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(54) **Lighting device**

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Description

Field of the invention

[0001] The present invention refers to a lighting device, particularly suitable for application to public lighting or industrial lighting.

[0002] In particular, the present invention refers to a lighting device that employs point light sources, such as Light Emitting Diodes or LEDs.

[0003] More precisely, the present invention relates to a lighting device that employs LEDs as light sources and is provided with an improved LEDs mounting for optimizing the removal of the heat generated by said LEDs.

Prior art

[0004] The Kyoto Protocol, that came into force on 16th February 2005, compels the industrialised Countries, which are the main responsible for greenhouse gases emissions, to adopt as from 2008 policies and strategies suitable for obtaining a greater efficiency in energy consumption.

[0005] Public lighting provides for a marginal, but still not negligible contribution to energy consumption and greenhouse gases emissions.

[0006] Therefore, the need of intervening on the field of public lighting for providing a substantive contribution to the achievement of the goals set forth by the Kyoto Protocol is fully justified.

[0007] By the way, from this point of view the field of public lighting has clear advantages: firstly, thanks to the unitary management of the service, which can be attributed to a sole central decision-making authority, it is easy to deal with the field of public lighting in order to establish the course of action to follow; secondly, the field of public lighting can be considered as an easily programmable system, since it is a system that consumes electric energy through apparatuses which are limited in their number and kind, which are intended for one kind of function only and whose location, number, power and operation period are known.

[0008] Nevertheless, until now no intervention has been carried out for trying to reduce the electric consumption of street-lamps and other fixed lighting devices, employed either in public lighting or in industrial lighting.

[0009] In the light fixtures currently used for public and industrial lighting, mercury vapour lamps including metal iodides or sodium vapour lamps are usually employed.

[0010] In these light fixtures, a high percentage of the light flux is dispersed along unwanted directions, with a consequent efficiency reduction and consumption increase. Concerning public lighting, for instance, a large part of the luminous flux is directed upwards, instead of downwards, i.e. towards the road surface.

[0011] Recently, thanks to the development of new technologies, light sources have been considered that are more compact and suitable for directing the light

emission where required, so as to reduce the light dispersion and, consequently, the light pollution and the energy consumption.

[0012] More particularly, light fixtures using point sources, namely LEDs, as light sources have been proposed. For instance, light fixtures of this kind are disclosed, among others, in JP2005-327577, CN101059213, CN200946775Y.

[0013] Nevertheless, in the light fixtures employing LEDs described in the above-mentioned documents, LEDs are incorporated into conventional optical systems, so that the potential of these point light sources are not fully exploited and no optimised optical solution in terms of efficiency and energy saving is provided.

[0014] Some attempts have been carried out for trying to manufacture lighting devices employing LEDs and provided with an optical system expressly designed for exploiting the nature of these point light sources.

[0015] WO 2005/055328 discloses a LEDs lighting device comprising a plurality of short wavelength LEDs carried by a central mounting which is a thermal conductor and a reflector arranged around said LEDs and comprising a concave reflecting surface provided with a conversion unit for emitting light having a wavelength converted with respect to the short wavelength emitted by the LEDs.

[0016] US 2006/0181873 discloses a lighting device comprising a plurality of LEDs radially arranged on a central mounting and a reflector arranged around said central mounting; the reflector is subdivided in portions having a substantially paraboloid shape, provided in the same number as the LEDs, so that a reflecting surface appositely dedicated is provided for each LED.

[0017] EP 1,826,474 discloses a lighting device comprising an annular mounting, on the inner surface of which a plurality of equally spaced LEDs are mounted; each LED is associated to a respective, dedicated concave reflecting surface.

[0018] US 2004/125610, EP 1,471,304, EP 1,698,823 and WO 01/86198 analogously disclose lighting devices comprising a plurality of LEDs.

[0019] However, also the above-described devices are affected by drawbacks.

[0020] In fact, even if the removal of the heat generated by the LEDs represents one of the critical points in the design of LED lighting devices, the above-described devices do not provide for specific solutions for solving this problem.

[0021] As a consequence, they are not suitable for applications to high power LEDs, which have to be employed for obtaining lighting devices with satisfactory performances, especially in the field of public lighting or industrial lighting.

[0022] An object of the present invention is to overcome the drawbacks of prior art by providing a lighting device employing point light sources - namely LEDs - which is unexpensive, efficient and long-lasting.

[0023] More particularly, an object of the present invention is to provide a lighting device allowing an effective

removal of the generated heat, so as to allow to employ a number of light sources high enough to assure a good lighting with a device having a limited overall size.

[0024] These and other objects are achieved by the lighting device as claimed in the appended claims.

Summary of the invention

[0025] Thanks to the arrangement of the point light sources and to the configuration of the optical elements associated thereto, it is possible to obtain, for the same performance, an energy consumption that is largely lower than the one of conventional lighting devices.

[0026] More particularly, thanks to the use of an appropriately shaped reflector, the light flux emitted by each single point light source can be collected, reflected and directed in an optimum way.

[0027] According to the invention, thanks to the provision of a mounting for the point light sources made of a material with high thermal conductivity and comprising a pair of separated arms, spaced from each other, it is possible to mount a sufficiently high number of said light sources in a conveniently limited space.

[0028] Thus, the lighting device according to the invention can be advantageously employed as fixed lighting device in applications to public lighting or industrial lighting.

[0029] According to the invention, LEDs are preferably employed as point light sources. The use of LEDs guarantees high light efficiency, long average life, good colour yield, reduced size, adjustable light flux, immediate lighting without transients, improved vision in case of foggy weather.

Brief description of the drawings

[0030] Further advantages and features of the invention will become more evident from the following detailed description of some preferred embodiments of the invention, given by way of non limiting example, with reference to the attached drawings, wherein:

- Figure 1 is an exploded perspective view of a first example of a lighting device employing point light sources;
- Figure 2 is a magnified view of a detail of Figure 1, showing the reflector;
- Figure 3 is a magnified view of a detail of Figure 1, showing the mounting of the light sources;
- Figure 4 is a simplified scheme showing the functioning of the lighting device of Figure 1;
- Figure 5 is an exploded perspective view of a first example of a lighting device employing point light sources;
- Figure 6 is a magnified view of a detail of Figure 5, showing the reflector;
- Figure 7 is a magnified view of a detail of Figure 5, showing the mounting of the light sources;

- Figure 8 is a plan view of a lighting device according to a first embodiment of the invention;
- Figure 9 is a perspective view of the mounting of the light sources of the lighting device of Figure 8;
- Figure 10 is a cross section taken along a vertical plane of the mounting of Figure 9;
- Figure 11 is a plan view of a lighting device according to a second embodiment of the invention;
- Figure 12 is a perspective view of the mounting of the light sources of the lighting device of Figure 11
- Figure 13 is a cross section taken along a vertical plane of the mounting of Figure 12.

Detailed description of preferred embodiments of the invention

[0031] With reference to Figure 1, a first example of a lighting device 101 with point light sources and an optical system appositely dedicated thereto is shown.

[0032] Said lighting device 101 comprises a hollow housing 103, containing:

- a plurality of point light sources 105 arranged on a central mounting 107; in the illustrated example, said light sources are Light Emitting Diodes (LEDs) and there are six of them;
- a reflector 109, arranged around said mounting 107;
- a refractor, namely a lens 117.

[0033] In general, a vertical axis L can be identified in the housing 103, which is cylindrical in the illustrated example but which could as well have a different shape, determined by both operational and aesthetic reasons. The housing 103 - and, as a consequence, the lighting device 101 - will be advantageously oriented so that the vertical axis L forms an angle close to 90° with the surface to be lighted.

[0034] The light sources 105 can be arranged along the external perimeter of the mounting 107, preferably equally spaced from one another. Said light sources 105 are arranged on the mounting 107 along a circumference lying on a plane that is substantially perpendicular to the longitudinal axis L and they are oriented so that the main emitting direction of each of said light sources is substantially perpendicular to the vertical axis L and, as a consequence, substantially parallel to the surface to be lighted.

[0035] As a result, the light beam emitted by the light sources 105 is not directed towards the surface to be lighted; on the contrary, this light beam is directed towards the reflector 109 having the function of collecting, reflecting and directing the light flux emitted by the light sources 105 towards the surface to be lighted.

[0036] As shown in Figure 2, the reflector 109 has an inner surface 109a comprising a plurality of concave longitudinal channels 111, open towards the light sources 105, preferably provided in the same number as the light sources 105, each channel facing a corresponding

source 105.

[0037] Thus, each channel 111 is dedicated to the corresponding light source 105, so as to reflect and direct the light flux thereof in an optimum way, as it will be disclosed in detail hereinafter.

[0038] Moreover, in order to optimise the performances of the reflector 109, the surface of the longitudinal channels 111 is deformed by means of corrugations or undulations so as to obtain a rough surface. More particularly, in the example of Figures 1-3, said surface is provided with transversal corrugations 113.

[0039] The configuration of the reflector 109 so obtained results in a lower light intensity with respect to a reflector with a smooth surface, but it allows to illuminate a larger area, so that the light coming from the light sources 105 can be correctly directed onto the surface to be lighted.

[0040] As a general rule, the inner surface 109a of the reflector 109 is uniformly subdivided into channels 111. Nevertheless, the shape and size of these channels 111 can vary depending on the number of the expected light sources, as well as on technical or aesthetic needs - if any - concerning the overall size of the lighting device 101. Therefore, on the surface 109a the channels 111 can be in some cases alternated with flat, smooth intermediate portions 115.

[0041] It is evident that, since said intermediate portions 115 do not provide a relevant contribution to the reflection of the light emitted by the light sources 105, the optimisation of the geometry of the reflector 109 implies the minimization of the surface of said intermediate portions 115.

[0042] The reflector 109 is preferably made of a plastic material obtained by pressure die casting, such as polycarbonate, and the inner surface 109a is metallized by a process of aluminium vacuum deposition. Preferably, a thin silicon-based protection layer is provided for protecting the metallized surface 109a from weather.

[0043] Referring now to Figure 3, the light sources 105 and the mounting 107 carrying said light sources are shown in detail.

[0044] As anticipated above, in the example illustrated in Figure 1 - 3 LEDs 105 are employed as light sources, said LEDs being arranged along the external perimeter of the mounting 107, aligned and equally spaced from one another.

[0045] As well known, LEDs 105 comprise a small bulb 105a carried by a semiconductor chip 105b, wherein an anode and a cathode are obtained: by letting an electric current flow through the chip lost, photons can be produced from the recombination of electron-hole pairs, leave the chip and be emitted as light.

[0046] In the example illustrated in Figures 1 - 3, there are six of said light sources; correspondingly, the mounting 107 has the shape of an hexagon-based prism, with a LED 105 mounted on each lateral face, in a proper seat 108.

[0047] Since the performances of the LEDs deteriorate

with the increasing of temperature, it is desirable that the mounting 107, besides supporting the LEDs, also carries out the function of heat dissipator, so as to evacuate the heat generated by the LEDs during operation. To this purpose, the mounting 107 is made of a material having a high thermal conductivity, typically anodized aluminium.

[0048] With reference to Figure 4, the optical functioning of the lighting device 101 is schematically shown.

[0049] As well known, LEDs emit a light beam in a cone C centred around a main emitting direction D and having an angle of about 120°.

[0050] As disclosed above, each LED 105 is oriented so that its main emitting direction D is substantially perpendicular to the vertical axis L of the lighting device 101; said LED 105 is oriented towards the surface of the reflector 109 and, more particularly, towards the longitudinal channel 111 of said reflector 109 facing said LED 105.

[0051] Advantageously, the dimensions of the longitudinal channel 111 are set so as to intercept the most part of the light cone C emitted by the LED 105, reflect it and direct it in a beam F oriented along a direction that is substantially parallel to the vertical axis L of the lighting device 101.

[0052] At the outlet of said lighting device 101, the beam F is intercepted by the lens 117, giving as final result the refracted light beam F'.

[0053] Referring now to Figures 5 - 7, a second example of a lighting device 201 with point light sources and an optical system appositely dedicated thereto is illustrated.

[0054] As shown in Figure 5, said lighting device 201 comprises a hollow housing 203, arranged for being mounted on supporting brackets 202 and containing:

- a plurality of point light sources 205 arranged on a central mounting 207; in the illustrated example, said light sources are Light Emitting Diodes (LEDs) 205 and there are thirty of them;
- a reflector 209 arranged around said mounting 207;
- a refractor, namely a lens 217.

[0055] In the illustrated example, the lens 217 has an annular shape.

[0056] Also in the example of Figure 5, the light sources 205 are arranged along a circumference on the external perimeter of mounting 207, preferably equally spaced from one another and arranged so as to lie in a plane substantially perpendicular to the vertical axis L of the lighting device 201; said light sources 205 are oriented so that the main emitting direction of each light source is perpendicular to the vertical axis L and, as a consequence, substantially parallel to the surface to be lighted.

[0057] The light beam of the light sources 205 is therefore directed towards the reflector 209.

[0058] As shown in Figure 6, the reflector 209 has an inner surface 209a comprising concave longitudinal channels 211, open towards the light sources 205, pref-

erably provided in the same number as the light sources 205, each channel facing a corresponding source 205. Also in this case the surface of the longitudinal channels 211 is provided with a plurality of deformations, namely transversal corrugations 213, in order to optimise the reflector 209 performances.

[0059] Referring now to Figure 7, the light sources 205 are shown in detail, as well as the mounting 207 wherein said light sources are arranged, in proper seats 208.

[0060] Due to the large number of light sources, in this second example the mounting 207 has a substantially cylindrical shape and - also in this embodiment - besides supporting the LEDs, it also carries out the function of heat dissipator, so as to evacuate the heat generated by the LEDs in operation.

[0061] The optical functioning of the lighting device 201 is substantially similar to the one described above with reference to Figure 4.

[0062] Experimental tests carried out on lighting devices of the kind illustrated in Figures 1 - 3 and in Figures 5-7 have proved that, for the same performances in terms of illumination, such lighting devices with point light sources and an optical system appositely dedicated thereto allow to obtain a reduction of the energy consumption with respect to conventional devices (sodium vapour lamps, high pressure mercury vapour lamps including metal iodides) over 70%.

[0063] Even though allowing a considerable reduction in energy consumption, the structure of the above-described lighting devices does not allow to optimize the removal of the heat generated by the light sources and, contextually, to minimize the overall size of the lighting device for the same performances in terms of illumination.

[0064] In Figure 8, a lighting device 301 according to a first embodiment of the invention is shown.

[0065] Said lighting device 301 comprises a hollow housing 303 with circular plan, containing:

- a plurality of point light sources 305a,305b - namely LEDs in the illustrated embodiment - arranged on a mounting 307;
- a reflector 309;
- a refractor, namely a lens.

[0066] As better shown in Figures 9 and 10, according to the invention the mounting 307 carrying the LEDs 305a,305b has in its whole an annular shape and it comprises a base 307d from which a pair of arms 307a,307b departs, separated and spaced from each other, preferably parallel to each other, connected to the base by means of transversal arms 307c, so that a free gap 308 is defined between said arms 307a,307b, said gap having an annular shape in the illustrated embodiment.

[0067] Said mounting 307 is made of a material having a high thermal conductivity, for instance anodized aluminium.

[0068] It will be evident to the person skilled in the art

that the mounting 307, thanks to its material and to its specific geometrical structure, providing for two arms 307a,307b separated by a free gap, allows to remove the heat of the light sources mounted thereon in an optimum way.

[0069] The base 307d of the mounting 307 it is then directly fixed (for instance by means of a paste having a high thermal conductivity) to the housing 303, which in turn is made of a material having a high thermal conductivity, for instance aluminium. Thus, the heat generated by the LENDS is removed at first from the LEDs to the mounting and then, through said mounting, to the housing 303 and to the outside environment.

[0070] Thanks to this effective removal of the heat, it will be possible to mount both a plurality of LEDs 305a along the perimeter of the external surface of the external arm 307a of the mounting 307 and a plurality of LEDs 305b along the perimeter of the internal surface of the internal arm 307b of said mounting 307. Said LEDs will preferably be aligned and equally spaced from one another. More particularly, in the illustrated example, it is possible to provide twenty-four LEDs on the external arm 307a of the mounting 307 and twelve LEDs on the internal arm 307b of the mounting 307, for a total of thirty-six LEDs. Thanks to the specific geometrical structure of the mounting 307 it will be always possible to maintain the temperature of the LEDs 305a,305b below a pre-set threshold - for instance 80°C - beyond which a degradation of said LED performances could occur. Now, on the one hand it will be clear to the person skilled in the art that with a simple, conventional annular support it would be impossible to mount LEDs on both opposed walls of the mounting without causing a temperature increase and a consequent degradation of the performances of the LEDs themselves.

[0071] On the other hand, it will also be clear that the possibility of providing LEDs on both the arms of the mounting 307 allows to obtain - for the same number of the employed LEDs - a lighting device having very limited size.

[0072] In the illustrated embodiment, a circuit of a cooling fluid provided inside the gap 308 defined between the arms 307a,307b of the mounting 307 is not shown. Although experimental tests prove that the removal of the heat from the LEDs 305a,305b through the mounting 307 towards the external housing 303 and the outside environment is sufficient for maintaining the temperature of said LEDs below a pre-set threshold, of about 80°C, in case of specific needs or of specific conditions of application (for instance in case of applications in environments at high temperature), the circuit of a cooling fluid is provided inside said gap 308, so as to further optimize the removal of the heat generated by the LEDs 305a, 305b.

[0073] Referring again to Figure 8, as in the above-illustrated examples, the LEDs 305a,305b are arranged on the arms 307a,307b of the mounting 307 so that the main emitting direction of each of said LEDs is substan-

tially perpendicular to the vertical axis of the device 301 (i.e. to an axis perpendicular to the plane of the base of the housing 303 and to the plane of the lens) and, as a consequence, substantially parallel to the surface to be lighted and directed towards the reflector 309.

[0074] Said reflector 309 extends on both sides (internal and external) of the mounting 307 and has an inner surface comprising concave longitudinal channels 311a, 311b, open towards the LEDs 305a, 305b, preferably provided in the same number as the LEDs 305a, 305b, each channel facing a corresponding LED 305a, 305b. Thus, each channel 311a, 311b is dedicated to the corresponding LED 305a, 305b, so as to reflect and direct the light flux thereof in an optimum way, as disclosed above.

[0075] Also in the embodiment illustrated in Figure 8, the surface of the longitudinal channels 311a, 311b is deformed by means of transversal corrugations 313a, 313b so as to obtain a rough surface.

[0076] As a general rule, the inner surface of the reflector is uniformly subdivided into the channels; nevertheless, the shape and size of these channels can vary depending on the specific needs of the application and said channels can be in some cases alternated with flat, smooth intermediate portions.

[0077] For instance, in the illustrated embodiments, the portion of the reflector 309 on the internal side of the mounting 307 is completely subdivided into the channels 311b, converging in a central cusp; on the contrary, in the portion of the reflector 309 on the external side of the mounting 307, smooth portions 315a alternated with the channels 311a are present.

[0078] As in the above-illustrated examples, the reflector 309 is preferably made of a plastic material obtained by pressure die casting, such as polycarbonate, and the inner surface thereof is metallized, for instance by a process of aluminium vacuum deposition, and preferably provided with a thin silicon-based protection layer.

[0079] From the above disclosure, it is clear that the optical functioning of the lighting device 301 is substantially similar to the one described above with reference to Figure 4.

[0080] Referring now to Figure 11, a lighting device 401 according to a second embodiment of the invention is shown.

[0081] Said lighting device 401 comprises a hollow housing 403 with rectangular plan, containing:

- a plurality of point light sources 405a, 405b - namely LEDs in the illustrated embodiment - arranged on a mounting 407 made of a material having a high thermal conductivity, for instance anodized aluminium;.
- a reflector 409;
- a refractor, namely a lens.

[0082] As better shown in Figures 12 and 13, according to the invention the mounting 407 carrying the LEDs 405a, 405b has in its whole a rectilinear shape and it comprises a base 407d from which a pair of arms 407a, 407b

departs, separated and spaced from each other, preferably parallel to each other, connected to the base by means of transversal arms 407c, so that a free gap 408 is defined between said arms 407a, 407b, said gap having a rectangular shape in the illustrated embodiment.

[0083] In this embodiment, the base 407d of the mounting 407 is in turn "U"-shaped, so that a further gap 410 is advantageously defined below the gap 408.

[0084] Said base 407d is then directly fixed (for instance by means of a paste having a high thermal conductivity) to the housing 403, which in turn is made of a material having a high thermal conductivity, for instance aluminium. Thus, the heat generated by the LEDs is removed at first from the LEDs to the mounting and then, through said mounting, to the housing 403 and to the outside environment.

[0085] Also in this case, the mounting 407 allows the removal in an optimum way of the heat generated by the light sources mounted thereon and it allows a plurality of LEDs 405a, 405b to be mounted along the external surface of each arm 407a, 407b of the mounting 407, while maintaining their temperature below a pre-set threshold. Said LEDs will preferably be aligned and equally spaced from one another.

[0086] As a result, a high number of light sources - nine LEDs on each arm of the mounting 407, for a total of eighteen LEDs - can be mounted in a lighting device of limited size, while assuring an effective removal of the heat generated by the light sources themselves.

[0087] Also in the case of the rectilinear geometrical structure as shown in Figures 12 and 13, the circuit of a cooling fluid is provided inside said gap 308 and/or said gap 410, so as to further optimize the heat removal.

[0088] Referring again to Figure 11, also in this embodiment, the LEDs 405a, 405b are arranged on the arms 407a, 407b of the mounting 407 so that the main emitting direction of each of said LEDs is substantially perpendicular to the vertical axis of the device 401 (i.e. to an axis perpendicular to the plane of the base of the housing 403 and to the plane of the lens) and, as a consequence, substantially parallel to the surface to be lighted and directed towards the reflector 409.

[0089] Said reflector 409 extends on both sides (right and left) of the mounting 407 and has an inner surface comprising concave longitudinal channels 411a, 411b, alternated with smooth and plain intermediate portions 415a, 415b, open towards the LEDs 405a, 405b, preferably provided in the same number as the LEDs 405a, 405b, each channel facing a corresponding LED 405a, 405b. Thus, each channel 411a, 411b is dedicated to the corresponding LED 405a, 405b, so as to reflect and direct the light flux thereof in an optimum way, as disclosed above. Also in this embodiment, the surface of the longitudinal channels 411a, 411b is deformed by means of transversal corrugations 413a, 413b so as to obtain a rough surface.

[0090] The reflector 409 is preferably made of a plastic material obtained by pressure die casting, such as poly-

carbonate, and the inner surface thereof is metallized, for instance by a process of aluminium vacuum deposition, and preferably provided with a thin silicon-based protection layer.

[0091] Concerning the optical functioning of the lighting device 401, it will substantially follow the behaviour described above with reference to Figure 4.

[0092] From the above description, it will be clear to the person skilled in the art that the intended objects are achieved by the invention, which provides a lighting device of limited size comprising a high number of point light sources without causing a temperature increase, so as to obtain satisfactory performance in terms of illumination and reliability.

[0093] It will be also evident that the illustrated embodiments are given by way of a non-limiting example and many variants and modifications can be made, still remaining within the extent of the present invention, as defined by the appended claims.

Claims

1. Lighting device (301;401), comprising a hollow housing (303;403) containing:

- a plurality of point light sources (305a,305b; 405a,405b) arranged on a mounting (307;407) made of a material having a high thermal conductivity;
- a reflector (309;409);
- a refractor or a lens;

said point light sources (305a,305b;405a,405b) being arranged in a plane that is substantially perpendicular to the vertical axis of said housing (303;403) and being oriented so that the main emitting direction of each light source is substantially perpendicular to said vertical axis and directed towards said reflector (309;409), the inner surface of said reflector (309;409) comprising a plurality of concave longitudinal channels (311a,311b;411a,411b) open towards said light sources (305a,305b;405a,405b), said mounting (307;407) comprising a pair of arms (307a,307b; 407a,407b) separated and spaced from each other, so that a gap (308;408) is defined between said arms, said point light sources (305a,305b;405a,405b) being arranged on each of said arms (307a, 307b;407a,407b) on the wall opposed to the wall facing said gap (308; 408), **characterised in that** the circuit of a cooling fluid is arranged inside said gap (308;408) of said mounting (307;407).

2. Lighting device (301;401) according to claim 1, wherein said point light sources (305a,305b;405a, 405b) are aligned and preferably equally spaced from one another along said walls of said arms of said mounting (307;407).

3. Lighting device (301;401) according to claim 1, wherein said mounting comprises a base (307d; 407d) directly fixed to said housing (303;403), said arms (307a,307b;407a,407b) being connected to said base by means of transversal arms (307c;407c) and wherein said housing is made of a material having high thermal conductivity.
4. Lighting device (301;401) according to claim 3, wherein said base (407d) of said mounting is "U"-shaped.
5. Lighting device (301;401) according to any of the claims 1 to 4, wherein said arms (307a,307b;407a, 407b) of said mounting (307;407) are parallel to each other.
6. Lighting device (301;401) according to any of the claims 1 to 5, wherein said mounting (307) has a substantially annular shape.
7. Lighting device (301;401) according to any of the claims 1 to 5, wherein said mounting (407) has a substantially rectilinear shape.
8. Lighting device (301;401) according to any of the claims 1 to 7, wherein said mounting (307;407) is made of anodized aluminium.
9. Lighting device (301;401) according to claim 1, wherein said reflector (309;409) extends on both sides of said mounting (307;407) and wherein said concave longitudinal channels (311a,311b;411a, 411b) are provided in the same number as said light sources, each of said channels facing a corresponding light source (305a,305b;405a,405b).
10. Lighting device (301;401) according to claim 1, wherein the surface of said concave longitudinal channels (311a,311b;411a,411b) is deformed by means of corrugations or undulations so as to obtain a rough surface.
11. Lighting device (301;401) according to claim 10, wherein said concave longitudinal channels (311a, 311b;411a,411b) are provided with transversal corrugations (313a,313b;413a,413b).
12. Lighting device (301;401) according to claim 1 or 6 or 7, wherein said reflector (309;409) is made of plastic material obtained by pressure die casting and wherein the inner surface of said reflector comprises a metallized surface layer.
13. Lighting device (301;401) according to any of the preceding claims, wherein said point light sources are light emitting diodes (305a,305b;405a,405b).

Patentansprüche

1. Beleuchtungsvorrichtung (301; 401) mit einem hohlen Gehäuse (303; 403) enthaltend:

- eine Mehrzahl von Punktlichtquellen (305a, 305b; 405a, 405b), die auf einer Halterung (307; 407) angeordnet sind, die aus einem Material gemacht ist, das eine hohe Wärmeleitfähigkeit hat;
- einen Reflektor (309; 409);
- einen Refraktor oder eine Linse;

wobei die Punktlichtquellen (305a, 305b; 405a, 405b) in eine Ebene angeordnet sind, die im Wesentlichen senkrecht zur vertikalen Achse des Gehäuses (303; 403) ist und so orientiert ist, dass die Hauptausstrahlrichtung jeder Lichtquelle im Wesentlichen senkrecht zu dieser vertikalen Achse und auf den Reflektor (309; 409) gerichtet ist, wobei die Innenfläche des Reflektors (309; 409) mehrere konkave Längskanäle (311 a, 311b; 411 a, 411 b) aufweist, die zu den Lichtquellen (305a, 305b; 405a, 405b) hin offen sind, wobei die Halterung (307; 407) ein Paar von Armen (307a, 307b; 407a, 407b) aufweist, die von einander getrennt und in einem Abstand von einander angeordnet sind, so dass eine Lücke (308, 408) zwischen den Armen definiert ist, wobei die Punktlichtquellen (305a, 305b; 405a, 405b) jeweils auf diesen Armen (307a, 307b; 407a, 407b) auf der Wand angeordnet sind, welche der Wand, die der Lücke (308; 408) zugewandt ist, gegenüber liegt; **dadurch gekennzeichnet, dass** der Kreislauf einer Kühlflüssigkeit in der Lücke (308; 408) der Halterung (307; 407) angeordnet ist.

2. Beleuchtungsvorrichtung (301; 401) nach Anspruch 1, wobei die Punktlichtquellen (305a, 305b; 405a, 405b) ausgerichtet und vorzugsweise in gleichem Abstand von einander entlang der Wände der Arme der Halterung (307; 407) angeordnet sind.

3. Beleuchtungsvorrichtung (301; 401) nach Anspruch 1, wobei die Halterung einen Fuß (307d; 407d) aufweist, der direkt an dem Gehäuse (303; 403) befestigt ist, wobei die Arme (307a, 307b; 407a, 407b) mit dem Fuß mittels transversaler Arme (307c; 407c) verbunden sind und wobei das Gehäuse aus einem Material hoher Wärmeleitfähigkeit gemacht ist.

4. Beleuchtungsvorrichtung (301; 401) nach Anspruch 3, wobei der Fuß (407d) der Halterung U-förmig ist.

5. Beleuchtungsvorrichtung (301; 401) nach einem der vorstehenden Ansprüche 1 bis 4, wobei die Arme (307a, 307b; 407a, 407b) der Halterung (307; 407) parallel zueinander sind.

6. Beleuchtungsvorrichtung (301; 401) nach einem der Ansprüche 1 bis 5, wobei die Halterung (307) eine im Wesentlichen kreisförmige Form hat.

7. Beleuchtungsvorrichtung (301; 401) nach einem der Ansprüche 1 bis 5, wobei die Halterung (407) eine im Wesentlichen geradlinige Form hat.

8. Beleuchtungsvorrichtung (301; 401) nach einem der Ansprüche 1 bis 7, wobei die Halterung (307; 407) aus eloxiertem Aluminium ist.

9. Beleuchtungsvorrichtung (301; 401) nach Anspruch 1, wobei sich der Reflektor (309; 409) auf beiden Seiten der Halterung (307; 407) erstreckt und wobei die konkaven Längskanäle (311a, 311b; 411a, 411b) in derselben Anzahl wie die Lichtquellen vorhanden sind und jeder der Kanäle einer dazugehörenden Lichtquelle (305a, 305b; 405a, 405b) zugewandt ist.

10. Beleuchtungsvorrichtung (301; 401) nach Anspruch 1, wobei die Oberfläche der konkaven Längskanäle (311a, 311b; 411a, 411b) durch Riefen oder Wellen verformt ist, um eine unebene Oberfläche auszubilden.

11. Beleuchtungsvorrichtung (301; 401) nach Anspruch 10, wobei die konkaven Längskanäle (311a, 311b; 411a, 411b) mit Querriefen (313a, 313b; 413a, 413b) versehen sind.

12. Beleuchtungsvorrichtung (301; 401) nach Anspruch 1 oder 6 oder 7, wobei der Reflektor (309; 409) aus Kunststoffmaterial gemacht ist, das durch Druckguss erzeugt wurde und wobei die innere Oberfläche des Reflektors eine metallisierte Oberflächenschicht aufweist.

13. Beleuchtungsvorrichtung (301; 401) nach einem der vorstehenden Ansprüche, wobei die Punktlichtquellen lichtemittierende Dioden (305a, 305b; 405a, 405b) sind.

Revendications

1. Dispositif d'éclairage (301 ; 401), comportant un logement creux (303 ; 403) contenant :

- une pluralité de sources ponctuelles de lumière (305a, 305b ; 405a, 405b) disposées sur un support (307 ; 407) constitué d'un matériau présentant une conductivité thermique élevée ;
- un réflecteur (309 ; 409) ;
- un dispositif réfracteur ou une lentille ;

lesdites sources ponctuelles de lumière (305a, 305b ; 405a, 405b) étant agencées dans un plan qui

est essentiellement perpendiculaire à l'axe vertical dudit logement (303 ; 403) et étant orientées de façon à ce que la direction principale d'émission de chaque source de lumière soit essentiellement perpendiculaire au dit axe vertical et dirigé vers ledit réflecteur (309 ; 409), la surface interne dudit réflecteur (309 ; 409) comportant une pluralité de canaux concaves longitudinaux (311a, 311b ; 411a, 411b) ouverts vers lesdites sources de lumière (305a, 305b ; 405a, 405b), ledit support (307 ; 407) comprenant une paire de bras de support (307a, 307b ; 407a, 407b) séparés et distants l'un de l'autre, de telle sorte qu'un intervalle (308, 408) est défini entre lesdits bras de support, lesdites sources ponctuelles de lumière (305a, 305b ; 405a, 405b) étant disposées sur chacun desdits bras de support (307a, 307b ; 407a, 407b) et sur la paroi opposée à la paroi faisant face au dit intervalle (308 ; 408),

caractérisé en ce que

le circuit d'un fluide de refroidissement est agencé à l'intérieur dudit intervalle (308 ; 408) dudit support (307 ; 407).

2. Dispositif d'éclairage (301 ; 401) selon la revendication 1, dans lequel lesdites sources ponctuelles de lumière (305a, 305b ; 405a, 405b) sont alignées et, de préférence, équidistantes les unes des autres le long desdites parois desdits bras dudit support (307 ; 407).
3. Dispositif d'éclairage (301 ; 401) selon la revendication 1, dans lequel ledit support comporte une base (307d ; 407d) fixée directement sur ledit logement (303 ; 403), lesdits bras de support (307a, 307b ; 407a, 407b) étant connectés à ladite base au moyen de bras transversaux (307c ; 407c) et dans lequel ledit logement est constitué d'un matériau à conductivité thermique élevée.
4. Dispositif d'éclairage (301 ; 401) selon la revendication 3, dans lequel ladite base (407d) dudit support est configurée en forme de "U".
5. Dispositif d'éclairage (301 ; 401) selon l'une quelconque des revendications 1 à 4, dans lequel lesdits bras (307a, 307b ; 407a, 407b) dudit support (307 ; 407) sont parallèles l'un par rapport à l'autre.
6. Dispositif d'éclairage (301 ; 401) selon l'une quelconque des revendications 1 à 5, dans lequel ledit support (307) présente une configuration essentiellement annulaire.
7. Dispositif d'éclairage (301 ; 401) selon l'une quelconque des revendications 1 à 5, dans lequel ledit support (407) présente une configuration essentiellement rectiligne.

8. Dispositif d'éclairage (301 ; 401) selon l'une quelconque des revendications 1 à 7, dans lequel ledit support (307 ; 407) est constitué d'aluminium anodisé.

9. Dispositif d'éclairage (301 ; 401) selon la revendication 1, dans lequel ledit réflecteur (309 ; 409) s'étend sur les deux côtés dudit support (307 ; 407) et dans lequel lesdits canaux concaves longitudinaux (311a, 311b ; 411a, 411b) sont prévus en nombre égal à celui desdites sources de lumière, chacun desdits canaux faisant face à une source de lumière correspondante (305a, 305b ; 405a, 405b).

10. Dispositif d'éclairage (301 ; 401) selon la revendication 1, dans lequel la surface desdits canaux concaves longitudinaux (311a, 311b ; 411a, 411b) est déformée au moyen de cannelures ou d'ondulations de façon à obtenir une surface rugueuse.

11. Dispositif d'éclairage (301 ; 401) selon la revendication 10, dans lequel lesdits canaux concaves longitudinaux (311a, 311b ; 411a, 411b) sont prévus avec des cannelures transversales (313a, 313b ; 413a, 413b).

12. Dispositif d'éclairage (301 ; 401) selon la revendication 1 ou 6 ou 7, dans lequel ledit réflecteur (309 ; 409) est constitué d'un matériau plastique obtenu par moulage sous pression et dans lequel la surface intérieure dudit réflecteur comporte une couche superficielle métallisée.

13. Dispositif d'éclairage (301 ; 401) selon l'une quelconque des revendications précédentes, dans lequel lesdites sources ponctuelles de lumière sont des diodes électroluminescentes (305a, 305b ; 405a, 405b).

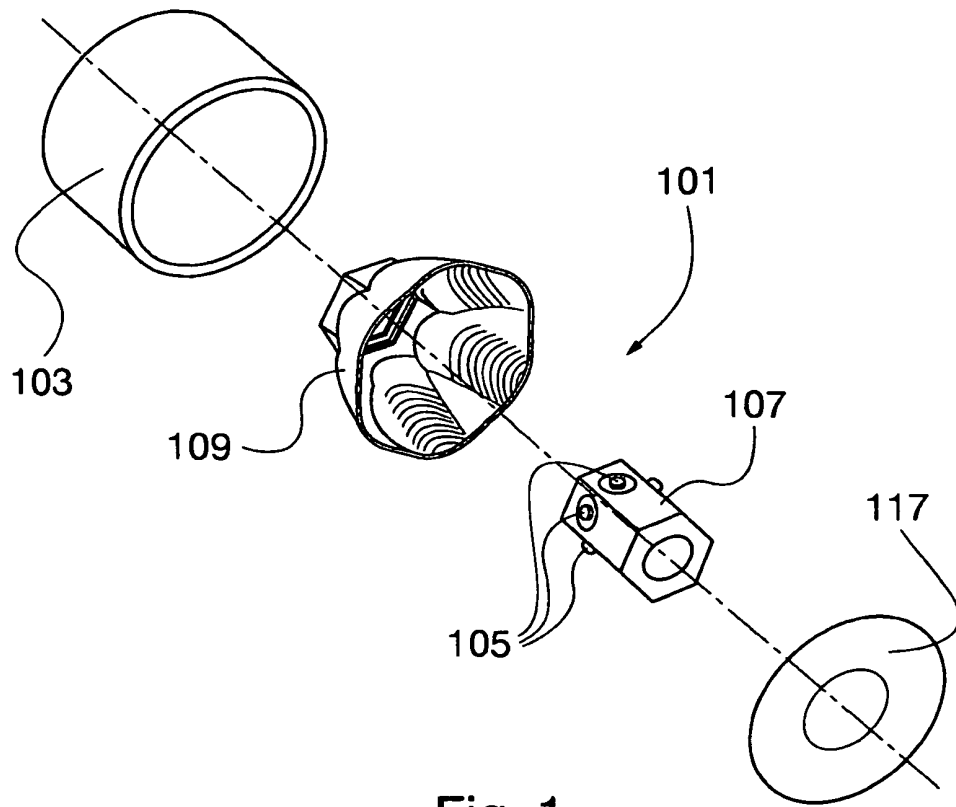


Fig. 1

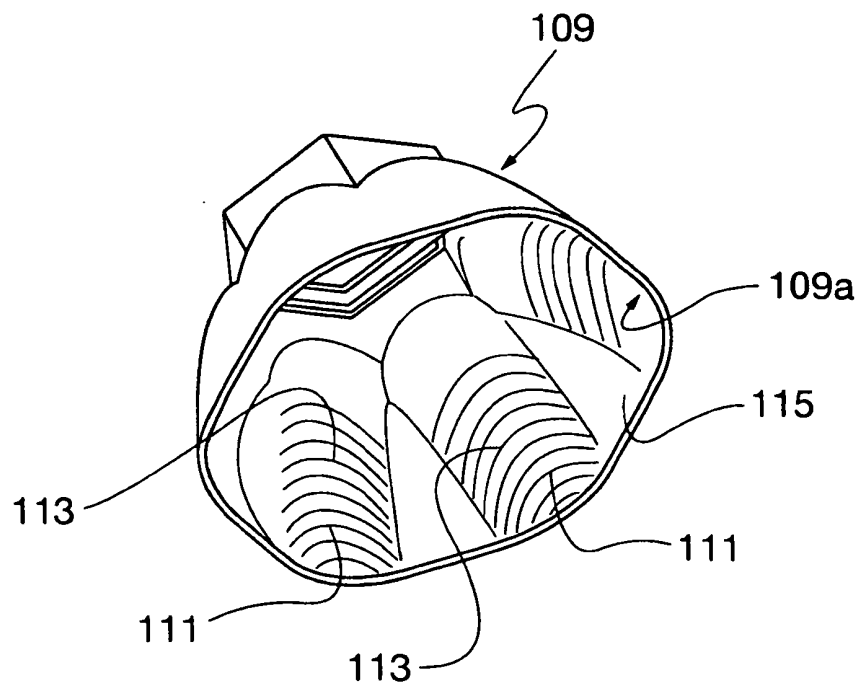


Fig. 2

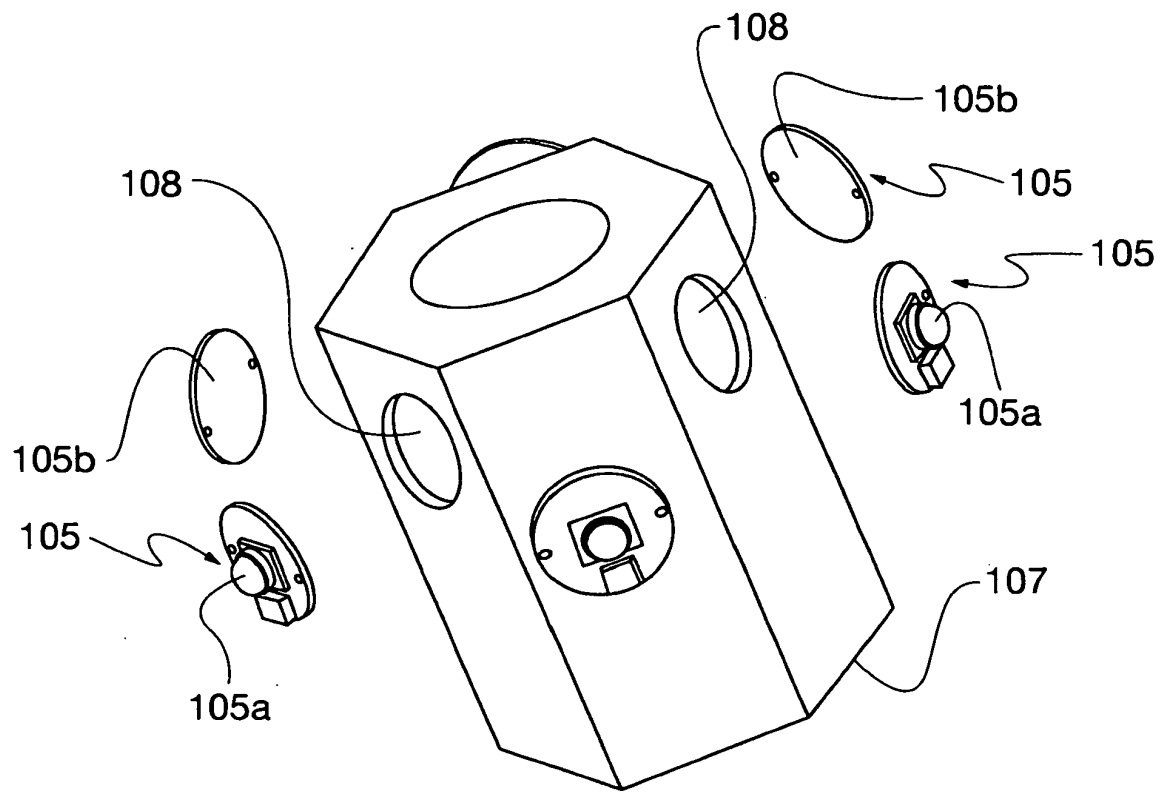


Fig. 3

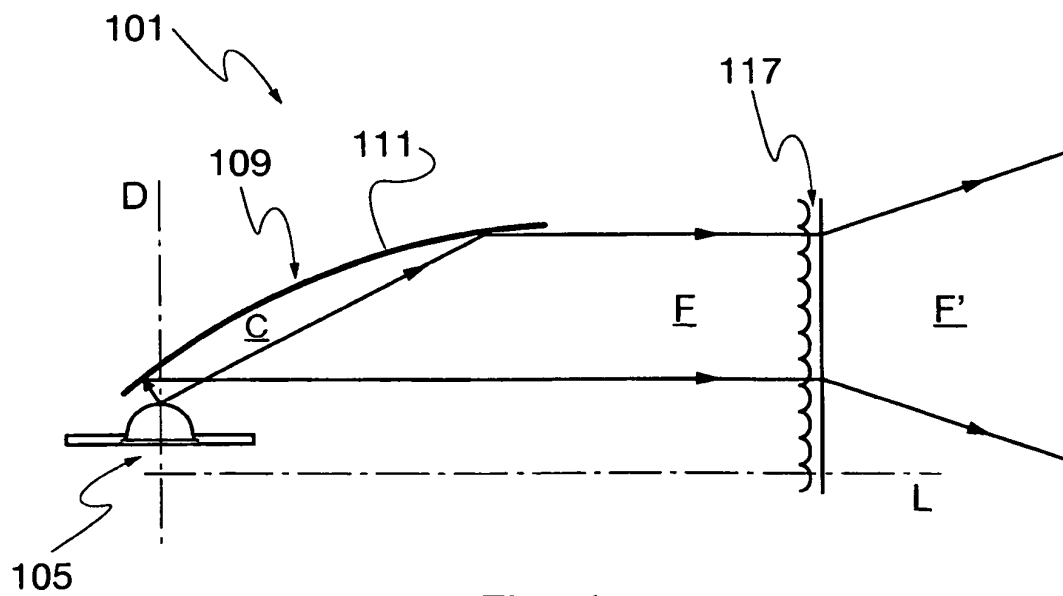


Fig. 4

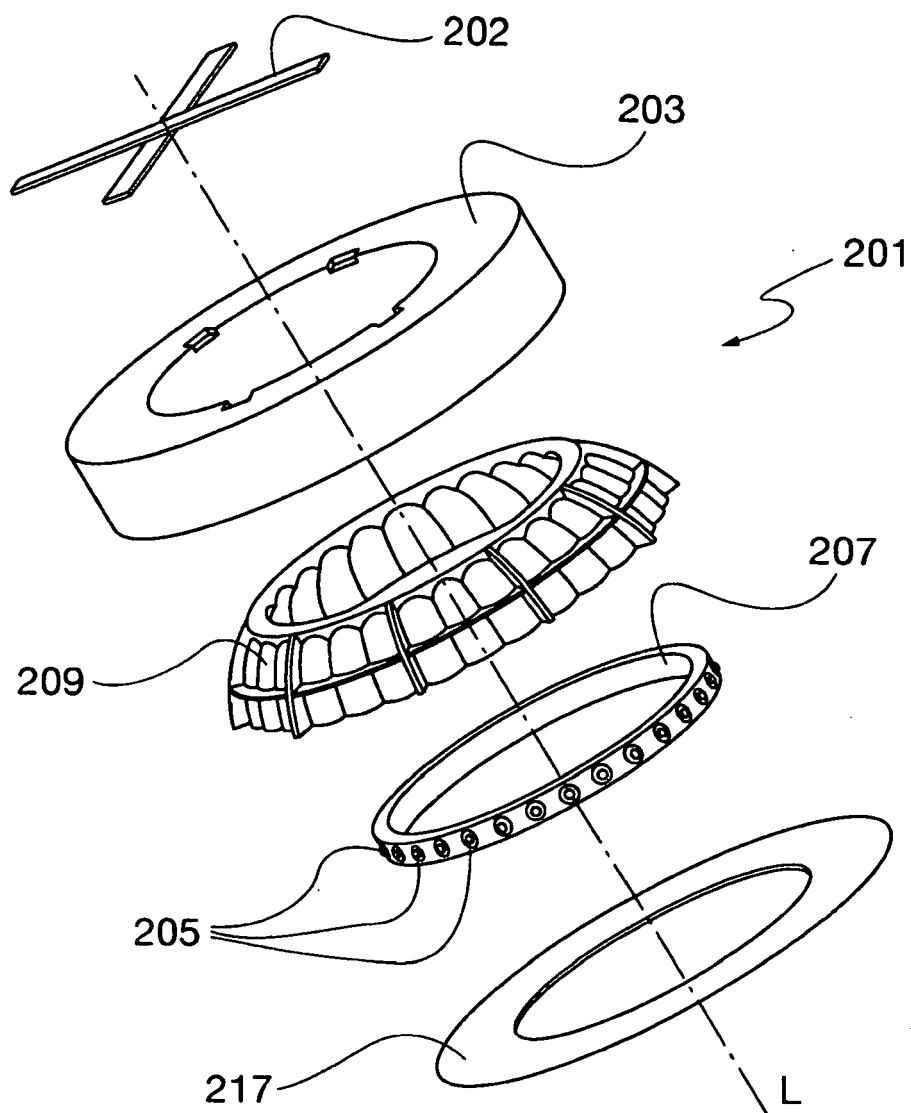


Fig. 5

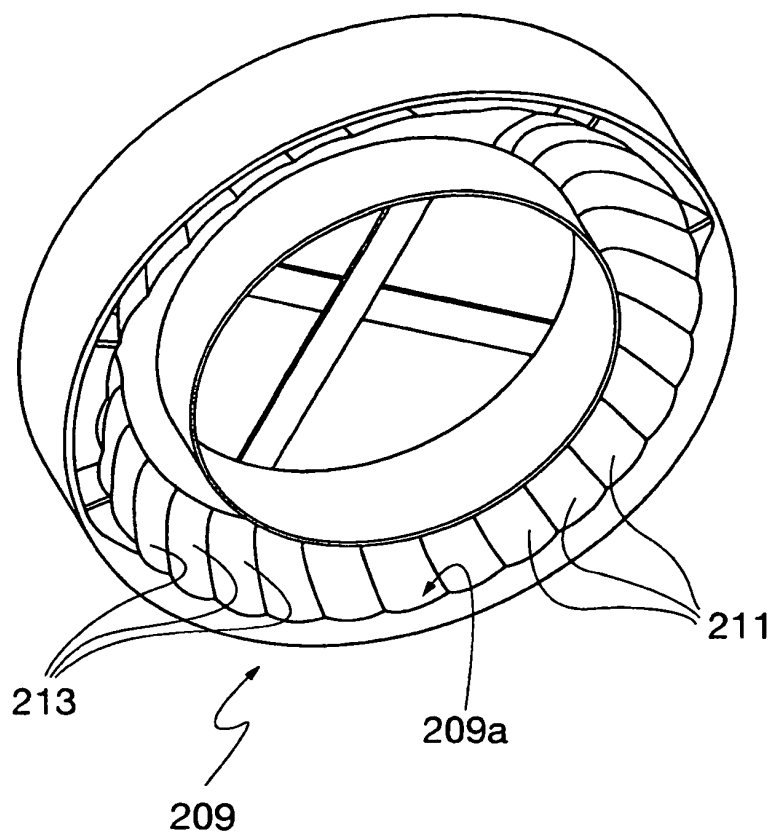


Fig. 6

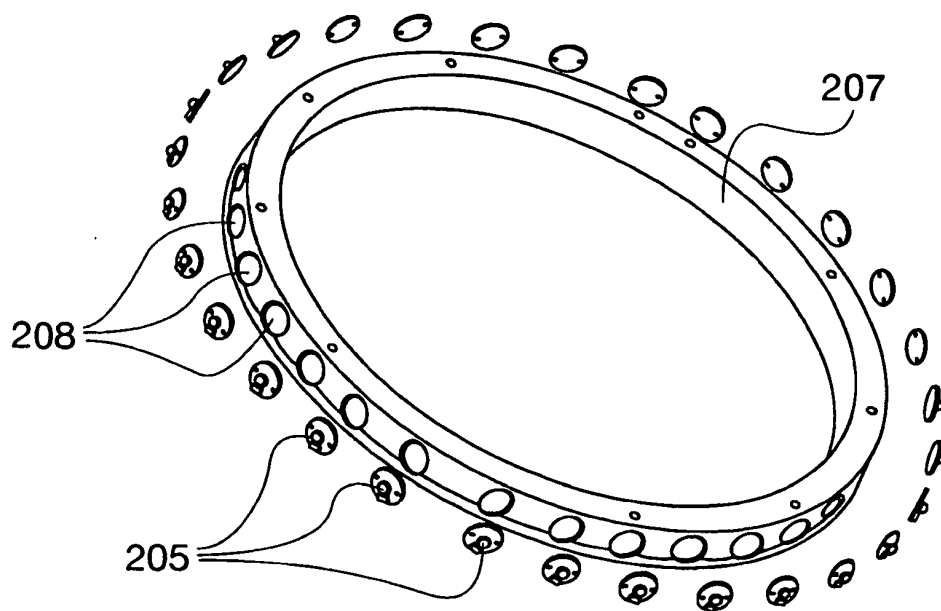


Fig. 7

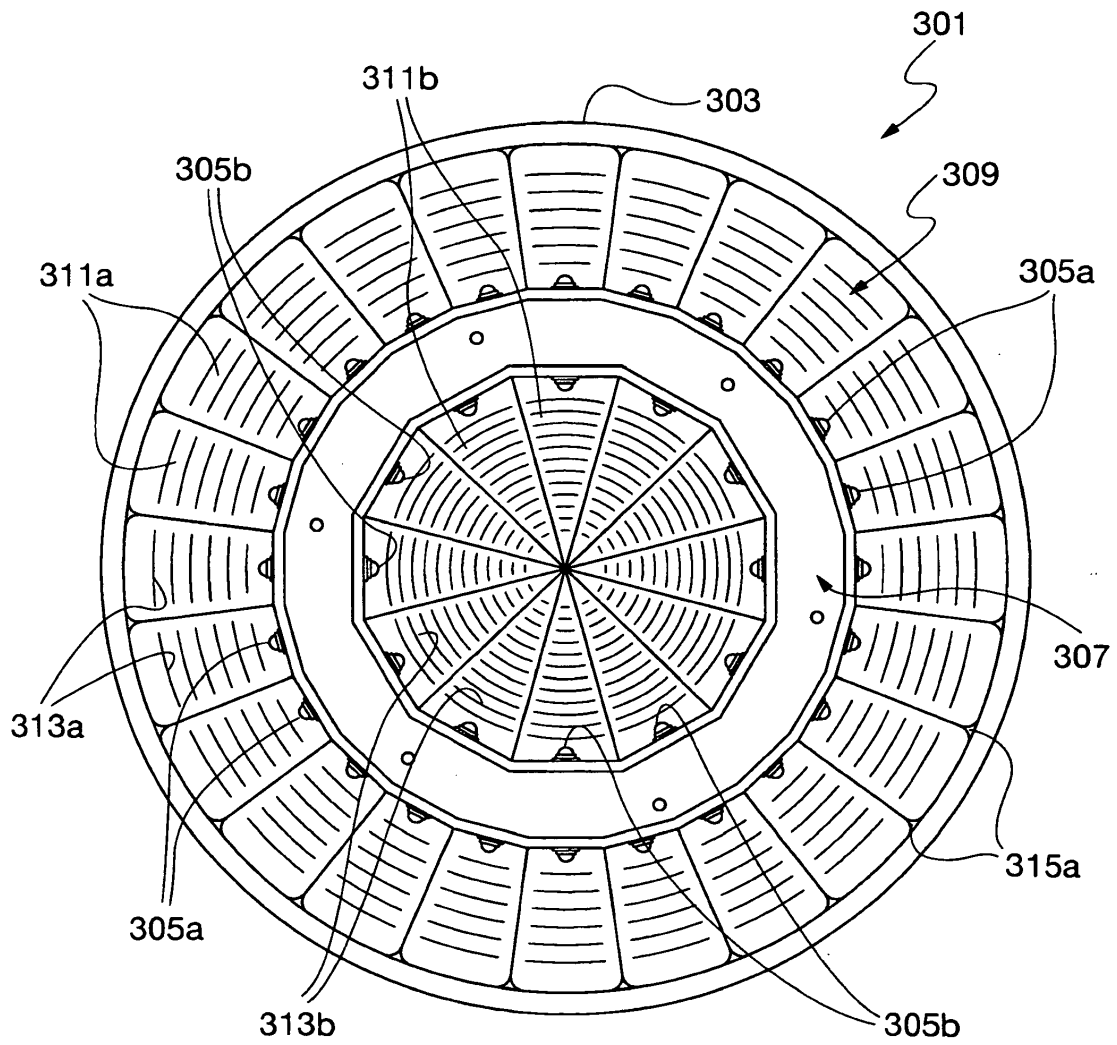


Fig. 8

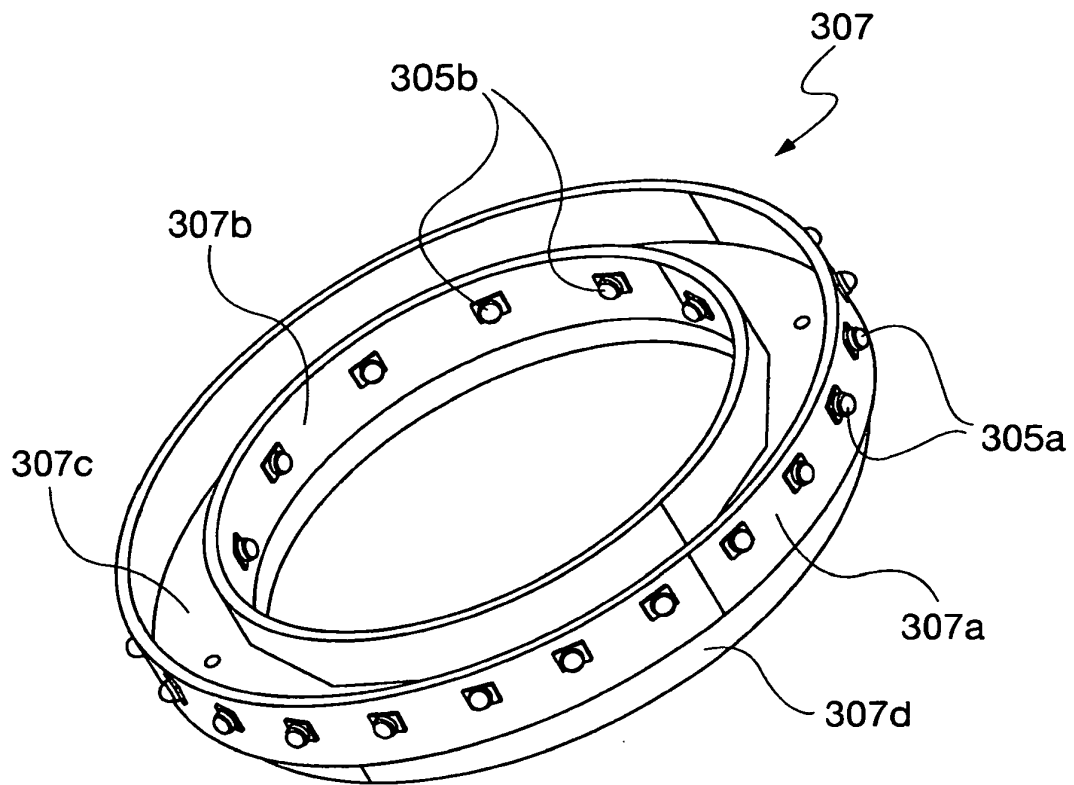


Fig. 9

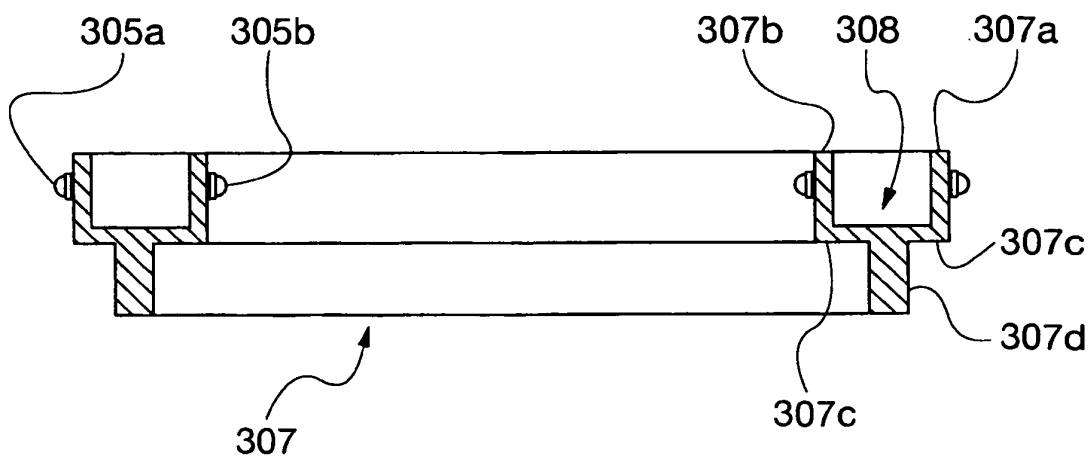


Fig. 10

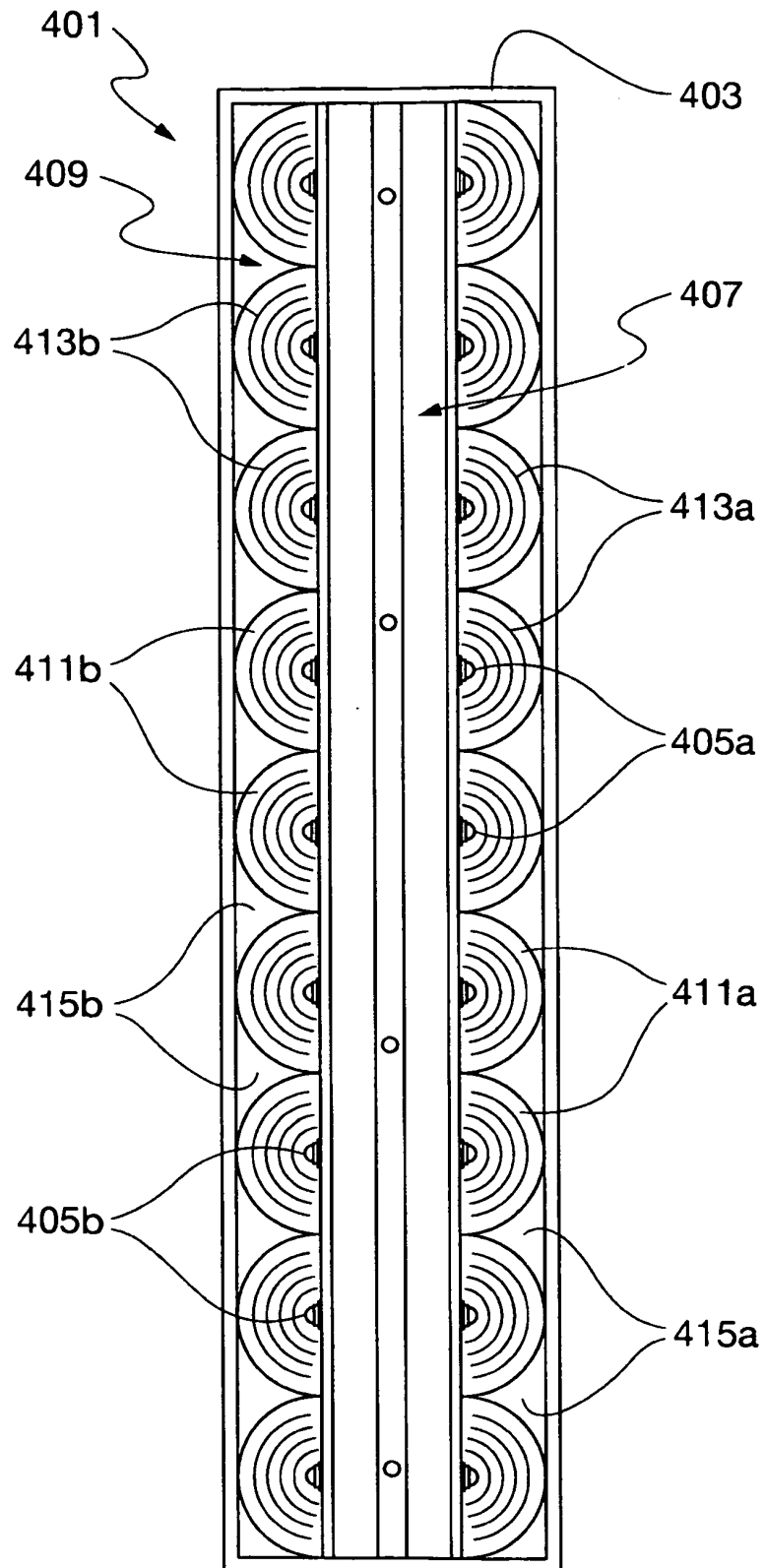


Fig. 11

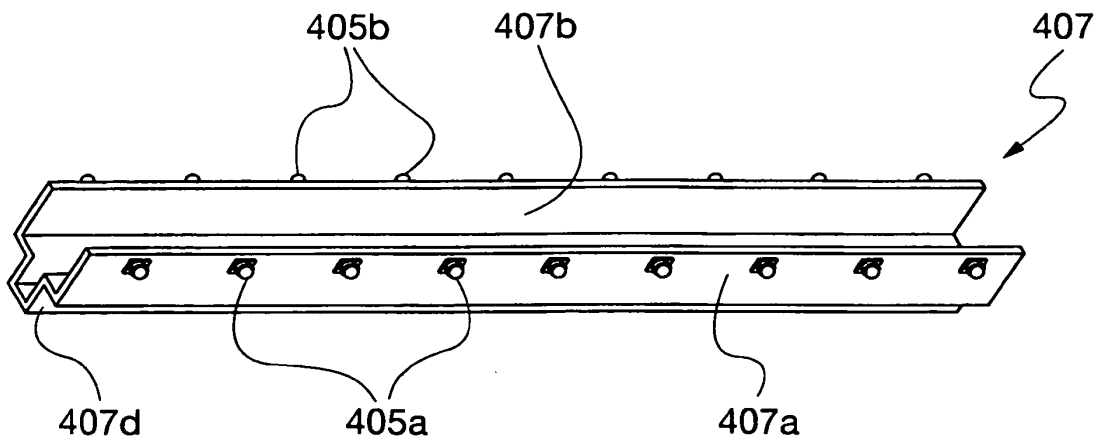


Fig. 12

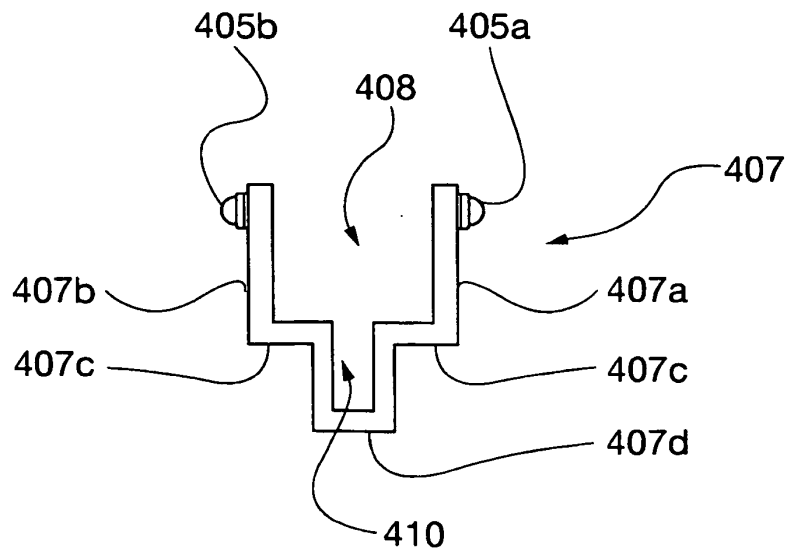


Fig. 13

REFERENCES CITED IN THE DESCRIPTION

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