(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 150 093 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
03.02.2010 Bulletin 2010/05

(51) Int Cl.:
H05B 33/08 *(2006.01)*

(21) Application number: **09009400.4**

(22) Date of filing: **20.07.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
AL BA RS

(30) Priority: **30.07.2008 EP 08425529**

(71) Applicant: **Magnaghi, Piero**
21030 Castello Cabiaglio (VA) (IT)

(72) Inventor: **Magnaghi, Piero**
21030 Castello Cabiaglio (VA) (IT)

(74) Representative: **Valentini, Giuliano**
Marietti Gislon e Trupiano S.r.l.
Via Larga 16
20122 Milano (IT)

(54) **LED lamp and method for operating the same**

(57) There is described a light lamp which can be supplied at mains voltage and a method for its operation, wherein the lamp includes at least one LED and at least one PTC thermistor connected in series to the supply line of the LED. The dissipation of heat generated into the lamp is provided to keep the PTC thermistor at a predetermined substantially constant operating temperature.

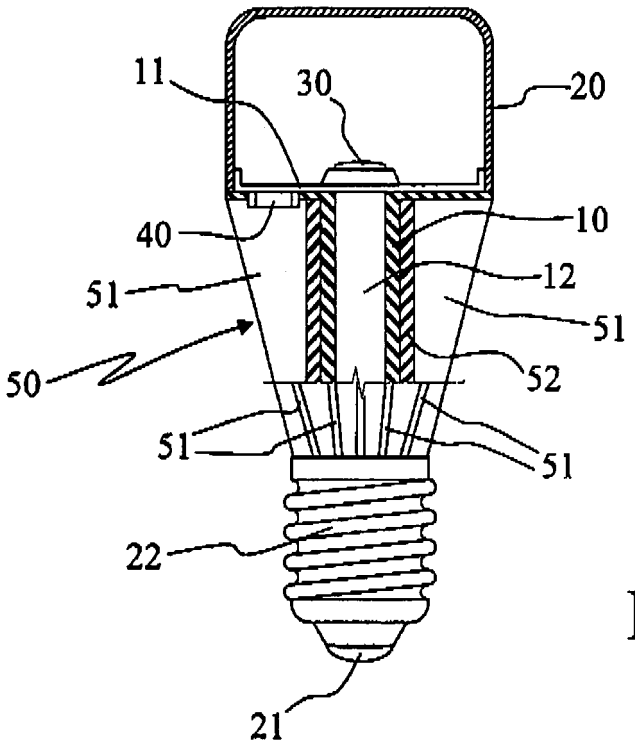

Fig. 1

EP 2 150 093 A2

Description

[0001] The present invention relates to a LED (Light Emitting Diode) illumination lamp and, in particular, to a lamp which can be supplied at mains voltage.

[0002] Due to increasing needs to curb energy consumptions also in the field of illumination, over the last years alternative lamps to conventional incandescent lamps have been proposed. In fact, it is known that a common incandescent lamp transforms only 10% of the energy received into light emission, while the remaining 90% of the energy received is dissipated in heat.

[0003] Therefore, lamps having an increased light emission yield have been proposed, such a compact fluorescent lamps and LED lamps which require less electrical energy to emit the same amount of light.

[0004] In the field of LED lamps there are already lamps on the market that use a plurality of low voltage LEDs. These LEDs are supplied with a direct current which is kept substantially constant by a high frequency control circuit to perform the necessary reduction in the power supply voltage and stabilize the current.

[0005] However, these known types of LED lamps still present different drawbacks.

[0006] In fact, suitable measures must be taken to guarantee electrical insulation of the various components present in the lamp, and to guarantee sufficient heat dissipation. In fact, the high frequency control circuit and also the LEDs, although to a lesser degree with respect to incandescent lamps, produce heat which must be dissipated. In fact, the temperature can influence the duration and correct operation of the LEDs.

[0007] The use of plastic materials only in LED lamps of known type can guarantee the necessary electrical insulation but is unsatisfactory from the viewpoint of heat dissipation.

[0008] Other measures must also be provided to limit electromagnetic emissions generated by the high frequency control circuit required to supply low voltage LEDs, in order to comply with the EMC standards in relation to electromagnetic emissions. Also in this case, besides requiring necessarily the use of suitable filters into the control circuit, the plastic materials used in LED lamps of known type alone do not provide any shielding against electromagnetic emissions.

[0009] EP-A-1526759 discloses some embodiments of LED lamps in which a temperature sensitive component, in particular a PTC thermistor, is used to protect the LEDs by limiting the maximum supply current as the temperature increases.

[0010] EP-A-0891120 relates to some circuits for protecting the LEDs from high currents and temperatures in lamps for motorvehicles, wherein a PTC thermistor is connected in series to the LED supply in order to obtain the desired protection.

[0011] In these examples of prior art the PTC thermistors are forced to work throughout their whole characteristic curve, particularly along the linear section where the coefficient is strongly positive. Indeed, in the linear section of the characteristic curve, the resistance increases significantly even for small changes in temperature and therefore, for the same supply voltage, the supply current of the LEDs is reduced drastically to avoid damage. This can lead however to a significant fluctuation of the light emission and power dissipation.

[0012] The task of the present invention is to provide a LED lamp that overcomes the drawbacks of the prior art.

[0013] Within this task, an object of the present invention is to provide a LED lamp having very limited or no electromagnetic emissions.

[0014] Another object of the present invention is to provide a LED lamp and a method for operating the same that allow the electrical power input of the lamp, and therefore its light emission, to be maintained as constant as possible, regardless of fluctuations in the electrical parameters in the mains power supply.

[0015] A further object of the present invention is to provide a LED lamp that allows the heat generated by these LEDs and by the relative power supply control circuit to be effectively dissipated.

[0016] These objects are achieved by the present invention, which relates to an illumination lamp according to claim 1 and a method for operating the same according to claim 7. Further features of the present invention are listed in the relevant dependent claims.

[0017] The LED lamp includes in particular at least one PTC thermistor connected in series to the supply line of the LED(s) and suitable means for dissipating the heat generated into the lamp in order to keep the PTC thermistor at a preset substantially constant operating temperature.

[0018] The dissipation of the heat generated into the lamp tends to stabilize the temperature of the system by varying the current in proportion through the PTC thermistor and other components of supply control circuit connected to it.

[0019] In other words, a particular thermodynamic coupling is established between the PTC thermistor and the lamp as a whole, so that the PTC thermistor can be operated at a specific point of its characteristic curve (also known as "knee") near or below its transition temperature.

[0020] The system according to the present invention has unique characteristics because it can be adapted to different environmental and voltage conditions, bringing the system to always work at the same temperature, then at the same power dissipation, and therefore at the same brightness level regardless of the voltage supply and other parameters.

[0021] This advantageously allows to make light lamps with high light emission without compromising the proper operation and useful life of the lamp itself.

[0022] The use of LEDs supplied directly with alternating current at mains voltage makes it possible to avoid the use of circuits operating at high frequency, which are

the main cause of electromagnetic emissions.

[0023] In the lamp according to the present invention, the means for heat dissipation include at least one body made of thermally conductive and electrically insulating plastic material to which a heat dissipator is thermally coupled.

[0024] The heat dissipator, preferably made of aluminium or its alloys, is produced in the form of a plurality of fins that project radially outward from a cylindrical body fixed by means of a thermally conductive material, such as a paste, a resin or the like, to this body in thermally conductive plastic material. In this manner, the most appropriate characteristics of each material are taken advantage of, the plastic having good thermal conductivity, and the aluminium having good heat dissipation properties, thereby making dissipation of the heat generated by the lamp particularly effective and, at the same time, allowing for the operation of the PTC thermistor in a very limited range of its characteristic curve.

[0025] Further characteristics and advantages of the present invention will be more apparent from the description below with reference to the accompanying drawings, in which:

- Figure 1 is a partially sectional schematic view of a lamp according to a possible embodiment of the present invention;
- Figure 2 is a diagram illustrating the characteristic curve of a PTC thermistor;
- Figure 3 is a diagram of the power supply control circuit according to a first embodiment of the present invention;
- Figure 4 is a diagram of the power supply control circuit in accordance with a second embodiment of the present invention; and
- Figures 5A and 5B are schematic plan views of other possible embodiments of a lamp according to the present invention.

[0026] The lamp shown in Figure 1 includes a body 10 made of thermally conductive and electrically insulating plastic material, on which a bulb 20, made of plastic material transparent to the light, is removably mounted. The embodiment represented here is that of a lamp having a common screw base provided with terminals 21 and 22.

[0027] The body 10 is made of thermally conductive plastic material, such as the compound LATICONTHER 82 manufactured by LATI S.p.A., or other similar materials having a good level of thermal conductivity, and the bulb 20 is produced, for example, of polycarbonate or other similar sufficiently heat-resistant materials.

[0028] The body 10 includes a hollow cylindrical portion 12 which if necessary can house a fuse 23 (Figures 3 and 4) and through which the conductors (not shown) pass for connection of the terminals 21 and 22 that supply the electrical power to the control circuit and, from this, to the LED or LEDs installed in the lamp.

[0029] Removably mounted on the body 10 is a board 11, which supports at least one LED 30 on the upper face thereof and can include on the lower face thereof the connection tracks for the components of the power supply control circuit, among which a thermistor 40 of the PTC type is provided, positioned in contact with this board 11.

[0030] The thermistor 40 is shown in Figure 1 as a component of the SMD type (Surface Mounting Device) mounted on the lower face of the board 11, but can also be of a different type and/or mounted on the upper face of the board 11, as will be explained below.

[0031] The LED 30 is preferably a LED supplied with alternating current at mains voltage, for example a LED of the ACRICHE series manufactured by Seoul Semiconductors.

[0032] The body 10 made of thermally conductive plastic material is thermally coupled to a heat dissipator 50 made of aluminium or its alloys. The dissipator 50 includes a plurality of fins 51 which project radially outward from a cylindrical body 52 fixed to the outer surface of the cylindrical portion 12 of the body 10 made of thermally conductive plastic material.

[0033] The heat dissipator 50 is also thermally coupled to the body 10 through interposition of a thermally conductive material between the surfaces reciprocally in contact. Suitable materials to produce fixing and thermal coupling are represented by the thermally conductive adhesives, such as a paste with the identification code 315 from the LOCTITE® line (Henkel), or other materials having similar characteristics.

[0034] The characteristic curve of a PTC thermistor is represented in Figure 2, by way of example, in a diagram that illustrates the values of resistance of the thermistor R_{PTC} as a function of the values of temperature T_{PTC} to which the thermistor is subject.

[0035] The transition temperature Ts (also known as the Curie temperature) is particularly highlighted in the graph, above which the thermistor takes a strongly positive and almost linear coefficient as the temperature changes.

[0036] The working point Wp of the PTC thermistor 40 is also highlighted along the characteristic curve, which corresponds to a predetermined working temperature Tw at which the thermistor is maintained using the means 50 for the heat dissipation according to the present invention. During operation, the working temperature Tw is maintained substantially constant, or anyway variable in a short range near the transition temperature Ts.

[0037] Preferably, the heat dissipation means allow to maintain the working temperature Tw at a value below the transition temperature Ts, contrary to what occurs in the known supply systems in which the PTC thermistor generally works in the linear section of the curve with temperatures above the transition temperature Ts.

[0038] Figure 3 represents the diagram of an electrical power supply control circuit in a lamp according to the present invention. Starting from the terminal 21, a resistor R1, of suitable value to limit the maximum current circu-

lating in the lamp, is connected in series downstream of the protective fuse 23.

[0039] Downstream of the resistor R1, the circuit continues with parallel connection between the PTC thermistor 40 and a resistor R2 with suitable value to correct the current of this thermistor 40. At the output of the parallel connection of these two components, the circuit continues with one or more LEDs 30 connected in parallel with one another and then continues to the other terminal 22 of the lamp.

[0040] An alternative embodiment to the circuit of Figure 3 is represented in Figure 4, in which, between the LEDs 30 and the terminal 22, a capacitor C1 as current limiter and a respective discharge resistor R3 are also provided, connected in parallel to each other.

[0041] This embodiment of the circuit is more suitable in the case in which low power LEDs 30 are used. In this case, the limiting resistor R1 must dissipate a large amount of energy and it is therefore advisable to fit a capacitor C1 in series with the circuit to vary the phase of the current and decrease leakages.

[0042] Figures 5A and 5B show some possible embodiments of a lamp according to the invention with two or three LEDs 30.

[0043] For example, the lamp in the configuration of Figure 5A provides for the use of two LEDs 30 and the PTC thermistor is composed of an SMD component mounted on the opposite face of the board 11 with respect to the LEDs 30.

[0044] The lamp in the configuration of Figure 5B includes, for example, three LEDs 30 and a PTC thermistor mounted on the same face of the board 11 housing the LEDs. In the case in which the PTC thermistor is not of the SMD type, as in the case represented in Figure 5B, it must in any case be thermally coupled to the surface of the board, for example using also in this case thermally conductive pastes such as those previously described for thermal coupling between the body made of plastic material 10 and the dissipator 50.

[0045] From the above, it is evident to those skilled in the art that the present invention allows all the previously illustrated problems of prior art to be solved and, above all, in full compliance with current legislations.

[0046] In particular, due to the absence of high frequency circuits, a lamp according to the present invention does not produce electromagnetic emissions.

[0047] Moreover, due to coupling of the thermally conductive plastic material with a dissipator made of aluminium or its alloys, an effective dissipation of the heat generated is obtained, thus solving all problems of electrical insulation of the internal components and, at the same time, all problems related to dissipation of the heat produced by the lamp.

[0048] Various modifications can be made to the embodiments represented herein without departing from the scope of the present invention. For example, the lamp can also be produced with a different base with respect to the screw base and can also comprise a different number of LEDs, if necessary also with different colours and/or emission temperatures to one another.

[0049] The supporting board 11 for the LEDs 30 and the board with the relative printed conductive tracks for supporting the components of the power supply control circuit can also be distinct from each other, provided that the contact is maintained between the thermistor 40 and the board 11, or at least a certain closeness sufficient to ensure the proper thermodynamic coupling between the PTC thermistor 40 and the heat dissipator 50.

[0050] Moreover, the body 10 made of thermally conductive plastic material can also be moulded directly on the aluminium dissipator 50.

Claims

1. An illumination lamp which can be supplied at mains voltage, including at least one LED and at least one PTC thermistor connected in series to the supply line of said at least one LED, **characterized by** including means for dissipating the heat generated into the lamp in order to keep said PTC thermistor at a preset substantially constant operating temperature.

2. The lamp as claimed in claim 1, wherein said means for dissipating the heat include at least one body made of thermally conductive and electrically insulating plastic material.

3. The lamp as claimed in claim 1 or 2, wherein said means for dissipating the heat also include a heat dissipator thermally coupled to said body made of thermally conductive plastic material.

4. The lamp as claimed in claim 3, wherein said heat dissipator is made of aluminium or its alloys.

5. The lamp as claimed in claim 1, wherein said at least one LED is mounted on a supporting board, and wherein said PTC thermistor is mounted in contact with said supporting board.

6. The lamp as claimed in claim 1, wherein said at least one LED is supplied with alternating current at mains voltage.

7. A method for operating an illumination lamp which can be supplied at mains voltage, wherein the lamp includes at least one LED and at least one PTC thermistor connected in series to the supply line of said at least one LED, **characterized by** dissipating the heat generated into the lamp in order to keep said PTC thermistor at a preset substantially constant operating temperature.

8. The method according to claim 7, wherein said PTC resistor is maintained at a preset temperature near

its transition temperature.

9. The method according to claim 7, wherein said PTC resistor is maintained at a preset temperature below its transition temperature.

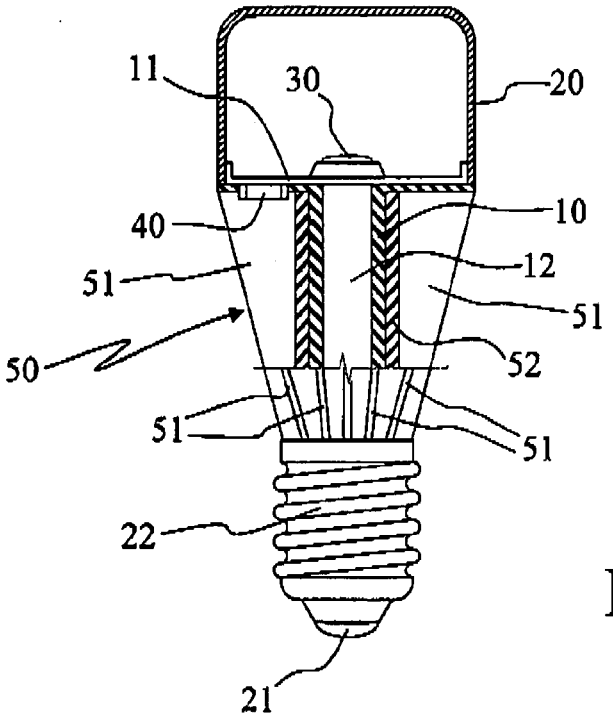
11
30
20
40
10
12
51
51
50
52
51
51
22
21

Fig. 1

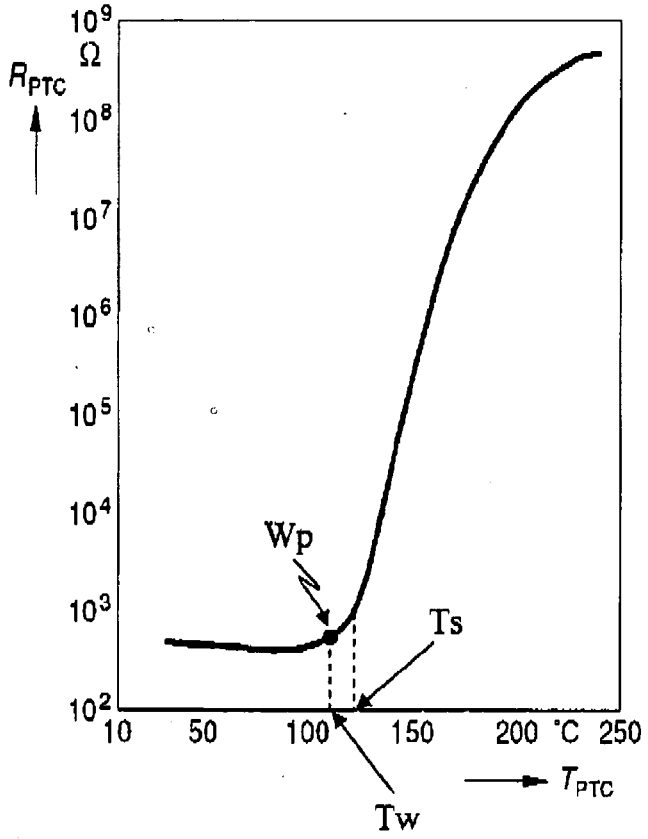
10^9
Ω
R_{PTC}
10^8
10^7
10^6
10^5
10^4
10^3
10^2
Wp
Ts
10
50
100
150
200 °C
250
T_{PTC}
Tw

Fig. 2

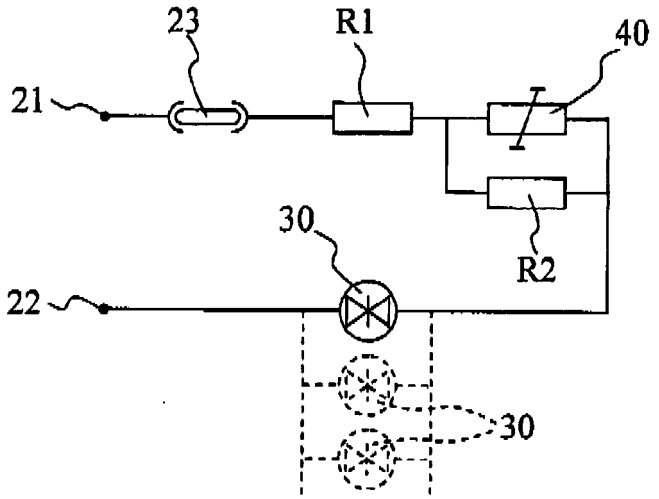

Fig. 3

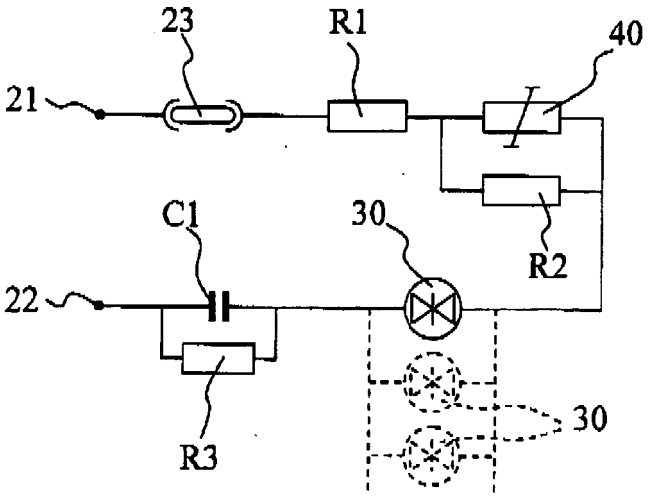

Fig. 4

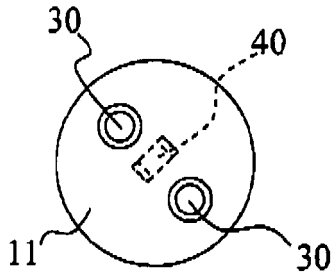

Fig. 5A

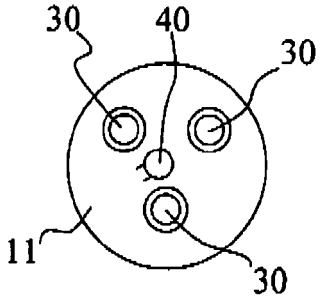

Fig. 5B

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 1526759 A **[0009]**
- EP 0891120 A **[0010]**