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GB A 2010606	**GB 1430322**
GB A 2008871	**GB 1194242**
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(58) Field of search
H2H

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(54) Protective circuit system for emergency light

(57) An emergency lighting system includes means to prevent over-charging and over-discharging of its battery VB. When the mains AC supply is present, relay CR1 is energised to close contacts CR1*a* to charge the battery VB from rectifier S1. When the battery voltage reaches a preset level, a transistor Q1 energises a relay CR3 thereby opening contacts CR3*b* to stop battery charging by turning off a bias G in the primary circuit of a charging transformer Tr. If the AC mains fails, transistor Q2 turns on relay CR2 to close contacts CR2*a* so that the battery VB discharges into the lamp RL until the battery voltage falls below the threshold set by Zener diode ZD3 whereupon transistor Q3 turns off to de-energise relay CR2 and stop discharge of the battery. If the ambient illumination is above a certain level when the mains supply fails, a photocell *Cds* prevents transistor Q2 turning on thereby preventing discharge of the battery VB into the lamp RL.

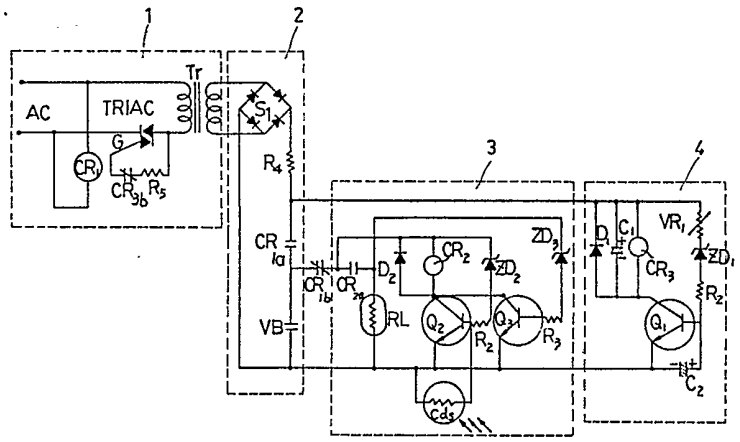

FIG. 2

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This print reflects (an) amendment(s) to the request for grant effected pursuant to Rule 35 of the Patents Rules 1978 or 1982.

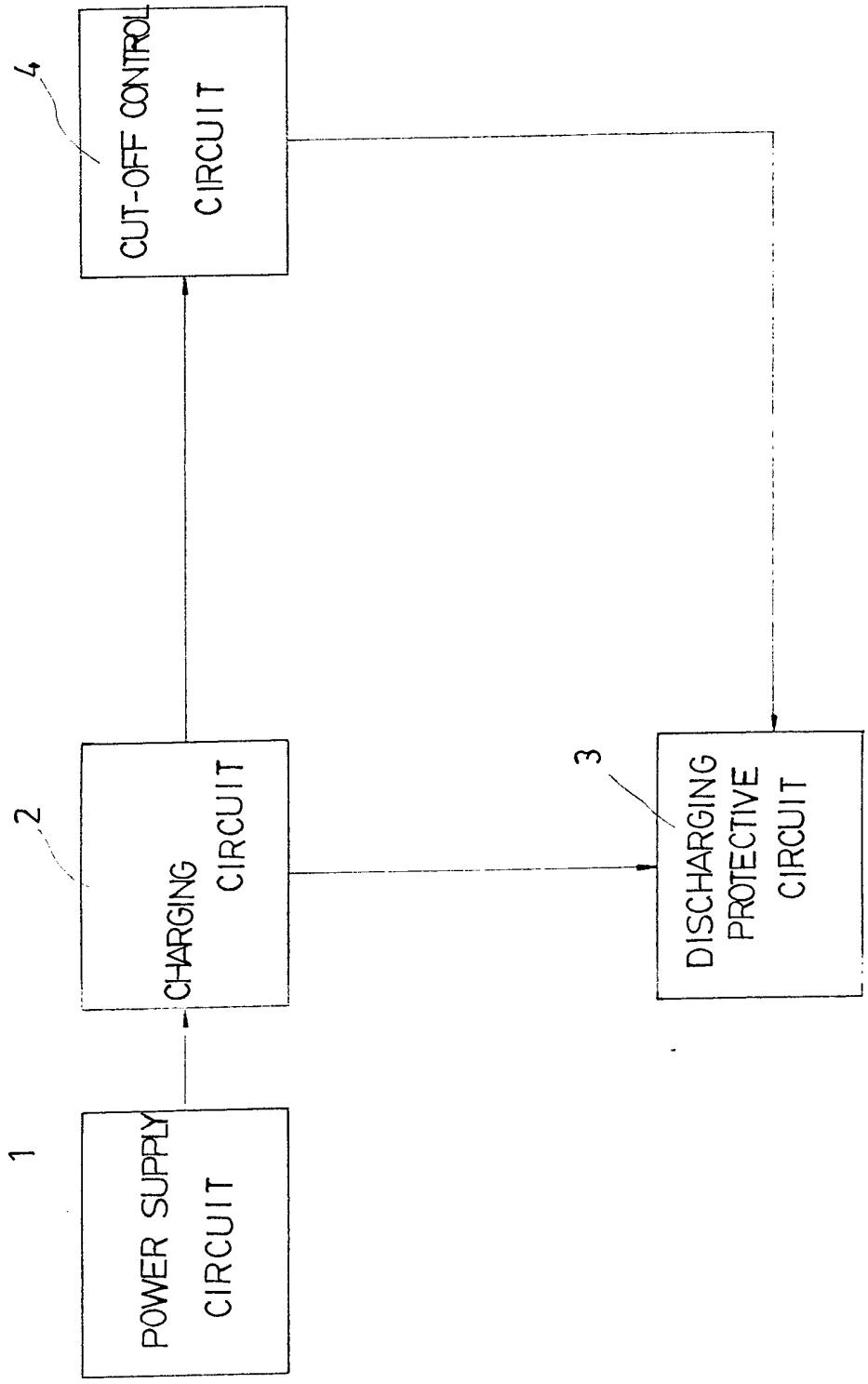
1
POWER SUPPLY CIRCUIT
2
CHARGING CIRCUIT
3
DISCHARGING PROTECTIVE CIRCUIT
4
CUT-OFF CONTROL CIRCUIT

FIG.1

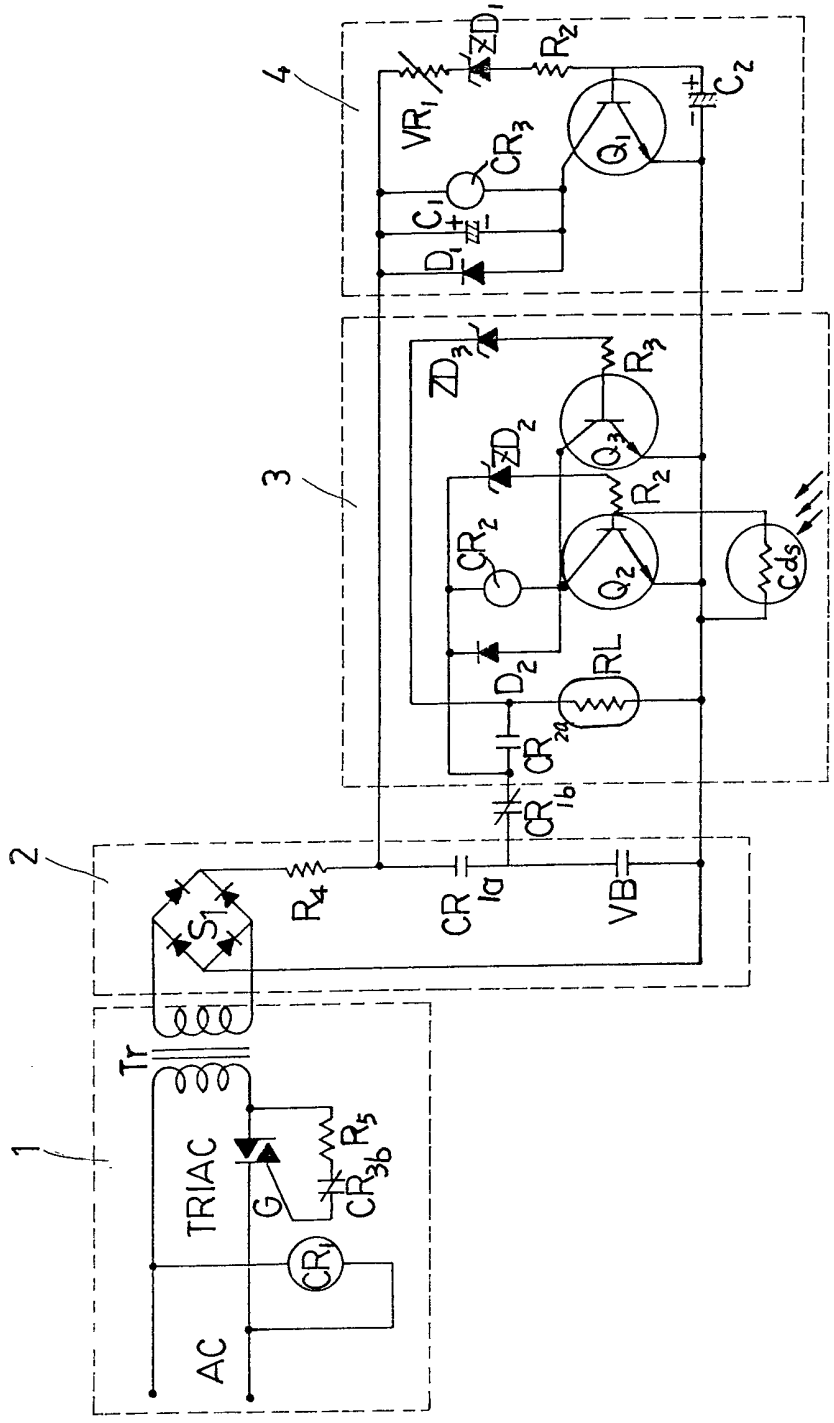
1
2
3
4
AC
TRIAC
Tr
G
CR1
CR3b
R5
S1
R4
CR1a
VB
CR1b
ZD3
R3
ZD2
Q3
R2
CR2
Q2
CdS
D2
RL
CR2a
VR1
ZD1
R2
Q1
C2
CR3
C1
D1

FIG. 2

SPECIFICATION

Protective circuit system for emergency light

This invention relates to a circuit system for emergency light, and is more particularly dealt with protective arrangement for energy saving and equipment protecting purposes.

Conventionally, all emergency lights are built with a circuit system for direct charging and discharging operations. When there is no power failure, the charging circuit thereof is always kept at a charging state consuming too much energy therein; whereas, when emergency lighting takes place during a power failure, the discharging circuit remains discharging until the power source from the storage battery thereof is completely consumed. Moreover, if the emergency power source of the storage battery is completely consumed in the day, no emergency light can be provided at night in case of power failure then and there. Besides, the over-charging and over-discharging operations often incur cracking to the battery plates, resulting in damaging the battery set thereof.

It is, accordingly, a primary object of this invention to provide a protective circuit system for emergency light with a novel discharging protective circuit for ensuring a function that the discharging operation is effected not solely by the failure of the power source but rather by the condition of the ambient illumination so as to conserve the energy of the storage battery and minimize power consumption as well.

It is another object of this invention to provide a protective circuit system for emergency light with discharging and cut-off control circuits for performing the double functions that when the storage battery is fully charged, the charging circuit thereof will be automatically cut off from the power source, and that when the emergency lighting takes place and the storage battery discharges to a certain voltage level, the discharging circuit thereof will also be automatically cut off, so that, no over-charging and over-discharging will occur so as to ensure the life span of the storage battery in addition to saving energy consumption.

These and other objects have been achieved by providing a protective circuit system for emergency light, which system comprises in combination a power supply circuit for being connected to the domestic A.C power source, a charging circuit coupled with the power supply circuit for performing charging functions, a discharging circuit connected to the charging circuit for removing energy from the charging circuit in accomplishing emergency lighting operations as well as for stopping the discharging operation under certain condition, and a cut-off control circuit coupled with both the charging circuit and the discharging circuit for automatically cutting off the charging operation when the storage battery is fully charged thereat.

To assist in a better understanding of this invention, a preferred embodiment is described hereunder in some detail with reference to and as illustrated in the accompanying drawings, in which:

Figure 1 is a block diagram illustrating a preferred embodiment of a protective circuit system for emergency light according to this invention; and

Figure 2 is a circuit diagram of the preferred embodiment shown in Figure 1.

Referring to Figure 1, there is shown a preferred embodiment of a protective circuit system for emergency light according to this invention, which system comprises in combination a power supply circuit 1 for providing the required power source, a charging circuit 2 connected to the power supply circuit 1 for receiving the power and performing the required charging operations, a discharging protective circuit 3 connected to the charging circuit 2 for removing the charged energy thereof and accomplishing emergency lighting operations under certain condition, and a cut-off control circuit 4 electrically coupled with both the charging circuit 2 and the discharging protective circuit 3 for automatically controlling the charging operations so as to protect the system from getting damaged by over charging and over discharging as well as to ensure economical consumption of the power source.

Referring to Figure 2, the power supply circuit 1 is mainly combined by a transformer Tr, a TRIAC arrangement and a relay CR_1. The primary coil of the transformer Tr is connected to the domestic A.C. power source with the relay CR_1 in parallel connection thereto. The TRIAC including a normally closed relay contact CR_{3b} and a resistor R_5 connected in series to the gate terminal G is coupled with the primary coil of the transformer Tr in serial connection through the two anodes thereof.

The charging circuit 2 mainly includes a bridge rectifier S_1 and a storage battery VB, together with a normally open relay contact CR_{1a} and a resistor R_4. The two input terminals of the bridge rectifier S_1 are respectively connected to the terminals of the secondary coil of the transformer while the output terminals are separately linked with the negative and positive terminals of the battery VB with the normally open relay contact CR_{1a} and the resistor R_4 connected in series to the positive end.

The discharging protective circuit 3 is electrically coupled with the charging circuit 2 through a normally open relay contact CR_{2a} and a normally closed relay contact CR_{1b} connected in series to the positive end of the storage battery VB. The major components of the discharging protective circuit 3 include an illuminator RL, a pair of transistors Q_2 and Q_3, a diode D_2, a relay CR_2, a photosensitive diode Cds, and a pair of zener diodes ZD_2 and ZD_3. The emitter of the transistor Q_2 is connected to the negative terminal of the battery VB, the collector to the normally closed relay contact CR_{1b} through the diode D_2 and the relay CR_2 connected in parallel thereat, and the base to the normally closed relay contact CR_{1b} through a resistor R_2 and the zener diode ZD_2. The connection of the emitter and collector of the transistor Q_3 is the same as that of the transistor Q_2 except for the base, which is connected to the normally open relay contact CR_{2a} through a series-connected resistor R_3 and the zener diode ZD_3. The illuminator RL is coupled between the negative terminal of the battery VB and the normally open relay contact CR_{2a}. The photosensi-

tive diode Cds is provided by having one end connected to the negative terminal of the battery VB and the other to the base of the transistor Q_2.

In the discharging protective circuit 3, the transistor Q_2 arrangement is used to control the high-level discharging operations while the transistor Q_3 arrangement is for controlling the low-level discharging operations.

The cut-off control circuit 4 coupled with both the charging circuit 2 and the discharging circuit 3 mainly includes: a transistor Q_1 having its emitter connected to the negative terminal of the battery VB, the collector and the base to the normally open relay contact CR_{1a}; a diode D_1, a polar capacitor C_1 and a relay DR_3 connected in parallel between the collector of Q_1 and the normally open relay contact CR_{1a}; a variable resistor VR_1, a zener diode ZD_1 and a resistor R_2 connected in series between the base of the transistor Q_1 and the normally open relay contact CR_{1a}; and a polar capacitor C_2 connected between the base and the emitter of the transistor Q_1.

Operations of the circuit system shown in Figure's 1 and 2 are as follows:

When the power supply circuit 1 is electrically connected to the domestic A.C. power source with the storage battery VB not fully charged thereat, the coil of the relay CR_1 will be energized to have its normally closed relay contact CR_{1b} between the charging circuit 2 and the discharging circuit 3 to be switched open (to contact a), causing the discharging circuit 3 to be in cut-off state; while, the normally open relay contact CR_{1a} of the relay CR_1 in the charging circuit 2 is switched closed (to contact b) so as to start charging the storage battery VB. At this time, owing to the fact that the charging potential of the battery VB is lower than the rated potential level thereof, the transistor Q_1 in the cut-off control circuit 4 cannot be actuated to conduct therefrom. As a result, the relay CR_3 of the cut-off control circuit 4 remains not energized thereat with its normally closed relay contact CR_{3b} in the power supply circuit 1 being kept in conducting condition therein for making the gate terminal G of the TRIAC being kept in triggered condition so as to enable the bridge rectifier S_1 of the charging circuit 2 to perform its full-wave rectifying function in charging the storage battery VB.

When the charging potential of the battery VB reached at the rated potential, the voltage drop across the variable resistor VR_1 (whose resistance value can be set in advance) will become high enough to cause the zener diode ZD_1 to avalanche and the polar capacitor C_2 to start charging therefrom. When the charging potential of the capacitor C_2 reached at its threshold value, a forward bias will cause the transistor Q_1 to conduct thereat, and the relay CR_3 is therefore energized to switch from the normally closed contact CR_{3b} in the power supply circuit 1 to open contact (contact a), and to cause the TRIAC to cut off thereat. As a result, the bridge rectifier S_1 is open, and no current flows to the storage battery VB. Thus, the fully charged battery VB is kept in normal recess condition, and the unnecessary charging operation is obviated accordingly.

During a power failure at day, if the ambient illumination is below 20 lux, the resistance value of the photosensitive diode Cds in the discharging protective circuit 3 will be rapidly increased to such a level that the circuit thereof is kept in an open state. At this time, due to the power failure of the power supply circuit 1, the relay CR_1 is de-energized with the normally open contact CR_{1a} remaining at off state and the normally closed contact CR_{1b} at closed condition, so that, the current of the storage battery VB flows into the discharging protective circuit 3. At this stage, if the discharging potential of the storage battery VB is higher than the threshold voltage (5.6V) of the zener diode ZD_2, a forward current will flow through the transistor Q_2 (because the Cds thereof has become an open circuit thereat as described above), and the relay CR_2 is energized with the normally open contact CR_{2a} being switched to closed contact condition (contact b), resulting in the lighting of the illuminator RL for accomplishing emergency illumination operation.

At the time when the relay CR_2 was switched from the normally open contact CR_{2a} to closed contact state (contact b), and the discharging potential of the battery VB is still higher than the threshold voltage (4 V) of the zener diode ZD_3, a forward current will continue to flow across the transistor Q_3, which is designed to enable the battery VB to keep on discharging after its potential becomes lower than the threshold voltage (5.6 V) of the zener diode ZD_2, and to keep the relay CR_2 in energized condition until the discharging potential of the battery VB is decreased to the level below the value of 4 vots, then, the transistor Q_3 will be finally cut off, and the relay CR_2 is therefore de-energized with the normally open contact CR_{2a} returning to its open state. As long as the potential value of the battery VB is below the threshold value of the zener diode ZD_2, no current will flow therefrom, and the relay CR_2 will remain de-energized thereat.

On the other hand, when the power source fails at day, but the ambient illumination is still above 20 lux, due to the fct that the sudden decrease of the resistance of the photosensitive diode Cds keeps its circuit in a closed state, no forward current will flow across the base of the transistor Q_2 to make it conduct, and the relay CR_2 remains not energized thereat, resulting in no discharging from the battery VB and no lighting by the illuminator RL so as to achieve energy saving purpose.

In order to prevent the preferred embodiment of this invention from taking erroneous operation at night, a lighting element (not shown) can be installed over the photosensitive diode Cds through the live line of the domestic power source so as to provide the Cds with an illumination without causing error action.

It shall be appreciated that this invention resides in the following advantageous features:

(1). When the storage battery VB is fully charged, the power source will be automatically cut off through the cut-off control circuit 4.

(2). The discharging action of the storage battery VB is effected only under the condition of the ambient illumination. If the ambient illumination in

the place is above a preset illuminating value, even the power source fails, no discharging action will take place, and no emergency lighting will occur, unless the ambient illumination is below the preset illuminating value thereof.

(3). When the storage battery VB discharges to a certain voltage level, it will automatically stop without over-discharging and incurring damage to the battery plates.

While a preferred embodiment has been chosen to illustrate this invention, it will be understood by those skilled in the art that various changes and modifications may be made therein without departing from the spirit and scope of this invention as defined in the appended claims.

CLAIMS

1. A protective circuit system for emergency light comprising:

power supply means for connection to the domestic power supply,

a charging circuit coupled to the power supply means and including a chargeable storage battery,

illuminating means for providing said emergency light,

a discharging protective means coupled between the charging circuit and the illuminating means, for discharging energy from the storage battery and supplying power to the illuminating means, the discharging protective means including means to stop discharging from the storage battery under prescribed conditions,

and cut-off control means coupled between the charging circuit and the discharging protective means for automatically controlling the charging and discharging of the storage battery so that no over-charging or over-discharging will take place.

2. A protective circuit system for emergency light according to claim 1, in which said power supply means comprises:

a transformer with its primary coil for connection with the domestic A.C. power supply,

a first relay device connected in parallel to the primary coil of said transformer and having a normally open contact and a normally closed contact; and

a TRIAC device connected in series with the primary coil of said transformer.

3. A protective circuit system for emergency light according to claim 2 in which the charging circuit comprises:

a bridge rectifier with two input terminals respectively connected to the secondary-coil terminals of the transformer,

and a resistance element connected to an output terminal of said bridge rectifier at one end and to the normally open contact of said first relay device at another,

the storage battery having its negative terminal connected to the other output terminal of the bridge rectifier and its positive terminal to said normally open contact of said first relay device.

4. A protective circuit system for emergency light according to claim 3 in which said discharging protective means comprises:

a first discharging control means coupled with the charging circuit for controlling the high-level discharging operations,

a second discharging means connected to said first discharging means for controlling the low-level discharging operations,

the illuminating means being coupled between the negative terminal of said storage battery and said second discharging means for performing emergency lighting operation, and

a photosensitive element connected between the negative terminal of said storage battery and said first discharging control means, so that, illuminating and discharging operations are automatically controlled under prescribed conditions.

5. A protective circuit system for emergency light according to claim 4 wherein said first discharging means comprises:

a second transistor having its emitter connected to the negative terminal of the storage battery,

a second diode with the anode connected to the collector of said second transistor and the cathode to said normally closed contact of said first relay device,

a second relay device connected between the collector of said second transistor at one end and the cathode of said second diode and having a normally open contact and a normally closed contact, and

a second zener diode with the cathode connected to said second relay device and the anode to the base of said second transistor.

6. A protective circuit system for emergency light according to claim 5 in which the second discharging means comprises:

a third transistor with its collector connected to the end of said second relay device in association with the collector of said second transistor, and its emitter to the negative terminal of said storage battery, and

a third zener diode with the cathode connected to said normally open contact of said second relay device and the anode to the base of said third transistor.

7. A protective circuit system for emergency light according to any one of claims 2 to 6 in which said cut-off control means is characterised by:

a first transistor with its emitter connected to the negative terminal of the storage battery,

a first diode with its cathode connected to said normally open contact of said first relay device and the anode to the collector of said first transistor,

a first polar capacitor connected between the collector of said first transistor and the cathode of said first diode,

a third relay having a normally open contact and a normally closed contact connected between the collector of said first transistor and said TRIAC device,

a second polar capacitor connected between the emitter and the base of said first transistor,

a first zener diode with the anode connected to the base of said first transistor, and

a variable resistor connected between the cathode of said first zener diode and the normally open contact of said first relay device, whereby, charging

operation of the storage battery may be controlled through the state of cut-off and conduction of said first transistor.

8. A protective circuit system for emergency light substantially as hereinbefore described with reference to and shown in the accompanying drawings.

9. A protective circuit for an emergency light according to claim 1, arranged substantially as described with reference to the accompanying drawings.

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