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(54) Title: SIDE-EMITTING GUIDEPIPE TECHNOLOGY ON LED LAMP TO MAKE FILAMENT EFFECT

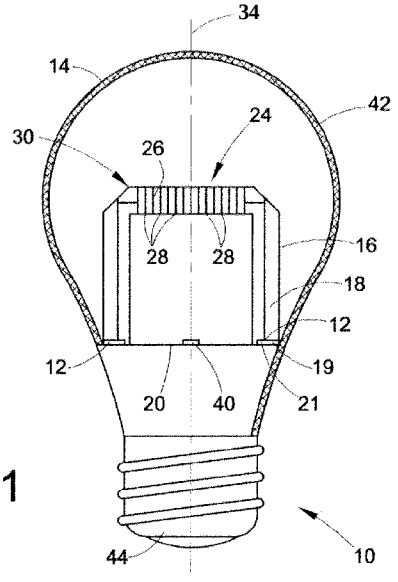

FIG. 1

(57) Abstract: A lamp (10) includes at least two light emitting diodes (12, 40) in thermal communication with a heat sink. A translucent envelope (14) receiving light emitted from the light emitting diodes (12, 40) is also provided. A light guide (16) is located to receive light emitted from at least one of the light emitting diodes (12). The light guide (16) includes a first leg extending away from the heat sink toward an interior of the envelope (14) and a light emitting second leg angled relative to the first leg. The second leg can be at least substantially perpendicular to a longitudinal axis of the lamp (10).

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SIDE-EMITTING GUIDEPIPE TECHNOLOGY ON LED LAMP TO MAKE FILAMENT EFFECT

BACKGROUND

[0001] Solid-state lighting technology, including light emitting diodes (LEDs), has long been seen as a way of producing lamps having greater energy efficiency than conventional incandescent lamps, and less negative environmental impacts than conventional compact fluorescent lamps. Accordingly, numerous so-called retrofit lamps, using solid-state lighting technology, have been introduced.

[0002] From a consumer's viewpoint, however, a significant drawback of these solid-state retrofit lamps is that they do not have the appearance of a conventional incandescent lamp. Moreover, LEDs predominantly provide a point source light distribution. To provide the general appearance of a traditional incandescent light bulb a coating can be provided on the lamp envelope to create a lambertian light distribution. However, the traditional incandescent appearance of filament generated light is not created. This is especially true for retrofits meant to replace conventional candelabra-style incandescent lamps.

BRIEF DESCRIPTION

[0003] According to a first embodiment, a lamp is provided. The lamp includes at least two light emitting diodes in thermal communication with a heat sink. A translucent envelope receiving light emitted from the light emitting diodes is also provided. A light guide is located to receive light emitted from at least one of the light emitting diodes. The light guide includes a first leg extending away from the heat sink toward an interior of the envelope and a light emitting second leg angled relative to the first leg. The second leg can be at least substantially perpendicular to a longitudinal axis of the lamp.

[0004] According to a second embodiment, a lamp including a transparent envelope at least substantially surrounding a light guide is provided. The light guide includes a first leg with a first end in light receiving relationship with a light emitting diode. The light guide includes a second leg angled relative to the first leg and oriented at least substantially perpendicular to the longitudinal axis of the lamp. The second leg further includes elements causing light to be emitted therefrom.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIGURE 1 is a side view partially in cross-section of a representative lamp embodiment; and

[0006] FIGURE 2 is a top view, partially in cross-section of the lamp of Figure 1.

DETAILED DESCRIPTION

[0007] Referring now to Figures 1 and 2, a lamp assembly 10 includes a first pair of light emitting diodes (LEDs) 12 disposed within an envelope 14. The envelope 14 may be formed from a dielectric material such as a polymer or glass. It is envisioned that envelope 14 can be transparent or translucent. The transparent form may be selected when a traditional candelabra style lamp is desired. Translucent may be selected when a light diffusing coating is included on the envelope to create a more lambertian style of light distribution. The LEDs 12 emit light into a light guide 16.

[0008] The light guide can be a cylindrical structure through which light is channeled or transmitted by total internal reflection. Total internal reflection prevents the light from passing from inside the light guide to outside of the light guide. Total internal reflection occurs when light impinges on an interface between the light guide and the atmosphere surrounding the light guide at an angle that is greater than a critical angle. The critical angle is a function of the indices of refraction for the medium of the light guide and the medium of the surrounding atmosphere. The light guide 16 can be formed from an optically clear material such as glass, polycarbonate, acrylic or other suitable plastic.

[0009] In one embodiment the light guide includes an attachment end 18 having a terminal wall defining a cavity 19 enclosing the LEDs 12 to capture substantially all the light generated by the LEDs. The attachment end 18 mates with the printed circuit board 20 upon which the LEDs 12 are mounted. The printed circuit board provides electrical connection to the LEDs and can be a metal core printed circuit board (MCPCB) to provide heat sinking. In this regard, heat sinking can include just the MCPCB or other typical heat spreading devices, such as heat dissipating fins in thermal communication with the MCPCB.

[0010] A transparent epoxy 21 can fill the cavity 19 and secure the attachment end 18 of the light pipe 16 to the LEDs 12 and the circuit board 20 and orient the light guide

16 to receive light emitted by the light emitting diodes 12. The light is transmitted through the light guide 16 via total internal reflectance from the attachment end 18 to a remote end 24. Light guide 16 can be a one piece injection molded component. To generate visible light from the light guide, it is possible to associate a phosphor or other wavelength converting material with LEDs 12. Alternatively, it is feasible to associate the wavelength converting material with light pipe 16. It may be desirable that light pipe emitted light have a color temperature CCT in the range of about 2700K to 10,000K.

[0011] Remote end 24 of guide 16 can include an internal or external reflecting strip or other surface element that reflects light impinging on the surface element. At least some of the reflected light strikes the interface between the outside surface of the light guide and the surrounding atmosphere at an angle that is less than the critical angle of the light guide-atmosphere interface, allowing light to escape from the light guide as emitted light.

[0012] A band or pattern 26 of individual reflective surface elements 28 can be provided on the remote end 24 of light guide 16. The surface elements 28 may be separated from one another. The surface elements 28 may be printed or otherwise adhered to an outer surface 30 of the light guide 16. Alternatively, the surface elements 28 may be formed on the inside of the light guide 16.

[0013] In one embodiment, the surface elements 28 reflect the light that impinges on the surface elements 28. For example, at least some of the light that is transmitted through the light guide 16 strikes the surface elements 28 and is reflected or scattered by the surface elements 28. At least a portion of light reflected by surface elements may exit the light guide 16 as emitted light 32. The emitted light 32 may emanate from the light guide 16 in a direction transverse to the lamps longitudinal axis 34. Of course, the emitted light 32 may emanate from the light guide 16 in a variety of directions.

[0014] The pattern 26 of the surface elements 28 may be provided along the length of the light guide remote end 24 in one or more of a shape and distribution in order to provide a desired distribution of the light 32 emanating from the light guide 16. The emitted light 32 may have a distribution defined by a length and a projection angle. The length represents the distance along the remote end of light guide 16 in a direction parallel to the transverse axis 38 that the light 32 emanates from the light guide 16 in

directions transverse to the longitudinal axis. The projection angle is the radial distance that the light extends over the surface of the light guide 16. In a representative embodiment, the distribution angle extends from about 30° to about 330° (with 0° facing the printed circuit board) to provide the light pattern typically associated with an incandescent filament.

[0015] Alternatively, as opposed to shaped elements, the surface elements 28 may include light transmissive elements having an index of refraction that differs from the index of refraction of the light guide 16. The interfaces between the surface elements 28 and the light guide 16 may alter the critical angle required for total internal reflection. For example, the surface elements 28 may have an index of refraction that increases the critical angle at the interface between the light guide 16 and the surface elements 28. Increasing the critical angle may reduce the amount of light that is internally reflected in the light guide 16 and may increase the amount of light that emanates from the light guide 16. The light that is refracted by the surface elements 28 may emanate from the light guide 16 through the surface elements 28. For example, the emanating refracted light may exit the light guide 16 proximate the same side of the light guide 16 on which the surface elements 28 are disposed.

[0016] By controlling the size and/or density of the surface elements 28 or the pattern 26, the amount of emanated light 32 may be controlled along the longitudinal axis 38. For example, the light 32 may emanate from the light guide 16 such that no appreciable gradient in the intensity of the emitted light 32 exists or it may be tailored to increase in intensity as the transverse axis 38 as it approaches the longitudinal axis 34.

[0017] Lamp assembly 10 further includes a pair of auxiliary LEDs 40 disposed on printed circuit board 20. LEDs 40 emit light which directly radiates upon envelope 14. In one embodiment LEDs 40 can emit at a first radiation to excite a phosphor material 42 (or other light converting material) associated with envelope 14 for conversion into a desired visible spectrum (e.g. white). Alternatively, the phosphor material can be directly associated with the LEDs 40, such as coated directly thereon. As a further option, multiple colored LED devices should could be utilized wherein the radiated light of each is blended to obtain a desired spectral output (e.g. R-G-B blend to produce white light). Of course, the lamp is not limited to any particular number of auxiliary

LEDs or light guide illuminating LEDs. An electronics package (not shown) can be disposed within connector base 44.

[0018] The exemplary embodiment has been described with reference to the preferred embodiments. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding detailed description. It is intended that the exemplary embodiment be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

CLAIMS:

1. A lamp comprising at least two light emitting diodes in thermal communication with a heat sink, a translucent envelope positioned to receive light emitted from said light emitting diodes, a light guide positioned to receive light emitted from at least one of said at least two light emitting diodes, said light guide including a first leg extending from adjacent the heat sink toward an interior of said envelope and a second leg angled relative to said first leg, said second leg being at least substantially perpendicular to a longitudinal axis of said lamp, said second leg emitting light from said light guide.

2. The lamp of claim, 1 wherein said first leg is at least substantially parallel to the longitudinal axis of the lamp.

3. The lamp of claim 1 wherein said light guide further comprises a third leg extending from adjacent said heat sink towards the interior of said envelope, the third leg intersecting said second leg.

4. The lamp of claim 3 wherein said third leg intersects said second leg at an end opposed to an end intersecting said first leg.

5. The lamp of claim 1 further comprising a light emitting diode emitting light into said third leg.

6. The lamp of claim 3 wherein said first and third legs have at least substantially total internal reflectance.

7. The lamp of claim 1 wherein at least one light emitting diode emits at least a preponderance of its entitled light directly onto said envelope.

8. The lamp of claim 7 further comprising a wavelength conversion material associated with said envelope which is excited by light emitted by said at least one light emitting diode and emits light at a different spectrum.

9. The lamp of claim 7 further comprising a wavelength conversion material associated with said at least one light emitting diode.

10. The lamp of claim 1 wherein said heat sink comprises a MCPCB.

11. The lamp of claim 1 wherein a wavelength converting material is disposed between said light emitting diode and said light guide.

12. The lamp of claim 1 wherein said light guide includes a wavelength converting material.

13. A lamp comprising a translucent envelope at least substantially surrounding a light guide, said light guide comprised of a first leg including a first end in light receiving relationship with at least one light emitting diode, said light guide including a second leg angled relative said first leg and oriented at least generally perpendicular to a longitudinal axis of said lamp, said second leg including elements causing light to exit the light guide.

14. The lamp of claim 13 wherein said envelope is transparent.

15. The lamp of claim 14 wherein said first leg of the light guide includes a cavity receiving said light emitting diode.

16. The lamp of claim 13 wherein said light guide includes a third leg, intersecting said second leg, said third leg being in a light receiving relationship with a further light emitting diode.

17. The lamp of claim 16 wherein said light guide is generally u-shaped.

18. The lamp of claim 13 wherein said elements comprise reflectors.

19. The lamp of claim 13 wherein said second leg is at least generally cylindrical and wherein light exits said between about 30° and 330° around the circumference of said second leg, wherein a 0° orientation of said second leg favors said light emitting diode.

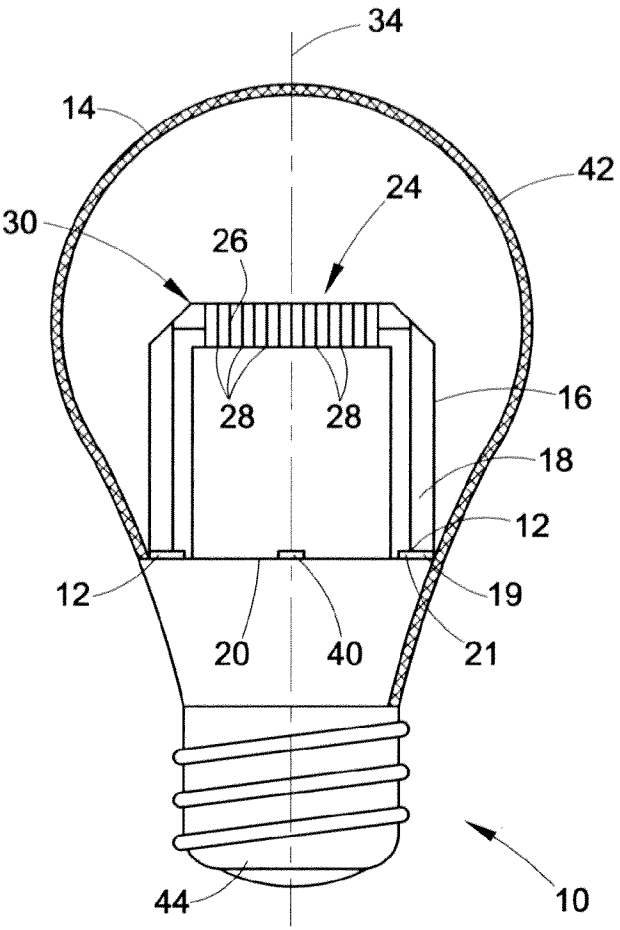
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FIG. 1

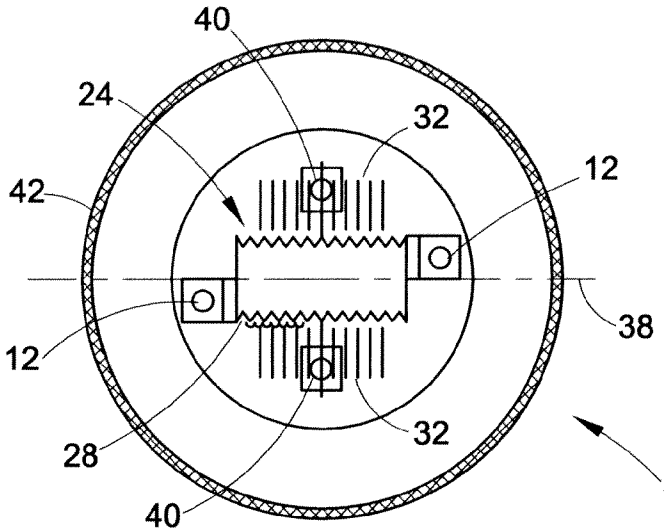
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FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/083943

A. CLASSIFICATION OF SUBJECT MATTER

see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F21S, F21V

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

ICPRSABS, CNABS, CNTXT, VEN, CNKI: lamp?, bulb?, light 1w emit+ 1w diode?, LED? guide+, lightguide, reflect+,

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	CN202203686 U(ZHEJIANG XIONGBANG ENERGY SAVING PROD CO) 25 Apr. 2012 (25.04.2012) description paragraphs [0005]-[0013], figures 1-3	1-19
X	CN201992379 U(LIN Xuejin et al) 28 Sep.2011 (28.09.2011), description paragraphs [0040]-[0049], figures 1-12	1-19
A	CN201326924 Y(YOUHAO CO LTD) 14 Oct. 2009 (14.10.2009) the whole document	1-19
A	CN201892080 U(PAN Jiahong) 06 Jul. 2011 (06.07.2011) the whole document	1-19
A	CN1712769 A(OSRAM SYLVANIA INC) 28 Dec. 2005 (28.12.2005) the whole document	1-19
A	US2005/0152141 A1(SUZUKIN) 14 Jul. 2005 (14.07.2005) the whole document	1-19

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
12 Sep. 2012 (12.09.2012)	**27 Sep. 2012 (27.09.2012)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer DAI, Yunli Telephone No. (86-10)62085585

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

F21S 2/00 (2006.01) i

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