

LED RETROFIT DEVICE FOR POST TOP LAMPS

FIELD OF TECHNOLOGY

[001] The present invention generally relates to lighting devices, particularly, post top lamps.

BACKGROUND

[002] A focus of LED lighting over the last several years relates to retrofitting conventional lamps with LED light sources. In order to continue usage of existing lamp fixtures, LED retrofit devices have been developed to directly replace conventional incandescent, halogen, or fluorescent lamps. The benefits of LEDs compared to conventional light sources include, for example, low power consumption, no need for an inert atmosphere, higher light intensity per unit energy and the like. However, LED light sources have their own technical issues, such as performance degradation from heat, and the consequent need for efficient heat extraction.

[003] Because LED retrofit devices must fit into the same volume of space that a conventional bulb occupies, any heat extraction function is limited by the size of that space. With limited capability to dissipate heat, the LED chips can be exposed to higher temperatures that results in performance degradation, or even junction meltdown could take place and cause a fire hazard when the LED chips are over-heated.

[004] In addition, aftermarket LED bulbs currently comprise arrays of LEDs mounted on conventional rigid circuit board substrates. These are relatively bulky, inflexible structures with conventional soldering of electrical connections beneath the rigid substrates. The limited flexibility of the substrates adversely affects heat extraction from the LEDs.

[005] Amongst the various types of lamps that are currently in use, lamps used in outdoor lighting, such as post mounted lamps, typically have a good amount of real estate

within the lamp enclosure, making it a desirable candidate for LED retrofits because of the possibility of implementing a sizeable heat sink for which will enable use of high powered LED light sources such as light emitting semiconductor devices (LESDs). Several other considerations need to be made in retrofitting conventional light sources with LED light sources. For outdoor lamps, an important factor is the control of the light distribution pattern. In outdoor street lighting, the lighting illuminates walkways and locations of interest/risk, facilitates pedestrian activity after dark, and has to minimise excessive illumination which can cause unwanted glare and discomfort to pedestrians and nearby residences.

[006] It is desirable to provide a lighting device for retrofitting conventional lamps with an efficient thermal management design as well as light distribution capability, all inclusive within a single lighting device.

SUMMARY

[007] At least one aspect of the present invention provides a multi-functional lighting element for lamps, or more specifically public lamps, by incorporating LEDs on a flexible substrate as the lighting element. The use of a flexible substrate differs substantially from conventional design used in hard substrate-based LED bulbs. A flexible substrate neatly carries multiple circuit traces in a compact manner, thereby enabling a plurality of LEDs to be independently lit and controlled. By mounting the flexible substrate on a frame, heat produced by the LEDs is more favourably managed.

[008] In one aspect, there is provided a lighting device for public lamps, comprising: a heat-conducting body having two major surfaces located on two portions of the body, a first major surface defining a reflective sloped recess extending across a substantial area of the first major surface, a second major surface comprising at least one heat dissipation structure; an illumination source comprising a single, continuous substrate of flexible circuit, at least one light emitting semiconductor device (LESD) formed on the flexible circuit; a thermal interface material interposed between the illumination source and the first major surface; and securing features located on the body for coupling to support structures in the lamp to mount the body to the lamp.

[009] Preferably, when the illumination source is lit, light emanating from the lighting device has a substantially conical or frustum shaped distribution pattern.

[010] The first major surface is preferably formed at an angle of between 5° to 45° relative to a horizontal axis.

[011] It is preferable that the single, continuous substrate is a polyimide flexible circuit substrate.

[012] Preferably, the LESDs comprise RGB LEDs capable of being controlled by a light mixing controller for emitting a plurality of shades of colored light.

[013] It is also preferable that the illumination source terminates in a non- electrical connector comprising an E27/E40 bulb adaptor, the E27/E40 bulb adaptor being configured for enabling a centrally mounted device and also for enabling mechanical stability when mounted to an E27/E40 holder.

[014] Preferably, the device is mounted in a manner such as, for example, vertically, horizontally, vertically inverted and so forth.

[015] The heat-conducting body can preferably comprise a monolithic die cast aluminum heat sink, the heat sink being configured to handle electrical wattage of less than 40 W and to maintain a temperature of less than 70°C.

[016] The recess may have the shape of either a dome or a polyhedron.

[017] The securing features can preferably comprise a plurality of notches on the periphery of the body for coupling to supports extending from the lamp, a screw threaded cavity defined along a central axis of the body for coupling to a support extending from the lamp, or a screw threaded stem for coupling to a cavity defined within the lamp.

[018] The lighting device can further comprise a plurality of light sensors distributed along the flexible circuit for detecting a level of illumination.

[019] Preferably, the at least one heat dissipation feature is a plurality of integrally-formed fins extending away from the body. The thermal interface material can also include adhesive properties.

[020] The two portions can be either at opposite ends of the body or adjacent to each other.

[021] The lighting device can further comprise a plurality of motion sensors for detecting motion in a vicinity of the device.

[022] The second major surface can preferably include a plurality of visible coloured LEDs for providing illuminated LEDs for decorative and festive purposes.

[023] In another aspect, there is provided a lamp comprising the aforementioned lighting device.

[024] The lamp can further comprise a transparent or translucent housing for accommodating the lighting device, supports extending from the base of the housing to support the lighting device, and an electrical driver for powering the lighting device, as well as a lamp post having a height of at least 3 metres.

[025] This and other aspects of the invention are described in the detailed description below. In no event should the above summary be construed as a limitation on the claimed subject matter which is defined solely by the claims as set forth herein.

BRIEF DESCRIPTION OF FIGURES

[026] Throughout the specification, reference is made to the appended drawings, where like reference numerals designate like elements, wherein:

[027] Figure 1(a) and 1(b) respectively show a perspective view and base view of a first embodiment of a lighting device of the present invention.

[028] Figure 2 shows a perspective view of a second embodiment of a lighting device of the present invention.

[029] Figure 3 shows a side view of a possible embodiment of a lighting device of the present invention.

[030] Figure 4 shows a side view of the lighting device of Figure 3 including a diffuser.

[031] Figure 5 shows a simplified light distribution pattern of a lighting device of the present invention during use.

[032] Figures 6(a) and 6(b) show photographs of a sample E27/E40 bulb adaptor.

[033] Figures 7(a) and 7(b) show luminous intensity distribution graphs for a sample illumination source.

[034] Figure 8 shows a light distribution pattern for a sample illumination source when mounted to the public lamp of Figure 5.

[035] Figure 9 shows different mounting possibilities for a sample E27/E40 bulb adaptor.

[036] Figure 10 shows a light distribution pattern and illumination readings of a lighting device of the present invention during use.

[037] The figures are not necessarily drawn to scale. However, it will be understood that the use of a numeral to refer to a component in a given figure is not intended to limit the component in another figure labeled with the same number.

DETAILED DESCRIPTION

[038] The present invention provides a means to retrofit existing light bulbs in public lamps. Conventional lamps can be retrofitted with lighting with an efficient thermal

management design as well as light distribution capability. Figures 1 to 5 show possible embodiments of a lighting device for public lamps. Detailed descriptions will follow in the subsequent paragraphs.

[039] Referring to Figures 1(a) and 1(b), there is provided a first embodiment of a lighting device 20 for public lamps, particularly for replacing existing light bulbs in public lamps. The lighting device 20 comprises a heat-conducting body 22 having two major surfaces 28, 34 located on two portions of the body 22. The two major surfaces 28, 34 can be adjacent to one another (as shown). A first major surface 34 defines a reflective sloped recess extending across a substantial area of the first major surface 34, while a second major surface 28 comprises at least one heat dissipation feature. The first major surface 34 is typically formed at an angle of between 5° to 45° relative to a horizontal axis. For example, the major surface 34 can be formed at an angle of 30° relative to the horizontal axis. The heat-conducting body 22 also comprises a monolithic die cast aluminum heat sink configured for efficient heat dissipation. For example, the heat-conducting body 22 is in a form of a circular structure configured for handling electrical wattage of up to 40 W, and for maintaining a temperature of less than 70°C, whereby thermal equilibrium is attained for efficient functioning of an illumination source 35 (an element of the lighting device 20 which will be described in a later paragraph).

[040] The second major surface 34 can include a plurality of visible coloured LEDs to provide illuminated LEDs possibly for decorative and festive purposes.

[041] The reflective sloped recess defined by the first major surface 34 can be dome-shaped (as shown) or irregular asymmetrically shaped. The at least one heat dissipation feature is a plurality of integrally-formed fins 26 extending away from the body 22 (as shown). It should be appreciated that the at least one heat dissipation feature can also include a coating with high heat transmissivity, and other heat transmission structures.

[042] The lighting device 20 can include the illumination source 35 comprising a single, continuous substrate of flexible circuit 32, and at least one light emitting semiconductor device (LESD) 30 formed on the flexible circuit 32. The single, continuous substrate of flexible circuit 32 is a polyimide flexible circuit substrate. The polyimide

flexible circuit substrate enables advantages such as, for example, multi-axial (eg. 3 dimensional) conformability, a single substrate with multiple LED footprints, dense packaging of LEDs on a substrate with efficient thermal management, and so forth. Furthermore, the LED dies used can be of the chip scale packaging (CSP) type. The LEDs 30 can comprise RGB LEDs capable of being controlled by a light mixing controller 38 for emitting a plurality of shades of colored light. Furthermore, when white LEDs (cyan based conversion) are coupled with AlInGaP LEDs, a desired wavelength range (mesopic) is incorporated in the white wavelength spectrum which causes the light to appear to be brighter to the human eye. The illumination source 35 can also include a plurality of light sensors 24 distributed along the flexible circuit 32 to detect a level of ambient brightness to control the level using the light mixing controller 38. The plurality of light sensors 24 can be located along a pole of a public lamp, and motion sensors can also be included with the light sensors 24. The motion sensors can be configured to activate/vary a brightness of the lighting device 20 upon detection of movement in areas surrounding the public lamp.

[043] In addition, the illumination source 35 terminates in a non-electrical connector 36 comprising an E27/E40 (as per electrical norms for driving an AC voltage) bulb adaptor 100. Referring to Figures 6(a) and 6(b), there is shown an example of the E27/E40 bulb adaptor 100. The E27/E40 bulb adaptor 100 is made of aluminum. A first end 102 of the adaptor 100 includes a screw thread that enables the adaptor 100 to be mounted to the heat conducting body 22 and a second end 104 includes E27/E40 thread that enables the adaptor 100 to be mounted to an E27/E40 holder/cavity 106 of any existing lamp fixtures. It should be appreciated that the E27/E40 bulb adaptor 100 can enable a centrally mounted lighting device 20 and can also enable mechanical stability when mounted to the E27/E40 holder/cavity 106. A driver is attached to an AC voltage source and converts the voltage to DC voltage for the illumination source 35. Referring to Figure 9, there is shown how the E27/E40 bulb adaptor 100 can also be configured for horizontal mounting 100(a) or for inverted vertical mounting 100(b) (other than as the vertical mount as depicted in Figures 6(a) and 6(b)). In Figure 9, a glass cover, possibly integrated with a diffuser, can be used to cover the illumination source 35 to form an luminaire.

[044] The plurality of light sensors 24 is configured to process the feedback signals (via an algorithm) from a sensor feedback coverage area (area above the illumination source 35) to effect a change in relation to the level of ambient brightness. For example, the illumination source 35 can be powered up if the level of ambient brightness is low, the illumination source 35 can be powered down if the level of ambient brightness is high, or the illumination source 35 can be powered down at pre-determined times such as durations, for example, when human traffic is low.

[045] The lighting device 20 also includes a thermal interface material 25 interposed between the illumination source 35 and the first major surface 34. The thermal interface material 25 is pre-cut to a desired shape and attached to the first major surface 34, then the flexible circuit 32 is attached to the thermal interface material 25. The thermal interface material 25 can include adhesive properties which are retained under high temperatures. There are also securing features (not shown) located on the body 22 for coupling to support structures in the lamp in order to mount the body 22 to the lamp. The securing features can comprise, for example, a plurality of notches on a periphery surface of the body 22 for coupling to supports extending from the lamp, a screw threaded cavity defined along a central axis of the body 22 for coupling to a support extending from the lamp or a screw threaded stem for coupling to a cavity defined within the lamp.

[046] It should be appreciated that due to the configuration of the lighting device 20, specifically how the at least one light emitting semiconductor device (LESD) 30 is formed on the flexible circuit 32 on a reflective concave first major surface 34, when the illumination source 35 is lit, light emanating from the lighting device 20 has a substantially conical or frustum shaped distribution pattern, as shown in Figure 5. Figure 5 depicts when the lighting device 20 is mounted to a public lamp 10 and powered by an external driver which connects to an existing power supply of the public lamp 10. Referring to Figures 7(a) and 7(b), there is shown luminous intensity distribution graphs of the illumination source 35. In addition, Figure 8 also demonstrates the substantially conical or frustum shaped distribution pattern. In addition, Figure 10 also shows a light distribution pattern of the lighting device 20 mounted to the public lamp 10 with a table denoting the illumination readings at various test point axes and distances. It should be appreciated that even though the table of Figure 10 indicates that maximum illumination

occurs around 2.5 m from the public lamp 10, actual test results indicate the maximum illumination occurs at a 2 m radius from the public lamp 10.

[047] Referring to Figure 2, there is provided a second embodiment of a lighting device 40 for public lamps, particularly for replacing existing light bulbs in public lamps. The lighting device 40 comprises a heat-conducting body 42 having two major surfaces 48, 54 located on two portions of the body 42. The two major surfaces 48, 54 can be adjacent to one another (as shown), or at opposite ends of the body 42 (in other embodiments). A first major surface 54 defines a reflective sloped recess extending across a substantial area of the first major surface 54, while a second major surface 48 comprises at least one heat dissipation feature. The first major surface 54 is typically formed at an angle of between 5° to 45° relative to a horizontal axis. For example, the major surface 34 can be formed at an angle of 30° relative to the horizontal axis. The heat-conducting body 42 also comprises a monolithic die cast aluminum heat sink configured for efficient heat dissipation. For example, the heat-conducting body 42 is in a form of a circular structure configured for handling electrical wattage of up to 40 W, and for maintaining a temperature of less than 70°C, whereby thermal equilibrium is attained for efficient functioning of an illumination source 55 (an element of the lighting device 40 which will be described in a later paragraph).

[048] The reflective sloped recess defined by the first major surface 54 is polyhedral-shaped (as shown). The at least one heat dissipation feature is a plurality of integrally-formed fins 46 extending away from the body 42 (as shown). It should be appreciated that the at least one heat dissipation feature can also include a coating with high heat transmissivity, and other heat transmission structures.

[049] The lighting device 40 can include the illumination source 55 comprising a single, continuous substrate of flexible circuit 52, and at least one light emitting semiconductor device (LESD) 50 formed on the flexible circuit 52. The single, continuous substrate of flexible circuit 52 is a polyimide flexible circuit substrate. The polyimide flexible circuit substrate enables advantages such as, for example, multi-axial (eg. 3 dimensional) conformability, a single substrate with multiple LED footprints, dense packaging of LEDs on a substrate with efficient thermal management, and so forth.

Furthermore, the LED dies used can be of the chip scale packaging (CSP) type. The LEDs 50 can comprise RGB LEDs capable of being controlled by a light mixing controller 58 for emitting a plurality of shades of colored light. Furthermore, when white LEDs (cyan based conversion) are coupled with AlInGaP LEDs, a desired wavelength range (mesopic) is incorporated in the white wavelength spectrum which causes the light to appear to be brighter to the human eye. The illumination source 55 can also include a plurality of light sensors 44 distributed along the flexible circuit 52 to detect a level of ambient brightness to control the level using the light mixing controller 58. The plurality of light sensors 44 can be located along a pole of a public lamp, and motion sensors can also be included with the light sensors 44. The motion sensors can be configured to activate/vary a brightness of the lighting device 40 upon detection of movement in areas surrounding the public lamp.

[050] In addition, the illumination source 55 terminates in an electrical connector 56 comprising an E27/E40 (as per electrical norms for driving an AC voltage) bulb adaptor 100. Referring to Figures 6(a) and 6(b), there is shown an example of the E27/E40 bulb adaptor 100. The E27/E40 bulb adaptor 100 is made of aluminum. A first end 102 of the adaptor 100 includes a screw thread that enables the adaptor 100 to be mounted to the heat conducting body 42 and a second end 104 includes E27/E40 thread that enables the adaptor 100 to be mounted to an E27/E40 holder/cavity 106 of any existing lamp fixtures. It should be appreciated that the E27/E40 bulb adaptor 100 can enable a centrally mounted lighting device 40 and can also enable mechanical stability when mounted to the E27/E40 holder/cavity 106. A driver is attached to an AC voltage source and converts the voltage to DC voltage for the illumination source 55. It should be appreciated that the adaptor 100 can also be configured for horizontal or inverted vertical mounting as discussed in an earlier paragraph.

[051] The plurality of light sensors 44 is configured to process the feedback signals (via an algorithm) from a sensor feedback coverage area (area above the illumination source 55) to effect a change in relation to the level of ambient brightness. For example, the illumination source 55 can be powered up if the level of ambient brightness is low, the illumination source 55 can be powered down if the level of ambient brightness is high or

the illumination source 55 can be powered down at pre-determined times such as durations, for example, when human traffic is low.

[052] The lighting device 40 also includes a thermal interface material 45 interposed between the illumination source 55 and the first major surface 54. The thermal interface material 45 is pre-cut to a desired shape and attached to the first major surface 54, then the flexible circuit 52 is attached to the thermal interface material 45. The thermal interface material 45 can include adhesive properties which are retained under high temperatures. There are also securing features (not shown) located on the body 42 for coupling to support structures in the lamp in order to mount the body 42 to the lamp. The securing features can comprise, for example, a plurality of notches on a periphery surface of the body 42 for coupling to supports extending from the lamp, a screw threaded cavity defined along a central axis of the body 42 for coupling to a support extending from the lamp or a screw threaded stem for coupling to a cavity defined within the lamp.

[053] It should be appreciated that due to the configuration of the lighting device 40, specifically how the at least one light emitting semiconductor device (LESD) 50 is formed on the flexible circuit 52, when the illumination source 55 is lit, light emanating from the lighting device 40 has a substantially conical or frustum shaped distribution pattern, as shown in Figure 5. Figure 5 depicts when the lighting device 20/40 is mounted to a public lamp 10 and powered by an existing power supply of the public lamp 10.

[054] Referring to Figures 3 and 4, there is provided a third embodiment of a lighting device 60 for public lamps, particularly for replacing existing light bulbs in public lamps. The lighting device 60 comprises a heat-conducting body 66 having two major surfaces 62, 66 located on two portions of the body 66. The two major surfaces 62, 66 are at opposite ends of the body 66. A first major surface 62 defines a reflective sloped recess extending across a substantial area of the first major surface 62, while a second major surface 48 comprises at least one heat dissipation feature. The heat-conducting body 66 also comprises a monolithic die cast aluminum heat sink configured for efficient heat dissipation. For example, the heat-conducting body 62 is in a form of a circular structure configured for handling electrical wattage of up to 40 W, and for maintaining a temperature of less than 70°C, whereby thermal equilibrium is attained for efficient

functioning of an illumination source 80 (an element of the lighting device 60 which will be described in a later paragraph).

[055] The lighting device 60 can include the illumination source 80 comprising a single, continuous substrate of flexible circuit 72, and at least one light emitting semiconductor device (LESD) 70 formed on the flexible circuit 72. The single, continuous substrate of flexible circuit 72 is a polyimide flexible circuit substrate. The polyimide flexible circuit substrate enables advantages such as, for example, multi-axial (eg. 3 dimensional) conformability, a single substrate with multiple LED footprints, dense packaging of LEDs on a substrate with efficient thermal management, and so forth. Furthermore, the LED dies used can be of the chip scale packaging (CSP) type. The single, continuous substrate of flexible circuit 72 is mounted to the first major surface 62. The LESDs 70 can comprise RGB LEDs capable of being controlled by a light mixing controller (not shown) for emitting a plurality of shades of colored light. Furthermore, when white LEDs (cyan based conversion) are coupled with AlInGaP LEDs, a desired wavelength range (mesopic) is incorporated in the white wavelength spectrum which causes the light to appear to be brighter to the human eye. The illumination source 80 can also include a plurality of light sensors (not shown) distributed along the flexible circuit 72 to detect a level of ambient brightness to control the level using the light mixing controller. In addition, the illumination source 80 terminates in an electrical connector comprising an E27/E40 bulb adaptor. A driver is attached to an AC voltage source and converts the voltage to DC voltage for the illumination source 80.

[056] The plurality of light sensors is configured to process the feedback signals (via an algorithm) from a sensor feedback coverage area (area above the illumination source 80) to effect a change in relation to the level of ambient brightness. For example, the illumination source 80 can be powered up if the level of ambient brightness is low, or the illumination source 80 can be powered down if the level of ambient brightness is high.

[057] The lighting device 60 also includes a thermal interface material interposed between the illumination source 80 and the first major surface 62. The thermal interface material is pre-cut to a desired shape and attached to the first major surface 62, then the flexible circuit 72 is attached to the thermal interface material. The thermal interface

material can include adhesive properties which are retained under high temperatures. There are also securing features located on the body 42 for coupling to support structures in the lamp in order to mount the body 42 to the lamp. The securing features a screw threaded stem 64 for coupling to a cavity defined within the lamp.

[058] Lighting device 60 also includes a diffuser 74, so that the light which emanates from the lighting device is diffused to get uniform light distribution and reduce glare.

[059] It should be appreciated that due to the configuration of the lighting device 60, specifically how the at least one light emitting semiconductor device (LESD) 70 is formed on the flexible circuit 72, when the illumination source 80 is lit, light emanating from the lighting device 60 has a substantially conical or frustum shaped distribution pattern, as shown in Figure 5. Figure 5 depicts when the lighting device 20/40/60 is mounted to a public lamp 10 and powered by an existing power supply of the public lamp 10.

[060] Referring again to Figure 5, there is shown a public lamp 10 that can be retrofitted with the lighting devices 20/40/60. The lamp 10 further comprises a transparent or translucent housing 12 for accommodating the lighting device 20/40/60, supports 14 extending from the base 16 of the housing 12 to support the lighting device 20/40/60, and an electrical driver (not shown) for powering the lighting device 20/40/60. Furthermore, there is a lamp post 18 having a height of 3 metres or more connected to the housing 12. A lower portion of the lamp 10 can include a receptacle which enables access to an electric driver for the lighting device 20/40/60. The electric driver is remote from the lighting device 20/40/60 and the location of the receptacle facilitates ease of maintenance of the lamp 10.

[061] It should be appreciated that during use of the lighting device 20/40/60, whether or not it is mounted to a public lamp 10, the configuration of the lighting device 20/40/60 enables the provision of lighting with efficient thermal management as well as a controllable light distribution capability. In addition, the lighting device 20/40/60 can also provide uniform light distribution and reduce glare.

[062] The present specification is not limited to the specific examples set forth herein. The lighting devices disclosed herein are capable of being made, practiced, used, carried

out and/or formed in various ways expected of a skilled person in the field once an understanding of the invention is acquired. Numerical indicators, such as first, second, and third, as used in the description and the claims to refer to various structures, are not meant to be construed to indicate any specific structures, or any particular order or configuration to such structures. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in the specification, and no structures shown in the drawings, should be construed as indicating that any non-claimed element is essential to the practice of the invention. The use herein of the terms "including" "comprising" or "having" and permutations thereof, is meant to encompass the features defined thereafter and equivalents thereof, as well as additional items.

[063] Recitation of ranges of values herein are intended to refer individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. For example, if a compositional range is stated as 1% to 50%, it is intended that values such as 2% to 40%, 10% to 30%, or 1% to 3%, etc., are expressly enumerated in this specification. These are only examples of what is specifically intended, and all possible combinations of numerical values between and including the lowest value and the highest value enumerated are to be considered to be expressly stated in this disclosure. Use of the word "about" to describe a particular recited amount or range of amounts is meant to indicate that values very near to the recited amount are included in that amount, such as values that could or naturally would be accounted for due to manufacturing tolerances, instrument and human error in forming measurements, and the like.

[064] Unless otherwise stated, reference to any document herein does not constitute an admission that any of these documents forms part of the common general knowledge in the art. Any discussion of the references states what their authors assert, and the applicant reserves the right to challenge the accuracy and pertinency of any of the documents cited herein. All references cited herein are fully incorporated by reference, unless explicitly indicated otherwise.

[065] Although the present invention has been described with particular reference to preferred embodiments illustrated herein, it will be understood by those skilled in the art that variations and modifications thereof can be effected and will fall within the scope of this invention as defined by the claims thereto now set forth herein below.

CLAIMS

1. A lighting device for public lamps, comprising:

a heat-conducting body having two major surfaces located on two portions of the body, a first major surface defining a reflective sloped recess extending across a substantial area of the first major surface, a second major surface comprising at least one heat dissipation structure;

an illumination source comprising a single, continuous substrate of flexible circuit, at least one light emitting semiconductor device (LESD) formed on the flexible circuit;

a thermal interface material interposed between the illumination source and the first major surface;

and

securing features located on the body for coupling to support structures in the lamp to mount the body to the lamp.

2. The device of Claim 1, wherein when the illumination source is lit, light emanating from the lighting device has a substantially conical or frustum shaped distribution pattern.
3. The device of Claim 2, wherein the first major surface is formed at an angle of between 5° to 45° relative to a horizontal axis.
4. The device of Claim 1, wherein the single, continuous substrate is a polyimide flexible circuit substrate.
5. The device of Claim 1, wherein the LESDs comprise RGB LEDs capable of being controlled by a light mixing controller for emitting a plurality of shades of colored light.

6. The device of Claim 1, wherein the illumination source terminates in a non- electrical connector comprising an E27/E40 bulb adaptor, the E27/E40 bulb adaptor being configured for enabling a centrally mounted device and also for enabling mechanical stability when mounted to an E27/E40 holder.
7. The device of Claim 6, wherein the device is mounted in a manner selected from a group consisting of: vertically, horizontally, and vertically inverted.
8. The device of Claim 1, wherein the heat-conducting body comprises a monolithic die cast aluminum heat sink, the heat sink being configured to handle electrical wattage of less than 40 W and to maintain a temperature of less than 70°C.
9. The device of Claim 1, wherein the sloped recess has the shape of a dome.
10. The device of Claim 1, wherein the recess has the shape of a polyhedron.
11. The device of Claim 1, wherein the securing features comprise a plurality of notches on the periphery of the body for coupling to supports extending from the lamp.
12. The device of Claim 1, wherein the securing features comprise a screw threaded cavity defined along a central axis of the body for coupling to a support extending from the lamp.
13. The device of Claim 1, wherein the securing features comprise a screw threaded stem for coupling to a cavity defined within the lamp.
14. The device of Claim 1, further comprising a plurality of light sensors distributed along the flexible circuit for detecting a level of illumination.
15. The device of Claim 1, wherein the at least one heat dissipation feature is a plurality of integrally-formed fins extending away from the body.
16. The device of Claim 1, wherein the thermal interface material includes adhesive properties.

17. The device of Claim 1, wherein the two portions are at opposite ends of the body.
18. The device of Claim 1, wherein the two portions are adjacent to each other.
19. The device of Claim 1, further comprising a plurality of motion sensors for detecting motion in a vicinity of the device.
20. The device of Claim 1, wherein the second major surface includes a plurality of visible coloured LEDs for providing illuminated LEDs for decorative and festive purposes.
21. A lamp comprising a lighting device of any of claims 1 to 20.
22. The lamp of Claim 21, further comprising a transparent or translucent housing for accommodating the lighting device, supports extending from the base of the housing to support the lighting device, and an electrical driver for powering the lighting device.
23. The lamp of Claim 21, further comprising a lamp post having a height of at least 3 metres.