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(71) Applicant: **Petriccione, Alessandro**
80131 Napoli (NA) (IT)

(72) Inventor: **Petriccione, Alessandro**
80131 Napoli (NA) (IT)

(74) Representative: **Garavelli, Paolo**
A.BRE.MAR. S.R.L.
Consulenza in Proprietà Industriale
Via Servais 27
10146 Torino (IT)

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(54) **MODULAR LED LIGHTING SYSTEM AND RELATED PROCESS**

(57) A moduable LED lighting system is described, capable by means of at least one resistor device, of modulating the radiant power flux emitted by the lighting

system in a range between 4W and 5W, preferably 4.5W, or between 7W and 8W, preferably 7.5W, or between 8W and 9W, preferably 8.5W.

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Description

[0001] The present invention relates to a modulable LED lighting system, in particular to a LED lighting system capable of modulating the radiant power flux emitted by the LED lighting system.

[0002] The invention relates also to a process of modulating the radiant power flux emitted by the modulable LED lighting system.

[0003] In the field of lighting, the innovation of LED lamps having light-emitting diodes, which offer numerous advantages over traditional incandescent bulbs, such as higher energy efficiency, durability, quality and variety of light, is known in the art. Among the features of led lamps, one of the most interesting is the ability to regulate voltage and electric current. Likewise, there are electronic light intensity controllers capable of favouring and modifying the light output of lighting systems and/or devices of large physical dimensions, such as the well-known spotlights, so that the heat produced by the electrical/electronic elements/components of the system and/or device can be properly dissipated.

[0004] For this reason, many researchers and inventors have devoted themselves to the development of dimmable LED lamps, trying to improve the performance, quality, and safety of these devices. Dimmable LED lamps are disclosed in US20210267034, which discloses a LED lamp that can be dimmed via a push-button switch, without the need for an external dimmer. The lamp has a control circuit that detects the number and duration of button presses and adjusts the brightness according to a predefined table.

[0005] A LED lamp is also disclosed, that can be dimmed using a phase-cut dimmer, which is a type of dimmer that reduces the electrical voltage by cutting off part of the sine waveform. The lamp has a sensing circuit that measures the cutoff time and converts it into a PWM (pulse width modulation) signal that controls the LED current.

[0006] A LED lamp is disclosed, which describes a LED lamp that can be dimmed using a universal dimmer, that is, a type of dimmer that can work with different types of lamps. The lamp has a compensation circuit that adjusts the LED current according to the input voltage and temperature to avoid variations in brightness and colour.

[0007] Further prior art patents are US2023308093, US2018368232, EP3667156.

[0008] It is evident how there are no small LED lighting systems that can modulate the luminous flux emitted by the lighting system and its power as needed.

[0009] Object of the present invention is solving the above prior art problems by providing a modulable LED lighting system capable of modulating the radiant power flux of the lighting system.

[0010] Another object of the present invention is providing a modulable LED lighting system capable of modulating the radiant power flux emitted by the system, and/or modulating the colour temperature of the light

emitted by the system.

[0011] A final object of the present invention is providing a process for modulating the radiant power flux emitted by the modulable LED lighting system.

[0012] The above and other objects and advantages of the invention, as will result from the following description, are achieved with a modulable LED lighting system such as that described in claim 1. Likewise, the above and other objects and advantages of the invention, as will result from the following description, are achieved with a modulation process such as that described in claim 5. Preferred forms of embodiment and nontrivial variations of the present invention are the subject matter of the dependent claims.

[0013] It is understood that all appended claims form an integral part of this description.

[0014] It will be immediately obvious that innumerable variations and modifications (e.g., relating to shape, dimensions, arrangements, and parts with equivalent functionality) can be made to what is described without departing from the scope of the invention as it appears from the appended claims.

[0015] To better clarify the use of some of the units of measurements mentioned, the following definitions are given, whereas there are Radiometric Quantities such as Radiant (power) Flux, which have a photometric counterpart, radiant intensity, and Photometric Quantities such as luminous flux and luminous intensity:

- Luminous flux represents the radiant power emitted by a source referred to the relative spectral sensitivity of the human eye. It is the photometric counterpart of radiant flux. It is measured in lumens
- The lumen (lm) is the photometric equivalent of the radiometric watt and represents the radiant power flux in relation to visibility
- Radiant power flux is considered the fundamental quantity in radiometry and represents the flow of electromagnetic energy in the unit of time, hence a power. Its unit of measurement is the watt. When referred to an electromagnetic radiation source (e.g., LED), it represents the total power flux emitted.
- The Watt (W) is the fundamental unit for radiometric power, defined as the ratio of the energy of 1 joule per second. Energy is a function of the number of photons and wavelength.
- Colour temperature (CCT), is the colour temperature of a LED module, determined by comparing the light emitted by a LED module with the light of a black body and is expressed in degrees "Kelvin".

[0016] According to the present invention, a modulable LED lighting system is equipped with a resistor device capable of modulating the radiant power flux emitted by the lighting system in a range between 4W and 5W, preferably 4.5W, or between 7W and 8W, preferably 7.5W, or between 8W and 9W, preferably 8.5Watts, in terms of photometric magnitudes, the system is able to

modulate the luminous flux in a range between 4001m and 5001m, preferably 4501m, or between 7001m and 8001m, preferably 7501m, or between 8001m and 9001m, preferably 8501m.

[0017] Advantageously, the lighting system, according to the present invention, is equipped with:

- a container housing having a joint lever with at least one switch;
- a lamp-holder base, intimately connected to the lower portion of the container casing;
- a frosted cap, arranged on the upper portion of the container casing;
- an aluminium board arranged on at least one heat sink, provided with a first plurality of LEDs, arranged circularly on the surface of the aluminium board, and a second plurality of LEDs arranged concentrically on the surface of the aluminium board, surrounding the first plurality of LEDs, said aluminium board being electrically connected, by at least three cables, with an electrical board;
- the electrical board arranged inside the container housing, electrically connected to the aluminium board and the resistor device;
- the resistor device, electrically connected to the electric board, equipped with the joint switch with the lever and a plurality of resistor elements.

[0018] Advantageously, the resistor device is designed to vary the equivalent resistance value of the resistor device and consequently the watts of the LED lighting system, advantageously the variation of the equivalent resistance value is achieved by the modularity of the electrical connections between the resistor elements, such as by connecting two or more resistor elements in parallel. The variation in the number of resistor elements connected in parallel is chosen as needed by the user, preferably by operation of the second lever, which interacts with the switch and changes the electrical connections between the resistor elements of the resistor device.

[0019] A process is also described, for modulating the radiant power flow emitted by the LED lighting system, the process comprising the steps of:

- preparation of the lighting system
- first displacement of the lever by a user in a first position, corresponding to 4.5W, such first displacement moves the switch in the resistor device to a first position, which electrically connects a first and a second resistor element in parallel determining an equivalent resistance value in the electrical board, with which the resistor device is connected, inducing a watt value in the range of 4W to 5W, preferably 4.5W, or
- second displacement of the lever to a second position, corresponding to 7.5W, such second displacement moves the switch in the resistor device to a

second position, which electrically connects the first, second, and a third resistor element in parallel resulting in an equivalent resistance value in the electrical board, with which the resistor device is connected, inducing a watt value within a range of 7W to 8W, preferably 7.5W; or

- third movement of the lever to a third position, corresponding to 8.5W, such third movement moves the switch to a third position, which electrically connects the first, second, third and a fourth resistor element in parallel resulting in an equivalent resistance value in the electrical board, with which the resistor device is connected, inducing a watt value in a range between 8W and 9W, preferably 8.5Watts.

[0020] Likewise, it is known that colour temperature refers to the hue of light emitted by a light source. This value is expressed in degrees Kelvin (K) with a scale from 1000K to 12000K. the higher the Kelvin number, the whiter or bluer the light will appear. According to the present invention, in a second embodiment, a modifiable LED lighting system is designed to modulate the radiant power flux emitted by the lighting system in the range of 4W to 5W, preferably 4.5W, or 7W to 8W, preferably 7.5W, or 8W to 9W, preferably 8.5Watt, and at the same time to modulate the hue of light emitted by the system characterized by a colour temperature between 2700K and 3500K, preferably 3000K, or between 5700K and 7000K, preferably 6500K, or between 3500K and 4500K, preferably 4000K, while the lighting system lacks a plurality of 4000k LEDs.

[0021] Preferably, in such second embodiment, the system is equipped with:

- a housing enclosure equipped with a first joint lever with a first switch and a second joint lever with a second switch;
- a lamp-holder base;
- a satin-finish cap;
- an aluminium board arranged on at least one heat sink, provided with a first plurality of 3000K LEDs, arranged circularly on the surface of the aluminium board, and a second plurality of 6500K LEDs arranged concentrically on the surface of the aluminium board, surrounding the first plurality of 3000K LEDs, said aluminium board being electrically connected, by at least three cables, with an electrical board;
- the electrical board arranged within the container housing, electrically connected to the aluminium board and the resistor device, and is provided with the second joint switch with the second lever, and is designed to interact with a user by means of the second lever and send electrical pulses to the aluminium board according to the user needs;
- the resistor device, electrically connected to the electric board, equipped with the first switch conjoined with the first lever and a plurality of resistor

elements.

[0022] A process is also described for modulating the radiant power flow, and the hue of light emitted by the LED lighting system in a second embodiment, the process comprising the following steps:

- system setup;
- first displacement of the second lever by the user to a first position, corresponding to 3000K, such first displacement moves the second switch to a first position on the electrical board that advantageously activates the plurality of 3000K LEDs allowing the LED lighting device to emit light through the canopy at a hue characterized by a colour temperature between 2700K and 3500K, preferably 3000K; or
- second displacement of the second lever to a second position corresponding to 6500K, such second displacement moving the second switch to a second position on the electrical board advantageously activating the plurality of LEDs 6500K, allowing the LED lighting device to emit light by means of the canopy at a hue characterized by a colour temperature between 5700K to 7000K, preferably 6500K; or
- third positioning of the second lever by the user at an intermediate position, corresponding to 4000K, such third positioning moves the second switch to an intermediate position and advantageously the electrical board simultaneously activates the first plurality of 3000K LEDs and the second plurality of 6500K LEDs allowing the LED lighting device to emit light by means of the canopy, at a hue characterized by a colour temperature between 3500K to 4500K, preferably 4000K, the simultaneous activation of the first plurality of 3000K LEDs and the second plurality of 6500K LEDs at half power, is capable of simultaneously emitting light at a hue characterized by a colour temperature between 3500K to 4500K; and simultaneously in combination with the:
- first displacement of the first lever by a user in a first position, corresponding to 4.5W, such first displacement moves the first switch in the resistor device to a first position that advantageously electrically connects a first and a second resistor element in parallel determining an equivalent resistance value in the electric board, with which the resistor device is connected, inducing a watt value in the range of 4W to 5W, preferably 4.5W;
- or with the
- second displacement of the first lever to a second position, corresponding to 7.5W, such second displacement moves the first switch in the resistor device to a second position that advantageously electrically connects the first, second, and a third resistor element in parallel resulting in an equivalent resistance value in the electrical board, with which the resistor device is connected, inducing a watt value in

a range of 7W to 8W, preferably 7.5W; or at the

- third shift of the first lever to a third position, corresponding to 8.5W, such third shift moves the first switch to a third position that advantageously electrically connects the first, second, third and a fourth resistor element in parallel resulting in an equivalent resistance value in the electrical board, with which the resistor device is connected, inducing a watt value in a range of 8W to 9W, preferably 8.5Watts.

[0023] Advantageously, in such a second configuration, the modulation procedure allows the user to make nine possible combinations of modulation between radiant power flux values and light hue values, for a single LED lighting system, by the placement of the first lever between the three radiant power flux values preferably indicated as 4.5W, 7.5W, 8.5W, and simultaneously by the placement of the second lever between the three values related to the emitted light hue preferably indicated as 3000K, 4000K, 6500K.

[0024] Finally, according to the present invention, in a third embodiment, a modulable LED lighting system is designed to emit light at a hue characterized by a colour temperature between 2700K and 3500K, preferably 3000K, or between 5700K and 7000K preferably 6500K, or between 3500K and 4500K, preferably 4000K, being devoid of a plurality of 4000K LEDs.

[0025] The invention has the following advantages:

- varying the luminous intensity of three different light emissions present in the same LED lighting device;
- varying the power of the lighting device; and
- increase the life of the LED lighting devices while ensuring the same efficiency.

[0026] Some embodiments of the invention have been described, but of course they are susceptible to further modifications and variations within the same inventive idea.

Claims

1. Modulable LED lighting system, **characterized by** being configured to modulate the radiant power flux emitted by said lighting system in a range between 4W and 5W, or between 7W and 8W, or between 8W and 9W, the system comprising:

- a housing enclosure having at least one joint lever with at least one switch;
- a lamp-holder base, intimately connected to a lower portion of said container casing;
- a frosted cap, arranged on an upper portion of said container casing;
- an aluminium board disposed on at least one heat sink, said aluminium board having a first plurality of LEDs disposed on the surface of said

aluminium board, and a second plurality of LEDs disposed on the surface of said aluminium board, said aluminium board being electrically connected, by at least three wires, with an electrical board;

- said electrical board arranged within said container housing, electrically connected to said aluminium board and a resistor device;

- said resistor device electrically connected to said electric board, having said switch conjoined with said lever and a plurality of resistor elements.

2. System according to claim 1, capable of modulating the radiant power flux emitted by said system in a range from 4W to 5W, or from 7W to 8W, or from 8W to 9W, and simultaneously to modulate a hue of light emitted by said system **characterized by** a colour temperature and between 2700K and 3500K, or between 5700K and 7000K, or between 3500K and 4500K, while being said system lacking a plurality of 4000k LEDs, wherein said system comprises:

- an enclosure housing equipped with a first joint lever with a first switch and a second joint lever with a second switch;

- a lamp-holder base;

- a frosted cap;

- an aluminium board arranged on at least one heat sink, provided with a first plurality of 3000K LEDs arranged circularly on the surface of the aluminium board, and a second plurality of 6500K LEDs arranged concentrically on the surface of the aluminium board, surrounding the first plurality of 3000K LEDs, said aluminium board being electrically connected, by at least three cables, with an electrical board;

- said electrical board arranged within said container casing, electrically connected to said aluminium board and said resistor device, and having said second switch conjoined with said second lever, and designed to interact with at least one user by means of said second lever and send electrical pulses to said aluminium board according to the needs of said user;

- said resistor device, electrically connected to said electric board, equipped with said first switch conjoined with said first lever and a plurality of resistor elements.

3. Process for modulating a radiant power flux emitted from a modulatable LED lighting system, comprising the steps of:

- first displacement of a lever by said user in a first position, corresponding to 4.5W, said first displacement moving a switch in a first position, which electrically connects a first and a second

resistor element in parallel by determining an equivalent resistance value in an electrical board, with which a resistor device is connected, inducing a watt value in the range of 4W to 5W, or - second displacement of said lever to a second position, corresponding to 7.5W, said second displacement moves said switch in the resistor device to a second position, which electrically connects said first, said second and a third resistor element in parallel by determining an equivalent resistance value in said electric board, with which said resistor device is connected, inducing a watt value in the range of 7W to 8W; or

- third shift of said lever to a third position, corresponding to 8.5W, said third shift moves said switch to a third position, which electrically connects said first, said second, said third and a fourth resistor element in parallel by determining an equivalent resistance value in the electric board, with which said resistor device is connected, inducing a watt value in a range between 8W and 9W.

4. Process according to claim 3, capable of modulating the radiant power flow, and the hue of light emitted by the lighting system, comprising the steps of:

- first displacement of said second lever by the user to a first position, corresponding to 3000k, said first displacement moving said second switch to a first position on said electrical board activating said plurality of 3000K LEDs allowing said system to emit light by means of the canopy at a hue **characterized by** a colour temperature between 2700K and 3500K; or

- second displacement of said second lever to a second position corresponding to 6500K, said second displacement moving said second switch to a second position on said electrical board which advantageously activates said plurality of LEDs 6500K, enabling said LED lighting system to emit light by means of said canopy at a hue **characterized by** a colour temperature between 5700K to 7000K; or

- third positioning of said second lever by said user at an intermediate position corresponding to 4000K, said third positioning moves said second switch to an intermediate position and advantageously said electrical board simultaneously activates said first plurality of 3000K LEDs and said second plurality of 6500K LEDs allowing said system to emit light by means of said canopy at a hue **characterized by** a colour temperature between 3500K to 4500K, preferably 4000K, the simultaneous activation of said first plurality of 3000K LEDs and said second plurality of 6500K LEDs at half power, is capable

of simultaneously emitting light at a hue **characterized by** a colour temperature between 3500K to 4500K;

and simultaneously in combination with the:

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- first displacement of said first lever by said user in a first position, corresponding to 4.5W, said first displacement moves said first switch in said resistor device to a first position which advantageously electrically connects said first and said second resistor elements in parallel by determining an equivalent resistance value in said electric board, with which said resistor device is connected, inducing a watt value in a range from 4W to 5W;

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or with the

- second displacement of said first lever to a second position, corresponding to 7.5W, said second displacement moves said first switch in said resistor device to a second position that advantageously electrically connects said first, said second and said third resistor elements in parallel by determining an equivalent resistance value in said electric board electrical board, with which said resistor device is connected, inducing a value of watts in the range of 7W to 8W,; or to the

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- third displacement of said first lever to a 5 third position, corresponding to 8.5W, said third shift moves said first switch to a third position which advantageously electrically connects said first, said second, said third and said fourth resistor elements in parallel by determining an equivalent resistance value in said electric board, with which said resistor device is connected, inducing a watt value in a range of 8W to 9W.

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5. Process according to claim 4, capable of enabling said user to make nine possible combinations of modulation between radiant power flux values and light hue values, for a single modifiable LED lighting system, by placement of said first lever between radiant power flux values preferably indicated as 4.5W, 7.5W, 8.5W, and simultaneously by placement of said second lever between values relating to the emitted light hue preferably indicated as 3000K, 4000K, 6500K.

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EUROPEAN SEARCH REPORT

Application Number

EP 24 22 3159

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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		12 May 2025	Garavini, Elisa
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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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