source 8, for example, a storage battery of 12 volts operating voltage. At its other end, it is connected to the negative terminal of the same source of supply through the photo-electric cell II and, in parallel therewith, through break contacts 41 and 51 of the relays 4 and 5 and a make contact 31 of relay 3, which is connected in series therewith and which serves as a holding contact.

The winding of the second relay 4 is connected at one end to the point 6 and, at its other end, to the negative terminal of the source 8 via the photo-electric cell I. The

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winding of the auxiliary relay 5, in series with an electrolytic capacitor 9, bridges the same photo-electric cell, a second electrolytic capacitor 10 being connected in parallel with the photo-electric cell II.

The switching device shown in Fig. 5 comprises a third photo-electric cell III, which is incorporated in a case 12, in front of a light source, for example, a small incandescent lamp 11. The lamp 11 is connected to point 6 through a break contact 32 of relay 3 and to the negative terminal of the source 8 via the photo-electric cell I. The photo-electric cell III is connected in parallel with the cell II. A push-button switch 13, for example, a foot-operated switch, is provided, by means of which the photo-electric cells I and II, and III respectively, may be alternately short-circuited for a short period. Finally, the switching relay 3 comprises a make contact 33 and a break contact 34 for switching over from headlights (represented by a comparatively large incandescent lamp 14) to dimlights (small incandescent lamp 15) and conversely, and the switch 16 serves to switch off the photo-electric cells.

When the switch 7 is closed, and the switch 16 being closed the relay 3 is first energized by the charging current of the capacitor 10 and then holds itself in its second position via contacts 41, 51 and 31, so that the headlights are switched on via contact 33. If it is desired to switch over to dimlights, the photo-electric cell I is temporarily short-circuited by means of switch 13 (right-hand position). The relay 4 is thus energized, so that it opens its contact 41 and releases the relay 3, so that the dimlights are switched on via contact 34. A new push on the push-button switch 13 (left-hand position) brings about direct energization of the relay 3, which again holds itself via its holding contact 31. If automatic switching over from dimlights to headlights, and conversely, is to be made impossible, the switch 16 is opened and the switch 13 is operated manually.

If another car approaches at night, the switch 16 being closed, then at a certain distance therefrom the photo-electric cell I is illuminated by the headlights thereof to such an extent that its resistance considerably decreases. The second relay 4 is thus energized via the cell I. Said distance is, of course, dependent upon the strength and upon the concentration of the light from the headlights of the oncoming car and may be adjusted, for example, by partial screening of the photo-electric cell I, so that the driver of the vehicle comprising the switching device is not dazzled by this light before the headlights of his car are automatically switched over.

If the driver of the oncoming car does not switch over to dimlights, the internal resistance of the photo-electric cell I decreases further until the lamp 11 fed through this cell and back contact 32 flashes up and illuminates the photo-electric cell III. The internal resistance of this cell then greatly decreases and the relay 3 is energized through it with a simultaneous discharge of capacitor 10. Due to the energization of relay 3, the headlights are again switched over to headlights and the circuit of the lamp 11 is interrupted. However, relay 4 is still energized through the photo-electric cell I, which is now strongly illuminated so that the relay 3 cannot hold itself through its contact 31. The internal resistance of the cell III again increases, since it is no longer illuminated, and the relay 3 is released. The switching device thus automatically produces flicker-light signals with the headlights at a frequency which increases with the intensity of illumination of the cell I and until the headlights of the oncoming car are dimmed.

If the headlights of the oncoming car are dimmed before those of the vehicle comprising the switching device, this abrupt dimming causes a sudden increase of the internal resistance of the photo-electric cell I, so that the capacitor 9 must charge via the winding of auxiliary relay 5 and the comparatively low resistance winding of relay 4. This charging process temporarily energizes the relay

5, which opens its break contact 51 and interrupts the holding circuit of relay 3. The relay 3 is released and switches over to dimlights.

When the oncoming car finally passes the vehicle comprising the switching device, the photo-electric cell II is illuminated from a very small distance by the non-concentrated light of its headlights. The relay 3 is now energized through this cell and if the cell I is not illuminated, or only weakly illuminated at this time, said relay is energized and holds itself again in the headlights position through its contact 31.

Instead of utilizing a photo-electric cell III connected in parallel with the photo-electric cell II, it is alternatively possible to arrange the lamp 11 so that its light strikes the photo-electric cell II, for example, by reflection thereon by means of a transparent mirror. The capacitor 10 prevents too rapid an increase in voltage at the terminals of the winding of relay 3 and hence unwanted switching over to headlights under the action of light from interfering light sources, for example, of the concentrated light from comparatively distant light sources.

Due to the provision of the auxiliary relay 5 and of the capacitor 9, the switching device is sensitive not only to a determined light intensity, but also to rapid variations in light intensity.

The embodiment shown in Fig. 6 resembles that of Fig. 5, corresponding parts of these switching devices and also of the switching device shown in Fig. 7 being provided with the same reference numerals.

In the embodiment shown in Fig. 6, the relay 3 comprises a second winding 3' having a comparatively large number of turns. In the energized position, the relay 3 holds itself via its contact 31 and a resistor 17, the value of which may be higher than that of the internal resistance of the photo-electric cell II in the illuminated condition. The cell I shunts the main winding of relay 3, the resistance of which in turn is higher than that of the illuminated cell I, so that the relay 3 is deenergized upon sufficiently intense illumination of the photo-electric cell I. When the headlights of an oncoming car are dimmed first, the capacitor 9 discharges through the auxiliary winding 3' and the main winding of relay 3. Furthermore, the current traversing the main winding of the relay 3 and the resistor 17 increases. However, the respective numbers of turns of the main winding and of the auxiliary winding and the value of capacitor 9 may be so chosen that the effect of the current traversing the auxiliary winding, which counteracts the current traversing the main winding, is temporarily predominant and causes the relay 3 to be deenergized. When the photo-electric cell II is illuminated while cell I is not, the main winding of relay 3 is energized through cell II.

With respect to the embodiment shown in Fig. 5, in that shown in Fig. 6, two relays (4 and 5) are dispensed with at the price of a more expensive relay 3 provided with two windings. A flicker-light signal device comprising photo-electric cell III and lamp 11 is not shown in Figs. 6 or 7, but could be added in exactly the same manner to the embodiments of these figures as well.

In the embodiment shown in Fig. 7, the photo-electric cells I and II control a transistor change-over switch, which in turn switches the current through the winding of switching relay 3. The change-over switch shown is of the type described in copending U.S. application Serial No. 564,068, filed Feb. 7, 1956. It comprises two transistors 18 and 19 of opposite conductivity types, the emitters of which are connected together and the collector-emitter paths of which are connected in series with each other and with a load (winding of relay 3). By way of the switch 16, the photo-electric cells I and II are shunted by resistors 20 and 21 of a potentiometer included between the collectors of the two transistors, the tapping point on the potentiometer being connected to the movable contact of push-button switch 13 and to the base of transistor 18. The base of transistor 19 is connected to the

tapping point of another potentiometer comprising resistors 22 and 23 and connected between point 6 and the negative terminal of the source 8. Furthermore, the bases of the two transistors are connected together via capacitor 9.

When the internal resistance of cell II decreases, or when the switch 13 is temporarily moved to its left-hand position, the base of transistor 18 becomes positive with respect to its emitter. This transistor becomes conducting, so that the emitter of transistor 19 becomes positive with respect to its base. Both transistors are then conducting and a considerable current flows through the winding of relay 3, which is energized and switches over to headlights. The voltage drop across the winding of relay 3 holds the transistor 18 and hence also the transistor 19 in the conducting state.

When the internal resistance of the photo-electric cell I greatly decreases, or when the switch 13 is temporarily moved to its right-hand position, the base of transistor 18 becomes negative with respect to its emitter and the circuit via the two transistors is cut off, so that the relay 3 is deenergized and switches over to dimlights. When the internal resistance of the cell I first decreases and then abruptly increases (premature dimming of the headlights of an oncoming car), a positive pulse reaches the base of transistor 18. This pulse would tend to open transistor 18 still further. However, via capacitor 9 and after differentiation and sharpening by the RC-members 9, 22, 23, it reaches the base of transistor 19 and cuts off this transistor, resulting in the circuit via the two transistors likewise being cut-off.

The embodiments described are adapted to the needs of traffic and the satisfactory operation thereof is by no means dependant on any standardized modification in the equipment of existing vehicles. They may be used with both dimming systems above described.

While the invention has been described by means of specific examples and in specific embodiments, we do not wish to be limited thereto, for obvious modifications will occur to those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A switching device controlled by an approaching light source, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said light source from a relatively large distance to relative proximity between said first cell and the said light source, a second light sensitive cell positioned in a manner whereby it is illuminated by said light source when the said light source reaches a point beyond the area wherein said first cell is illuminated by the said light source, a switching relay comprising a switching member having at least two stable positions and means for controlling the positioning of said switching member, and means coupling said first and second cells to said switching member control means in a manner whereby the said switching member is positioned in a first stable position when said first cell is illuminated and the said switching member is positioned in a second stable position when said second cell is illuminated.

2. A switching device controlled by a headlight on an approaching vehicle, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said headlight from a relatively large distance to relative proximity between said first cell and the said headlight, a second light sensitive cell positioned in a manner whereby it is illuminated by said headlight when the said headlight reaches a point beyond the area wherein said first cell is illuminated by the said headlight, a switching relay comprising a switching member having first and second stable positions and means for controlling the positioning of said switching member, a first light control circuit including said switching member in said first stable position, a second light control circuit including said switching member in said second stable position, and means coupling said

first and second cells to said switching member control means in a manner whereby the said switching member is positioned in said first stable position thereby closing said first light control circuit when said first cell is illuminated and the said switching member is positioned in said second stable position thereby closing said second light control circuit when said second cell is illuminated.

3. A switching device controlled by a headlight on an approaching vehicle, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said headlight from a relatively large distance to relative proximity between said first cell and the said headlight, a second light sensitive cell positioned obliquely to said first cell in a manner whereby it is illuminated by said headlight when the said headlight reaches a point beyond the area wherein said first cell is illuminated by the said headlight, a switching relay comprising a switching member having a first stable position, a second stable position and means for controlling the positioning of said switching member, a first light control circuit including said switching member in said first stable position, a second light control circuit including said switching member in said second stable position, and means coupling said first and second cells to said switching member control means in a manner whereby the said switching member is positioned in said first stable position thereby closing said first light control circuit when said first cell is illuminated and the said switching member is positioned in said second stable position thereby closing said second light control circuit when said second cell is illuminated.

4. A switching device controlled by an approaching light source, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said light source from a relatively large distance to relative proximity between said first cell and the said light source, a second light sensitive cell positioned in a manner whereby it is illuminated by said light source when the said light source reaches a point beyond the area wherein said first cell is illuminated by the said light source, a switching relay comprising a switching member having at least two stable positions and means for controlling the positioning of said switching member, said switching member control means comprising means including one of said cells for energizing said switching member when said one of the said cells is illuminated and means including the other of said cells for holding the said switching member in position, said holding means being inoperative when said other of the said cells is illuminated, and means coupling said first and second cells to said switching member control means in a manner whereby the said switching member is positioned in a first stable position when said first cell is illuminated and the said switching member is positioned in a second stable position when said second cell is illuminated.

5. A switching device controlled by an approaching light source, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said light source from a relatively large distance to relative proximity between said first cell and the said light source, a second light sensitive cell of high sensitivity positioned in a manner whereby it is illuminated by said light source when the said light source reaches a point beyond the area wherein said first cell is illuminated by the said light source, a switching relay comprising a switching member having at least two stable positions and means for controlling the positioning of said switching member, said switching member control means comprising means including said second cell for directly energizing said switching member when the said second cell is illuminated, and means coupling said first and second cells to said switching member control means in a manner whereby the said switching member is positioned in a first stable position when said first cell is illuminated and the said switching member is positioned in a second stable position when said second cell is illuminated.

6. A switching device controlled by an approaching light source, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said light source from a relatively large distance to relative proximity between said first cell and the said light source, a second light sensitive cell positioned in a manner whereby it is illuminated by said light source when the said light source reaches a point beyond the area wherein said first cell is illuminated by the said light source, a switching relay comprising a switching member having at least two stable positions and means for controlling the positioning of said switching member, said switching member control means comprising means including one of said cells for energizing said switching member when said one of the said cells is illuminated and means for holding the said switching member in position, said holding means comprising an auxiliary relay, an energizing circuit for said auxiliary relay, said energizing circuit including the other of said cells, and contact means controlled by said auxiliary relay for holding said switching member, said holding means being inoperative when said other of the said cells is illuminated, and means coupling said first and second cells to said switching member control means in a manner whereby the said switching member is positioned in a first stable position when said first cell is illuminated and the said switching member is positioned in a second stable position when said second cell is illuminated.

7. A switching device controlled by an approaching light source, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said light source from a relatively large distance to relative proximity between said first cell and the said light source, a second light sensitive cell positioned in a manner whereby it is illuminated by said light source when the said light source reaches a point beyond the area wherein said first cell is illuminated by the said light source, a switching relay comprising a switching member having at least two stable positions and means for controlling the positioning of said switching member, said switching member control means comprising means including said second cell for energizing said switching member when the said second cell is illuminated and means for holding the said switching member in position, said holding means comprising an auxiliary relay, an energizing circuit for said auxiliary relay, said energizing circuit including said first cell, and contact means controlled by said auxiliary relay for holding said switching member, said holding means being inoperative when said first cell is illuminated, and means coupling said first and second cells to said switching member control means in a manner whereby the said switching member is positioned in a first stable position when said first cell is illuminated and the said switching member is positioned in a second stable position when said second cell is illuminated.

8. A switching device for an automotive vehicle controlled by a headlight on an approaching vehicle, comprising a first light sensitive cell positioned on said automotive vehicle in a manner whereby it is illuminated by said headlight from a relatively large distance to relative proximity between said first cell and the said headlight, a second light sensitive cell positioned on said automotive vehicle in a manner whereby it is illuminated by said headlight when the said headlight reaches a point beyond the area wherein said first cell is illuminated by the said headlight, a switching relay comprising a switching member having a first stable position, a second stable position and means for controlling the positioning of said switching member, a dimlight circuit for said automotive vehicle including said switching member in said first stable position, said switching member control means comprising means for positioning said switching member in said first stable position thereby closing said dimlight circuit when said first cell is initially illuminated and said illumination is abruptly decreased in intensity whereby

said switching member is positioned in said first stable position when said headlight of said approaching vehicle is dimmed, a headlight circuit for said automotive vehicle including said switching member in said second stable position, and means coupling said first and second cells to said switching member control means in a manner whereby the said switching member is positioned in said first stable position thereby closing said dimlight circuit when said first cell is illuminated and the said switching member is positioned in said second stable position thereby closing said headlight circuit when said second cell is illuminated.

9. A switching device for an automotive vehicle controlled by a headlight on an approaching vehicle, comprising a first light sensitive cell positioned on said automotive vehicle in a manner whereby it is illuminated by said headlight from a relatively large distance to relative proximity between said first cell and the said headlight, a second light sensitive cell positioned on said automotive vehicle in a manner whereby it is illuminated by said headlight when the said headlight reaches a point beyond the area wherein said first cell is illuminated by the said headlight, a switching relay comprising a switching member having a first stable position, a second stable position and means for controlling the positioning of said switching member, a dimlight circuit for said automotive vehicle including said switching member in said first stable position, said switching member control means comprising an auxiliary relay winding for controlling the positioning of said switching member, a capacitor connected in series circuit arrangement with said auxiliary relay winding for energizing the said winding and means connecting said series circuit arrangement across said first cell whereby when said first cell is initially illuminated and said illumination is abruptly decreased in intensity said winding is energized and said switching member is positioned in said first stable position thereby closing said dimlight circuit when said headlight of said approaching vehicle is dimmed, a headlight circuit for said automotive vehicle including said switching member in said second stable position, and means coupling said first and second cells to said switching member control means in a manner whereby the said switching member is positioned in said first stable position thereby closing said dimlight circuit when said first cell is illuminated and the said switching member is positioned in said second stable position thereby closing said headlight circuit when said second cell is illuminated.

10. A switching device controlled by a headlight on an approaching vehicle, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said headlight from a relatively large distance to relative proximity between said first cell and the said headlight, a second light sensitive cell positioned in a manner whereby it is illuminated by said headlight when the said headlight reaches a point beyond the area wherein said first cell is illuminated by the said headlight, a third light sensitive cell, means for illuminating said third cell, a switching relay comprising a switching member having a first stable position, a second stable position and means for controlling the positioning of said switching member, a first light control circuit including said switching member in said first stable position, said illuminating means and means connecting the said illuminating means in said first light control circuit in a manner whereby the said illuminating means is energized when the said first light control circuit is closed and said first cell is relatively intensely illuminated, a second light control circuit including said switching member in said second stable position, and means coupling said first, second and third cells to said switching member control means in a manner whereby the said switching member is positioned in said first stable position thereby closing said first light control circuit when said first cell is illuminated and the said switching member is positioned in said second stable

position thereby closing said second light control circuit when said second cell is illuminated and when said third cell is illuminated.

11. A switching device controlled by a headlight on an approaching vehicle, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said headlight from a relatively large distance to relative proximity between said first cell and the said headlight, a second light sensitive cell positioned in a manner whereby it is illuminated by said headlight when the said headlight reaches a point beyond the area wherein said first cell is illuminated by the said headlight, a third light sensitive cell connected in parallel circuit arrangement with said second cell, means for illuminating said third cell, a switching relay comprising a switching member having a first stable position, a second stable position, a break contact and means for controlling the positioning of said switching member, a first light control circuit including said switching member in said first stable position, said illuminating means and means connecting the said illuminating means in said first light control circuit with said first cell and said break contact in a manner whereby the said illuminating means is energized when the said first light control circuit is closed and said first cell is relatively intensely illuminated, a second light control circuit including said switching member in said second stable position, and means coupling said first, second and third cells to said switching member control means in a manner whereby the said switching member is positioned in said first stable position thereby closing said first light control circuit when said first cell is illuminated and the said switching member is positioned in said second stable position thereby closing said second light control circuit when said second cell is illuminated and when said third cell is illuminated.

12. A switching device for an automotive vehicle controlled by a headlight on an approaching vehicle, comprising a first light sensitive cell positioned on said automotive vehicle in a manner whereby it is illuminated by said headlight from a relatively large distance to relative proximity between said first cell and the said headlight, a second light sensitive cell positioned on said automotive vehicle in a manner whereby it is illuminated by said headlight when the said headlight reaches a point beyond the area wherein said first cell is illuminated by the said headlight, auxiliary means for illuminating said second cell, a switching relay comprising a switching member having a first stable position, a second stable position, a break contact and means for controlling the positioning of said switching member, a dimlight circuit for said automotive vehicle including said switching member in said first stable position, said illuminating means and means connecting the said illuminating means in said dimlight circuit with said first cell and said break contact in a manner whereby the said illuminating means is energized when the said dimlight circuit is closed and said first cell is relatively intensely illuminated, a headlight circuit for said automotive vehicle including said switching member in said second stable position, and means coupling said first and second cells to said switching member control means in a manner whereby the said switching member is positioned in said first stable position thereby closing said dimlight circuit when said first cell is illuminated and the said switching member is positioned in said second stable position thereby closing said headlight circuit when said second cell is illuminated.

13. A switching device controlled by an approaching light source, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said light source from a relatively large distance to relative proximity between said first cell and the said light source, a second light sensitive cell positioned in a manner whereby it is illuminated by said light source when the said light source reaches a point beyond the area wherein

said first cell is illuminated by the said light source, a switching relay comprising a switching member having at least two stable positions and means for controlling the positioning of said switching member, said switching member control means comprising means including said second cell for energizing said switching member when the said second cell is illuminated and means for holding the said switching member in position, said holding means comprising a winding portion of said switching relay and an energizing circuit for said winding portion, said energizing circuit including said first cell, said holding means being inoperative when said first cell is illuminated, and means coupling said first and second cells to said switching member control means in a manner whereby the said switching member is positioned in a first stable position when said first cell is illuminated and the said switching member is positioned in a second stable position when said second cell is illuminated.

14. A switching device controlled by an approaching light source, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said light source from a relatively large distance to relative proximity between said first cell and the said light source, a second light sensitive cell positioned in a manner whereby it is illuminated by said light source when the said light source reaches a point beyond the area wherein said first cell is illuminated by the said light source, a switching relay comprising a switching member having at least two stable positions and means for controlling the positioning of said switching member, a first light control circuit including said switching member in a first stable position, said switching member control means comprising at least two winding portions of said switching relay for controlling the positioning of said switching member, a capacitor connected in series circuit arrangement with said winding portions for energizing said winding portions and means connecting said series circuit arrangement across said first and second cells whereby when said first cell is initially illuminated and said illumination is abruptly decreased in intensity said winding portions are energized by said capacitor and said switching member is positioned in said first stable position thereby closing said first light control circuit, a second light control circuit including said switching member in a second stable position, and means coupling said first and second cells to said switching member control means in a manner whereby the said switching member is positioned in said first stable position thereby closing said first light control circuit when said first cell is illuminated and the said switching member is positioned in said second stable position thereby closing said second light control circuit when said second cell is illuminated.

15. A switching device controlled by an approaching light source, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said light source from a relatively large distance to relative proximity between said first cell and the said light source, a second light sensitive cell positioned in a manner whereby it is illuminated by said light source when the said light source reaches a point beyond the area wherein said first cell is illuminated by the said light source, a switching relay comprising a switching member having at least two stable positions and means for controlling the positioning of said switching member, said switching member control means comprising a winding portion of said switching relay for energizing said switching member when said second cell is illuminated and for holding the said switching member in position and a transistor switching arrangement, and means coupling said first and second cells to said winding portion and coupling said transistor switching arrangement between

said first and second cells and said winding portion in a manner whereby said switching member is positioned in a first stable position when said first cell is illuminated and the said switching member is positioned in a second stable position when said second cell is illuminated.

16. A switching device controlled by an approaching light source, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said light source from a relatively large distance to relative proximity between said first cell and the said light source, a second light sensitive cell positioned in a manner whereby it is illuminated by said light source when the said light source reaches a point beyond the area wherein said first cell is illuminated by the said light source, a switching relay comprising a switching member having at least two stable positions and means for controlling the positioning of said switching member, said switching member control means comprising a winding portion of said switching relay for energizing said switching member when said second cell is illuminated and for holding the said switching member in position and a transistor switching arrangement comprising a pair of opposite conductivity type transistors each having emitter, collector and base electrodes and a collector-emitter path, the emitter electrodes of said transistors being connected together, means connecting said collector-emitter paths in series circuit arrangement with each other and with said winding portion, and means coupling said first and second cells to the base electrode of one of said transistors in a manner whereby said switching member is positioned in a first stable position when said first cell is illuminated and the said switching member is positioned in a second stable position when said second cell is illuminated.

17. A switching device controlled by an approaching light source, comprising a first light sensitive cell positioned in a manner whereby it is illuminated by said light source from a relatively large distance to relative proximity between said first cell and the said light source, a second light sensitive cell positioned in a manner whereby it is illuminated by said light source when the said light source reaches a point beyond the area wherein said first cell is illuminated by the said light source, a switching relay comprising a switching member having at least two stable positions and means for controlling the positioning of said switching member, said switching member control means comprising a winding portion of said switching relay for energizing said switching member when said second cell is illuminated and for holding the said switching member in position and a transistor switching arrangement, said transistor switching arrangement comprising a pair of opposite conductivity type transistors each having emitter, collector and base electrodes and a collector-emitter path, the emitter electrodes of said transistors being connected together, means connecting said collector-emitter paths in series circuit arrangement with each other and with said winding portion, and a potentiometer connected across said first and second cells and between the collector electrodes of said transistors, said first potentiometer having a tapping point connected to the base electrode of one of said transistors in a manner whereby said switching member is positioned in a first stable position when said first cell is illuminated and the said switching member is positioned in a second stable position when said second cell is illuminated.

References Cited in the file of this patent

UNITED STATES PATENTS

2,573,627	Vanderlip	Oct. 30, 1951
2,807,752	McIlvaine	Sept. 24, 1957