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(54) LED LIGHTING UNIT

(57) A light unit comprising:
a fire resistant housing (7) having a central symmetry axis;
a support (2) located in the housing;
a main lamp unit located axially on the support (2); and
wherein the housing (7) comprises a back section (30) having front and rear surfaces, one or more sides and a forwardly opening aperture through which light from the main lamp unit passes to the exterior;
the support (2) being located in contact with or adjacent a front of the back section (30);
a heat sink (4) located in contact with or adjacent a rear of the back section (30);
the back section (30) having one or more apertures (31, 32) communicating between the front and rear of the back section (30);
a thermally conducting element (36) in contact with the heat sink (4), the element (36) extending through a respective aperture (31,32) and contacting the support (2) adjacent a rear portion of the main lamp unit.

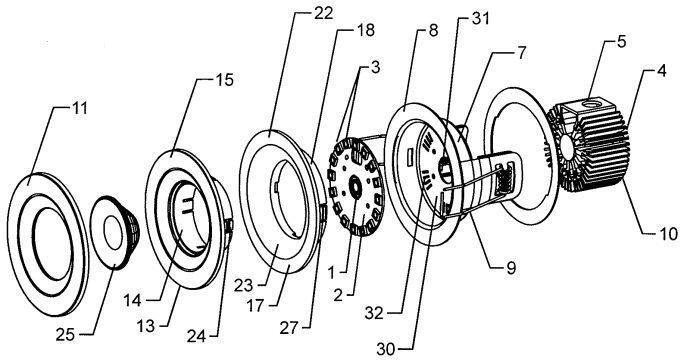

FIG 3.

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Description

[0001] This invention relates to a lighting unit of the kind used to mount a lamp on a ceiling, wall, panel or other fixture, particularly but not exclusively within a cavity formed in a fixture. In a typical application is the units may be received within a hole in a suspended ceiling or other fascia.

[0002] The lamp may comprise a LED lamp array. Alternative embodiments may employ halogen bulbs, OLED lamps or incandescent lamps.

[0003] Recessed LED lights, commonly known as LED downlights are widely known. Typically a LED downlight fixture comprises an array of LEDs in thermal connectivity with a heat sink, the array of LEDs being positioned adjacent a first aperture of a reflector assembly. A diffuser may be positioned proximal to and extending across a second aperture. Due to the arrangement and directional nature of LED components, these light units may project light vertically downwards in a narrow beam angle with essentially no diffusion in a horizontal direction.

[0004] It is important to prevent overheating of LED lamps as this can effect both the light output and service life of a lamp. A heat sink is commonly provided. Fire rated lighting units may be mounted in an aperture in a wall or ceiling partition and usually include a fire resistant housing which surrounds the lamp unit. This housing which may be composed of steel, fits into the aperture to maintain the integrity of the fire barrier by preventing flames from passing through the barrier into the void behind the barrier.

[0005] GB-A-2461935 discloses a fire resistant LED unit in which the housing has a front side and a rear side, the lighting element being mounted on the front side and a heat sink being mounted on the rear side.

[0006] According to the present invention a light unit comprises a fire resistant housing having a central symmetry axis;

a support located in the housing;

a main lamp unit located axially on the support; and

wherein the housing comprises a back section having front and rear surfaces, one or more sides and a forwardly opening aperture through which light from the main lamp unit passes to the exterior;

the support being located in contact with or adjacent a front of the back section;

a heat sink located in contact with or adjacent a rear of the back section;

the back section having one or more apertures communicating between the front and rear of the back section;

a thermally conducting element in contact with the heat sink, the element extending through a respective aperture and contacting the support adjacent a rear portion of the main lamp unit.

[0007] The lamp may comprise an LED lamp, halogen bulb, OLED lamp or incandescent lamp, an LED lamp is preferred.

[0008] The coupling/thermally conductive element may be integral with the heat sink to efficiently transfer heat from the lamp and support to the heat sink without any need for conduction through the back of the housing. Alternatively the element may be provided as a separate component for ease of manufacture. Optionally, the heat sink may be located in thermal contact with the rear of the back of the housing. Use of a coupling/thermally conductive element is advantageous in enabling the housing to be constructed from thicker or less thermally conductive material. In an embodiment the support and heat sink are positioned in thermal contact with the back of the housing so that the back acts as an additional or secondary means of conducting heat away from the LED units to the heat sink.

[0009] The conducting element may comprise a cylindrical portion having a first end arranged to engage an axial portion of the heat sink and a second end in arranged to engage the rear of the support adjacent the main lamp.

[0010] In an embodiment the cylindrical portion may extend axially into an aperture or bore in the heat sink. The cylindrical portion may comprise a cylindrical rod received in a bore of the heat sink and may be secured using a thermally conductive cement or binding agent. Such an arrangement has the advantage that the coupling/thermally conductive element efficiently delivers heat along the axial length of the heat sink, so that the heat sink is more uniformly heated.

[0011] The heat sink may comprise a generally radially symmetrical body, for example an aluminium extrusion, having an axial core and a multiplicity of radially extending fins.

[0012] The thermally conducting element may be integral with the heat sink. For example the core of the heat sink may extend axially forwardly into contact with the support or rear of the main lamp unit in use.

[0013] The thermally conducting element may be securely engaged within the aperture so that the fire resistant integrity of the unit is maintained.

[0014] The heat dissipating arrangement of the present invention may be used with a LED fixture comprising a main lamp unit and an array of secondary lamps.

[0015] In an advantageous embodiment, the lamp unit further comprises a multiplicity of secondary lamps located on the support and arranged in an array around the main lamp unit.

[0016] The back section may have a multiplicity of said apertures, the conductive element including a corresponding multiplicity of sub-elements, each element in contact with the heat sink and extending through a respective aperture and contacting the support at or adjacent the rear portion of one or more lamps of the secondary array.

[0017] The sub-elements may be integral with the heat sink and may for example comprise projections extending forwardly from a forward end of the heat sink.

[0018] Alternatively the conductive elements including the sub-elements may be provided as a separate com-

ponent. This may facilitate manufacture reducing the need to machine the forward end of the heat sink to form the projections.

[0019] The forward facing ends of the projections may be co-planar forming a circular array arranged along a circumference located behind the secondary LED array.

[0020] The conductive element may comprise a plate, for example a circular discharging sub-element extending from the front face. The rear face may be planar to engage the forward surface of the heat sink or may carry a layer of fire resistant material.

[0021] Alternatively the conductive element may comprise an axial core and a multiplicity of radially extending arms, each arm carrying one or more sub-elements. For example, a single sub-element may be located at an end of a respective arm.

[0022] Use of a separate conductive element confers several advantages. The element may be made from a more highly thermally conductive material in comparison to the housing or heat sink, providing efficient transfer of heat to the heat sink without incurring the cost of manufacture of the housing or heat sink from a more expensive material, but without compromising the fire resistance of the unit.

[0023] The element may be composed of a resilient metal alloy for ease of manufacture. The element may be made to a higher dimensional tolerance than the housing or heat sink, providing superior heat dissipating performance without increasing the cost of manufacture of the standard housing and heat sink components.

[0024] A body of fire resistant material may be disposed between the support and housing, between the housing and heat sink or both. The fire resistant material may been an intumescent material which forms an expander fire resistant layer when exposed to a flame. For example the material may form an expanded layer of carbon. Soft or hard char intumescents may be used, for example a precut piece of intumescent putty may be applied to the rear of the support or to the interior or exterior of the back section of the housing.

[0025] The body of fire resistant material may insulate the support from the housing to prevent unnecessary heating of the housing.

[0026] In an embodiment the unit further comprises a front casing defining a central aperture through which light from the main lamp passes to the exterior in use, the front casing preventing light from the secondary array from entering the central aperture;

the front casing and housing defining a light guide channel;

a light guide located in the channel, the light guide having a first end comprising a light inlet proximate the array of secondary lamps and a second end comprising a light outlet proximate a periphery of the housing.

[0027] This embodiment provides a downlight, preferably an LED downlight which has a secondary peripheral light source. This may direct light horizontally, preferably throughout an angle of 360° from the light fixture in order evenly illuminate the mounting surface.

[0028] The light guide may, in use, deflect light from a direction parallel to the central axis at the light inlet to a direction away from the central axis at the light outlet.

[0029] The light outlet may be located in a plane normal to the central axis.

[0030] The light guide may be rotationally symmetrical about the central symmetry axis. The light guide may be circular. Alternatively the light guide may be oval or may have n-fold symmetry, wherein n is an integer, about the central axis.

[0031] The light guide outlet may be directed radially outwardly of the housing.

[0032] The light guide may be annular or toroidal having a first portion extending axially from the light inlet and a second portion extending radially to the light outlet. The light guide may be generally L-shaped in cross section.

[0033] An annular collar may be located over the light guide channel, the collar having an axial aperture communicating with the central aperture and the collar overlying the light guide in order to restrict egress of light to the circumferential or peripheral outlet.

[0034] The light guide may be composed of an acrylic polymer or other high refractive index material wherein the refractive index is selected so as to achieve total internal reflection of light passing from the light inlet to the light outlet. The inner and outer annular surfaces of the light guide may be polished to optimise internal reflection. The radius of the surface facing towards the central axis may have a maximum value having a central radius curving from the light inlet towards the outer flange surface, in order to optimise total internal reflection in use. The width in a radial direction of the light inlet is greater than the width in the axial direction of the outlet in order to concentrate the light beam as it passes from the inlet to the outlet.

[0035] One or both of the inlet and outlet surfaces of the light guide may be textured to increase uniform diffusion of light from the outlet.

[0036] A main LED may provide a full range of white light colour using a LED driver circuit assembly and a dual colour LED chip of 2700K (commonly referred to as 3000K) and 6500K (commonly referred to as 6000K). Mixing of these two colours via the driver's circuit assembly provides a colour contrast temperature (CCT) adjustable from 2700K to 6500K.

[0037] The secondary lamps comprise in an exemplary embodiment by a circular array of 16 LED chips with a total power of 2W. All are Red/Blue/Green RBG or alternating 2700K and 6500K LEDs.

[0038] The primary light brightness may be controlled by increasing the power from 0 to 10W. The secondary light brightness may be controlled by increasing the power from 0 to 2W, this power being distributed across all 16 LED chips.

[0039] A lens may be located in the central aperture in order to focus or collimate the main light beam.

[0040] The primary and secondary lights may be inde-

pendently or jointly controlled to change their colour and brightness.

[0041] Peripheral lighting is achieved in a preferred embodiment by 16 low powered LED chips that are mounted in a ring around the main LED chip. The chips may be positioned to point directly downwards parallel to the central axis. This has the advantage of minimising product depth, maintaining similar aesthetic appearance to a standard downlight assembly. Simplified construction is achieved. Peripheral lighting using the light guide which in a preferred embodiment has a toroidal configuration and is L-shaped in cross section.

[0042] Remote control may be provided using computer software or a smart device application. Commands from the software or device may be communicated to individual lights or to groups of lights by wireless communication methods such as Bluetooth (RTM) or WiFi (RTM). However signals may also be sent through the mains power supply.

[0043] Use of a light unit in accordance with the following invention provides many benefits including the following benefits.

1. remote control of the lights including on/off, colour and brightness control;
2. individual and group control of the lights;
3. ability to have either main lighting or ambient lighting only or both from a single unit; and
4. minimal product aesthetics with minimum product extension from the plane of the mounting surface.

[0044] The unit of the present invention is advantageous in relation to arrangement in which a ring of LED chips is located around the external surface of a typical LED downlight. In the latter case substantial unevenness or spotting of light would occur. In addition the placement of the LED chips around the external surface necessitate an undesirable protrusion of the product from the mounting surface of perhaps to a height of 15mm. The internal placement of the LED chips in vertical orientation for a downlight, combined with redirection of light using a light guide achieves superior diffusion and greatly reduces the appearance of spotting. Furthermore the unit has a minimum protrusion from a mounting fascia. Furthermore location of the main and secondary LEDs on the support allows direct connection of the peripheral chips to the heat sink in order to improve cooling performance.

[0045] The invention is further described by means of example but not in any limitative sense with reference to the accompanying drawings of which:

Figure 1 is a front elevation of a light unit in accordance with the present invention;
Figure 2 is a cross section on B-B of Figure 1;
Figure 3 is an exploded view of the unit;
Figure 4 is a front elevation of the housing;
Figure 5 is a perspective view of a heat sink in accordance with the invention;
Figure 6 is a detail of Figure 5;
Figure 7 is an exploded view of an alternative embodiment; and
Figure 8 is an exploded view of a further alternative embodiment.

[0046] The same reference numerals are used to denote like components in each of the Figures.

[0047] The light unit shown in Figures 1-6 comprises a main LED chip (1) mounted centrally on a support (2) located in a cylindrical housing (7).

[0048] A multiplicity of secondary LED lamp chips (3) are mounted on the support (2) in a circular array. A heat sink (4) having cooling fins (10) is mounted on the rear surface of the support and provides cooling for both the main and secondary LED chips. A guide (5) for a power supply cable is provided in the back casing (6).

[0049] The housing (7) has a central axis of symmetry and includes a circumferential flange (8). The housing is arranged to fit into an aperture in a ceiling panel or other fascia (not shown) with the flange overlying the surface of the fascia to conceal the aperture.

[0050] The unit is secured to the fascia by means of two spring clips (9) a decorative bezel (11) is secured to the collar by magnets (not shown).

[0051] Front casing (13) has a cylindrical rear portion (14) and a radially outwardly extending annular flange (15). The rear portion defines an axial cylindrical central aperture (16) within which the main LED chip is axially located. The circular array of secondary LED chips (3) are located radially outwardly of the rear portion. The rear portion contacts the support so that light from the secondary array cannot enter the central aperture to mix with light from the main lamp. Further light from the main lamp cannot pass outwardly to mix with light from the secondary array.

[0052] The support (2) has a central main LED lamp (1) and a circumferential array of secondary LED lamps (3). The support (3) is located at the rear of a cylindrical wall within housing (7) in contact with or adjacent the circular back section (30). The circular back section (30) has a central axial aperture (31) communicating between the forward and rear surfaces of the back section (30). A circular array (32) of secondary apertures is provided on the support. The array (32) may be intermittent with gaps (34) as shown or may form an entire circular array. The apertures of the array (32) are located behind corresponding secondary lamp units (3).

[0053] Screw holes (33) facilitate attachment to the heat sink (4).

[0054] Heat sink (4) comprises a cylindrical, axially extending core (35) and a multiplicity, typically eleven radially extending fins (10). In the embodiment shown in Figures 1 to 6 cylindrical coupling elements (36) is integral with the core (35) of the heat sink (4). The coupling element extends axially forwardly through the circular aperture (31) of the back section (30) of the housing. The forward facing surface of the coupling element (36) en-

gages the rear surface of the support (2) and main LED lamp (1). In an embodiment the forward facing surface directly engages the rear of main LED unit (1).

[0055] An array of secondary thermally conductive elements (37) extend forwardly, parallel to the axis of the unit, to form projections which extend through respective apertures (32) of the back portion (30) of the housing. The forward surfaces of the projections of secondary elements (37) engage the rear surface of the support (2), behind secondary LED units to provide direct thermal conduction of heat from the LED units (3) to the fins (10) of the heat sink (4).

[0056] Figure 7 is an exploded view of an alternative embodiment, generally similar to that shown in Figures 1 - 6. The conducting element (40) comprises a cylindrical plate having a planar rear surface (not shown) and a cylindrical axially located main coupling element (41) with a circular intermittent array of secondary coupling elements (42, 43) separated by gaps as shown. The rear surface of the element (40) contacts the entire end surface of the heat sink (4), providing rapid and efficient dispersion of heat energy from the main and secondary lamps.

[0057] Figure 8 shows an alternative embodiment to that of Figure 7, wherein a cylindrical rod extends axially rearwardly from the conductive element and is received in an axial bore (51) of the heat sink so that heat energy from the main lamp is transmitted directly along the length of the heat sink to apply uniform heating to the heat sink.

[0058] The housing (7) and front casing (13) define a light guide cavity occupied by light guide (17).

[0059] The light guide (17) is an annular or toroidal structure formed from acrylic polymeric resin and comprises a first generally cylindrical annular portion (18) having a planar radially extending annular light input surface (21) arranged to be located proximate to the light emitting portions of the LEDs of the secondary array. The light inlet may be located in contact with the LEDs or may be arranged in spaced relation to the LEDs.

[0060] The light guide has a radially outwardly extending flange portion (20) and a cylindrical outermost light outlet (22). The surface of the light outlet (22) extends coaxially with the central axis of symmetry of the unit.

[0061] The radially inner surface (23) extends in a smooth curve having a maximum radius from the light inlet (21) to the flange portion (20) in an axial direction towards the outward radial direction parallel to the fascia surface leading to the light outlet (22). This arrangement optimises total internal reflection by light passing from the light inlet to the light outlet. The width of the annular portion (18) in a radial direction with respect to the central axis is greater than the width of the flange portion in the axial direction with respect to the central axis in order to concentrate the light beam passing from the inlet to the outlet.

[0062] A lug (24) on the rear end of front casing (13) is received in a correspondingly shaped rebate (27) in the light guide in order to securely engage the casing to the guide.

[0063] A lens (25) is engaged within the central aperture (16) and is protected by an overlying window (26) integral with the bezel (11).

[0064] The light inlet (21) and outlet (22) surfaces of the light guide are polished and the inner surface (23) is unpolished in order to enhance diffusion of light emitted by the light outlet. This serves to reduce uneven illumination or spotting of the fascia surface.

[0065] The unit of the present invention provides a homogeneous and brightly illuminated halo effect on the ceiling or other fascia around the light unit.

Claims

1. A light unit comprising:

a fire resistant housing having a central symmetry axis;
a support located in the housing;
a main lamp unit located axially on the support; and
wherein the housing comprises a back section having front and rear surfaces, one or more sides and a forwardly opening aperture through which light from the main lamp unit passes to the exterior;
the support being located in contact with or adjacent a front of the back section;
a heat sink located in contact with or adjacent a rear of the back section;
the back section having one or more apertures communicating between the front and rear of the back section;
a thermally conducting element in contact with the heat sink, the element extending through a respective aperture and contacting the support adjacent a rear portion of the main lamp unit.

2. A light unit as claimed in claim 1, wherein the lamp is an LED lamp.

3. A light unit as claimed in claim 1 or 2, wherein the thermally conducting element is integral with the heat sink.

4. A light unit as claimed in claim 1 or 2, wherein the thermally conducting element is provided as a separate component.

5. A light unit as claimed in any preceding claim, wherein the heat sink is located in thermal contact with the rear of the back of the housing.

6. A light unit as claimed in any preceding claim, wherein the conducting element comprises a cylindrical portion having a first end arranged to engage an axial

portion of the heat sink, and a second end arranged to engage the rear of the support adjacent the main lamp.

7. A light unit as claimed in claim 6, wherein cylindrical portion extends axially into an aperture or bore in the heat sink.

8. A light unit as claimed in any preceding claim, wherein the heat sink core extends axially forwardly into contact with the support.

9. A light unit as claimed in any preceding claim, wherein the thermally conducting element is engaged within the aperture.

10. A light unit as claimed in any preceding claim, comprising a main lamp unit and an array of secondary lamps, and wherein the lamp unit comprises a multiplicity of secondary lamps located on the support and arranged in an array around the main lamp unit.

11. A light unit as claimed in claim 10, wherein the back section has a multiplicity of apertures, the conductive element including a corresponding multiplicity of sub-elements, each element in contact with the heat sink and extending through a respective aperture and contacting the support at or adjacent the rear portion of one or more lamps of the secondary array.

12. A light unit as claimed in claim 11, wherein the sub-elements are integral with the heat sink, and wherein the sub-elements comprise projections extending forwardly from a forward end of the heat sink.

13. A light unit as claimed in any of claims 11 or 12, wherein the conductive elements and sub-elements are provided as a separate component.

14. A light unit as claimed in claim 13, wherein the conductive element comprises a plate, wherein the conductive element comprises a circular disc having sub-elements extending forwardly from the front face thereof, and wherein the conductive element comprises a layer of fire resistant material on the rear face of the conductive element.

15. A light unit as claimed in any preceding claim, wherein comprising a body of fire resistant material disposed between the support and housing, between the housing and heat sink or both.

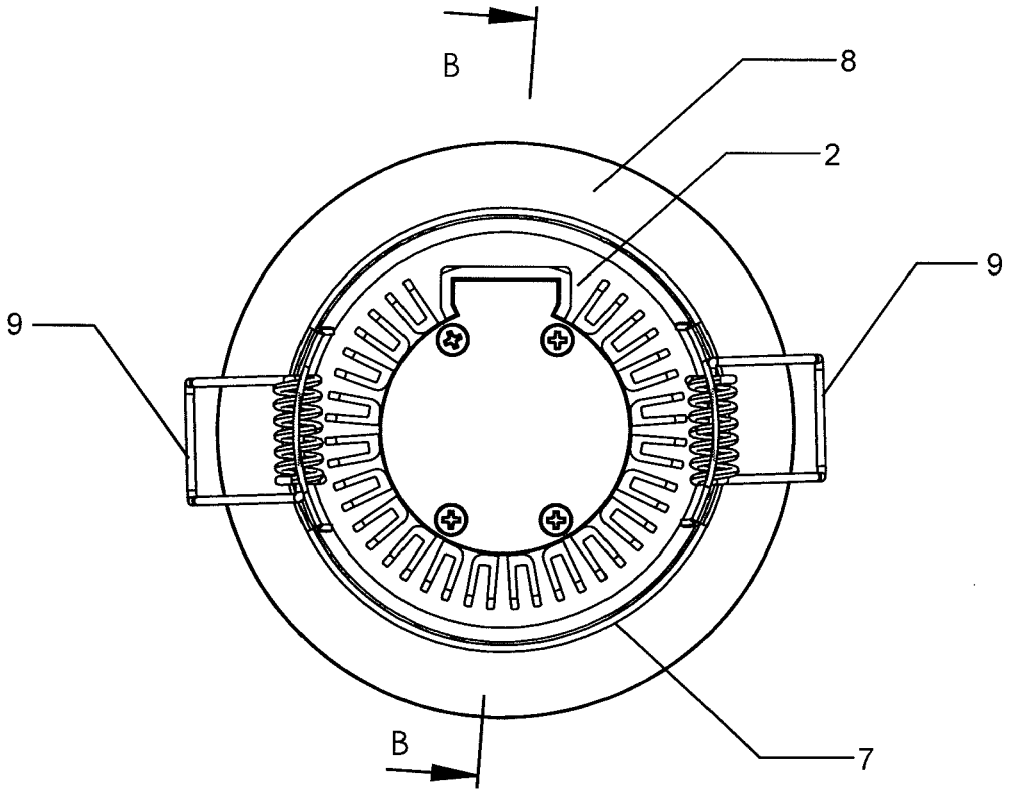

FIG 1.

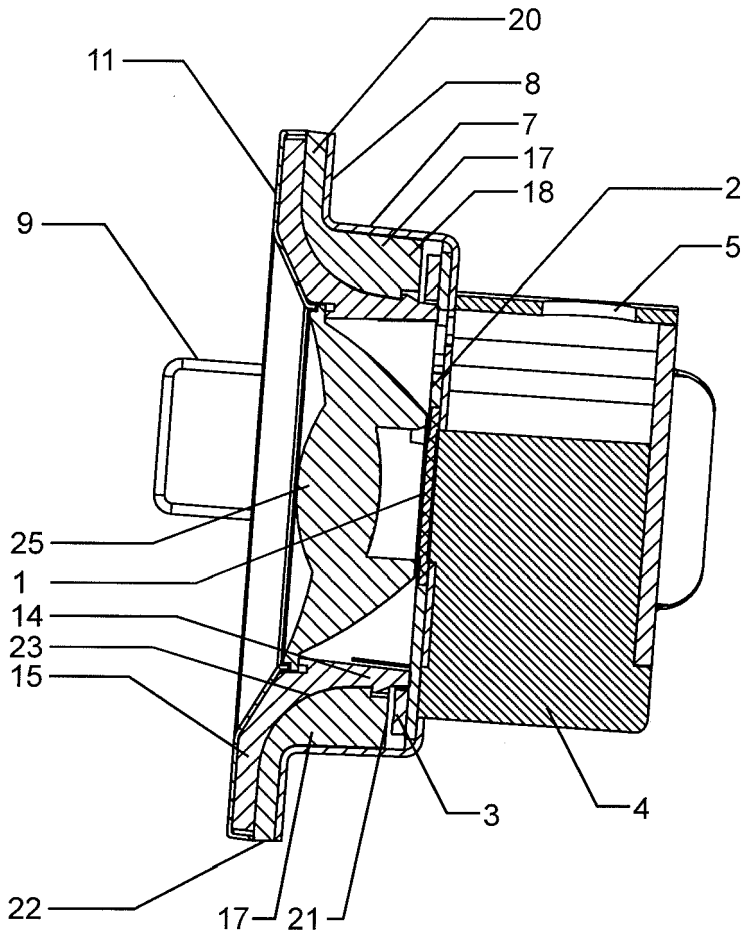

FIG 2.

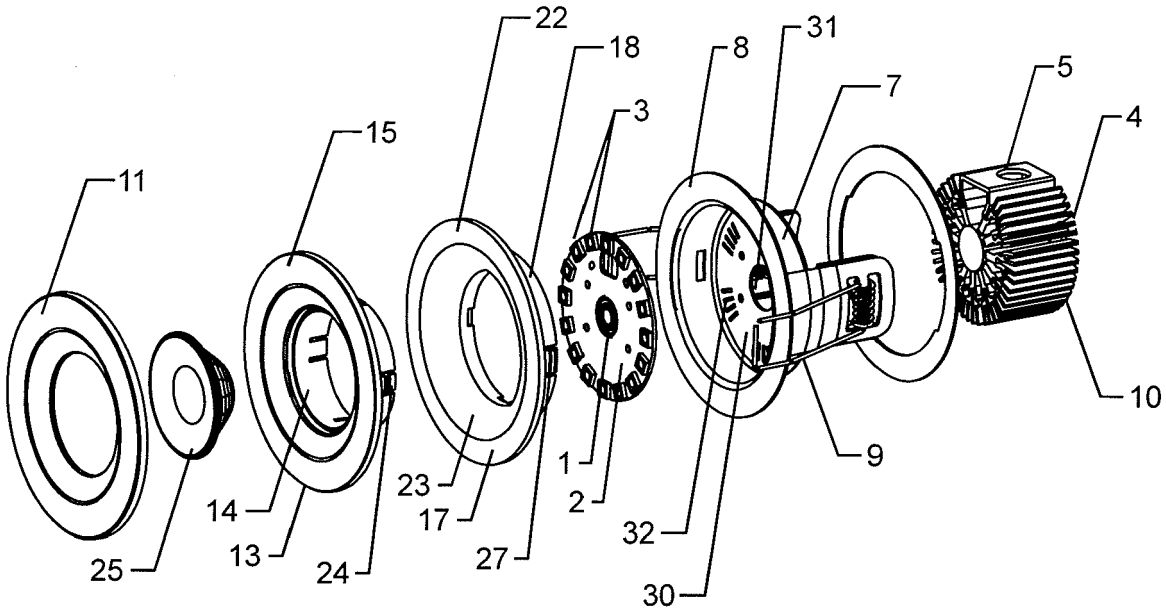

FIG 3.

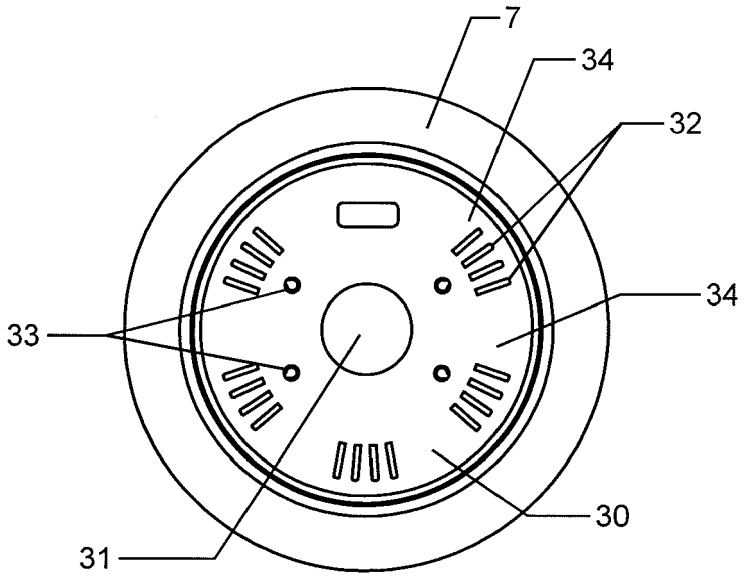

FIG 4.

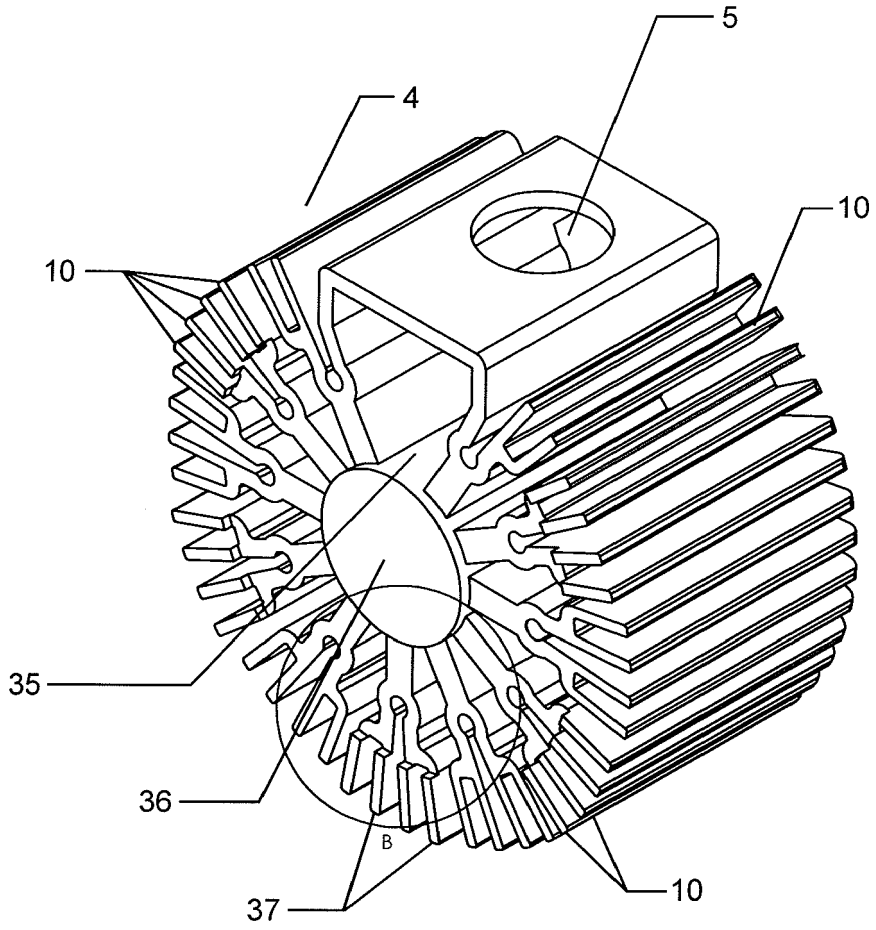

FIG 5.

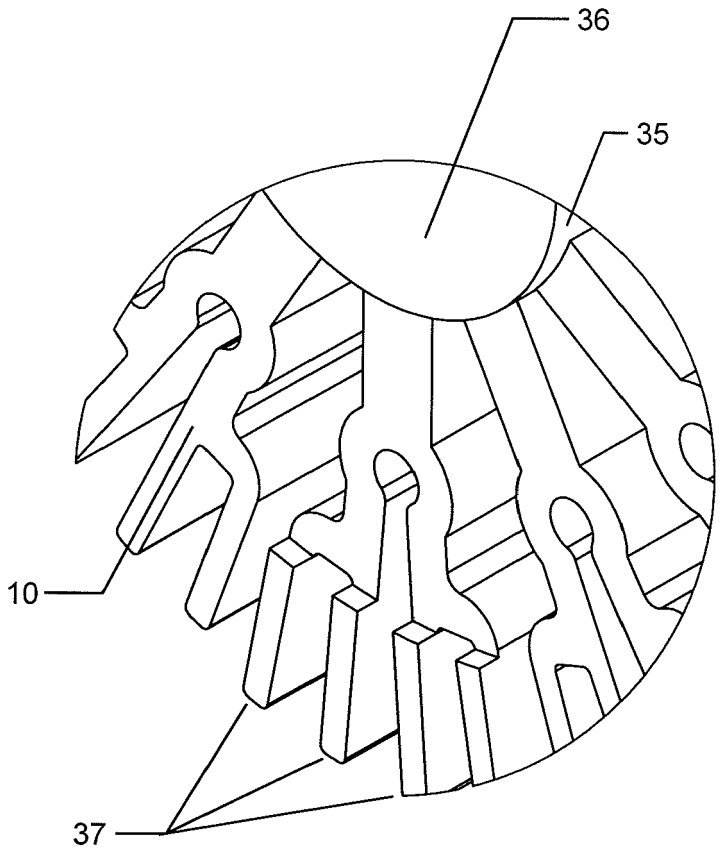

FIG 6.

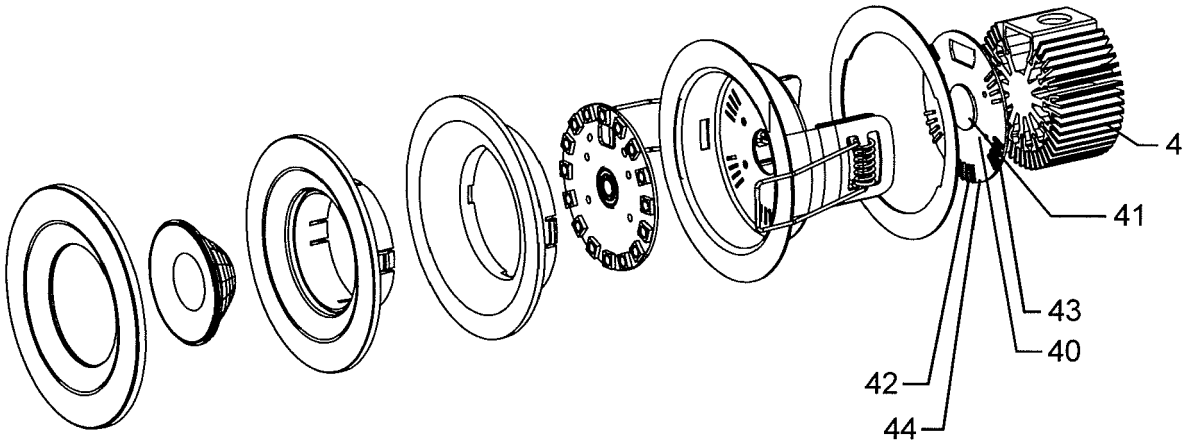

FIG 7.

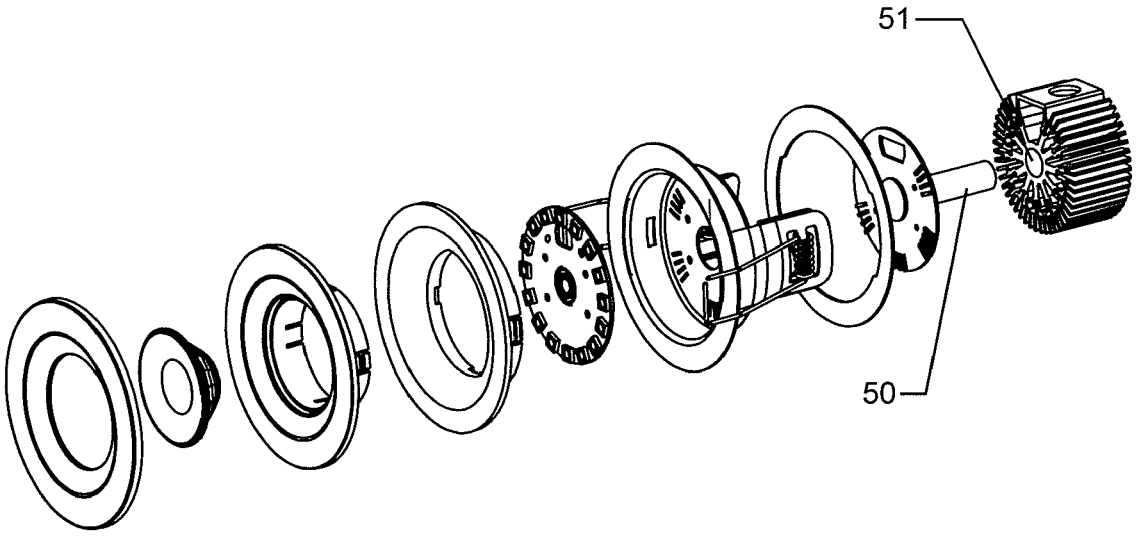

FIG 8.

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EUROPEAN SEARCH REPORT

Application Number
EP 17 17 0708

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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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
The Hague	12 July 2017	Dinkla, Remko

CATEGORY OF CITED DOCUMENTS

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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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