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(54) LED LIGHTING DEVICE AND LUMINAIRE

(57) LED lighting device (100), comprising a heat conductive carrier (101), at least one LED-module (103) arranged at a heat conductive carrier (101) surface facing the at least one LED lighting device (100), each of the at least one LED-module (103) comprising a substrate (106) and at least one LED (105) arranged on top of the substrate (106), and compressible spacer means (102) being arranged on the heat conductive carrier (101). The LED lighting device (100) further comprises a glass cover (104) supported by the compressible spacer means (102) for covering the at least one LED-module (103). The glass cover (104) is made of flat glass. The LED lighting device

(100) further comprises a seal (202) arranged between the glass cover (104) and the heat conductive carrier (101) for attaching the glass cover (104) to the heat conductive carrier (101), wherein the seal (202) is arranged at a lateral distance from the at least one LED-module (103), and wherein the seal (202) fully surrounds the at least one LED-module (103), thereby forming a gas-tight chamber containing the at least one LED-module (103) between the heat conductive carrier (101) and the glass cover (104). Luminaire (300) comprising the LED lighting device (100).

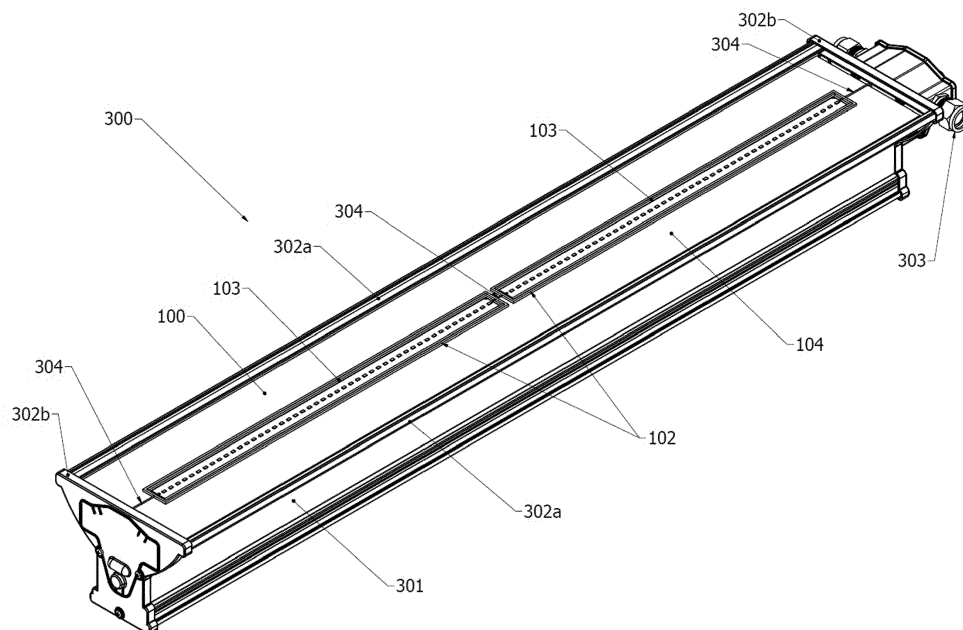


Fig. 3

EP 3 561 379 A1

Description

FIELD OF THE INVENTION

[0001] The invention relates to a LED lighting device and a luminaire comprising the LED lighting device.

BACKGROUND

[0002] High performance explosion proof lighting is achieved in the art using luminescent lamps which are housed in gas-tight lighting devices and luminaires, and which can be partially embedded in a resin to avoid exposure of hot parts and of electrical contacts carrying high or medium voltages with an ambient atmosphere which may contain dangerous explosive gasses. Luminaires having luminescent lamps may however be voluminous and power consuming.

[0003] With the emergence of lighting devices and luminaires with Light Emitting Diodes (LED) for lighting of private and public spaces, which can be relatively small compared to luminescent lamps and which require low voltage and low power consumption, a demand arises for explosion proof lighting devices having the same advantages as standard non-explosion proof lighting devices.

[0004] Explosion proof lighting devices and luminaires must however have long life span, have a consistent light output during their lifespan, and require high impact resistance and gas-tightness in a broad temperature range of -40 °C to 55 °C, to guarantee isolation from dangerous gases in the ambient atmosphere and thereby maintain their explosion proof property.

[0005] LED lighting devices in the art however may not comply with explosion proof requirements, exhibit inconsistent light output due to aging and low longevity of LEDs, whereas long life span of at least 100000 operation hours and at least 10 years product life is required within the temperature range as indicated above.

SUMMARY

[0006] It is therefore an object of the invention to provide a lighting device and luminaire which overcomes the problems and disadvantages set out above.

[0007] The object is achieved in a LED lighting device in accordance with claim 1.

[0008] According to an embodiment of the invention, the LED lighting device, comprises a heat conductive carrier, at least one LED-module arranged at a heat conductive carrier surface facing the at least one LED lighting device, each of the at least one LED-module comprising a substrate and at least one LED arranged on top of the substrate, and compressible spacer means being arranged on the heat conductive carrier. The LED lighting device further comprises a glass cover supported by the compressible spacer means for covering the at least one LED-module. The glass cover is made of flat glass. The

LED lighting device further comprises a seal arranged between the glass cover and the heat conductive carrier for attaching the glass cover to the heat conductive carrier, wherein the seal is arranged at a lateral distance from the at least one LED-module, and wherein the seal fully surrounds the at least one LED-module, thereby forming a gas-tight chamber containing the at least one LED-module between the heat conductive carrier and the glass cover.

[0009] The at least one LED-module may be commercially obtained and can have various shapes and configurations as will be set out below. The LED-module may be electrically connectable to an electrical supply using supply leads. The LED-module may further be interconnectable to another LED-module for series or parallel connection to a power supply.

[0010] The heat conductive carrier provides support for the at least one LED-module and allows heat generated in the at least one LED-module to be transferred to the environment. The compressible spacer allows the glass cover to be arranged over the LED-module at a distance from the LED's of the LED-module to ensure that the glass will maintain a low temperature. The flat glass cover allows the LED lighting device to be fitted in a luminaire using the glass cover edge to provide support for the LED lighting device.

[0011] The glass of the glass cover can be chosen to be of a hardened or laminated type to ensure impact resistance of the glass even at low temperatures such as -30 °C. The glass ensures transparency of the glass cover during its lifespan, without discoloration. The flatness of the glass provides optimal resistance against impact at right angles on the glass cover surface facing the environment. The compressible spacer means allow an impact on the glass to be absorbed within the LED lighting device, while maintaining the desired distance of the glass cover relative to the LED's of the LED-module and ensuring integrity of the seal between the glass cover and heat conductive carrier.

[0012] The seal can be disposed between the heat conductive carrier and glass cover for example by applying a continuous wall of seal material, e.g. a paste or resin, on one of the glass cover and the carrier. The lateral distance between seal and LED-module ensures that the seal material does not contaminate and obscure the LED's of the LED-module, thereby ensuring optimal light output of the LED-module.

[0013] The compressible spacer means prevent the seal from being flattened and maintain the distance between LED's and glass cover while allowing the seal to form a gastight wall to protect the LED-module from environmental gasses, and at the same time maintaining the LED lighting device explosion proof.

[0014] In an embodiment, said gas-tight chamber has a volume of less than 100 cm³.

[0015] This allows the LED lighting device to comply with international standards for explosion proof lighting devices.

[0016] In an embodiment, said gas-tight chamber is gas-filled.

[0017] This allows said gas-tight chamber to maintain dry and explosion proof while corrosion of the LED-module and LED's is prevented.

[0018] In a further embodiment, said gas-tight chamber is filled with dried air.

[0019] This allows the LED lighting device to be prepared sealed for life.

[0020] In an embodiment, the glass cover is arranged at a distance from the at least one LED of the LED-module of at least 1 mm, preferably in a range of 1 - 5 mm, more preferably 2 - 4 mm, most preferably 2, 5 - 3,5 mm.

[0021] Within this range, the distance between glass cover and LED's is sufficient to maintain a temperature at the glass cover outer surface complying with explosion proof specifications, while the gas-tight chamber volume can be kept at the 100 cm³ requirement for LED-modules having for example a width of 3 - 4 cm and a total length in a range of for example 50 - 250 cm.

[0022] In an embodiment, the glass cover is provided with an opaque section at least facing the seal, and a transparent section at least facing the LED's of the at least one LED-module for allowing light emitting from the LED-module to escape through the glass cover.

[0023] This allows to shield off parts of the LED lighting device from visibility while leaving the LED's exposed for emitting light through the glass cover.

[0024] In an embodiment, the opaque section is formed by a UV protective coating on a side of the glass cover facing the heat conductive carrier and wherein the transparent section is formed by an opening in the UV protective coating at least facing the LED's.

[0025] The UV protective coating protects the seal from deteriorating due to UV-light, thereby maintaining an integrity of the seal and explosion proof worthiness during a long lifespan of the LED lighting device. The LED's of the LED-modules remain uncovered to allow unhindered light to escape from the LED lighting device.

[0026] In an embodiment, a section of the glass cover facing the LED-module is provided with a matted or structured surface.

[0027] The matted or structured surface allows scattering or dispersion of the light from the LED's of the at least one LED-modules. This allows comfortable use of the LED lighting device in spaces where direct light from the LED's of the LED-modules may be a hinderance.

[0028] In an embodiment, the seal comprises a hydrophilic material.

[0029] This ensures dryness of the gas or air within the gas-tight chamber, thereby further preventing corrosion of the at least one LED-module on the long term.

[0030] In an embodiment, the heat conductive carrier is manufactured from a metal.

[0031] This allows structural stability of the LED lighting device while providing sufficient heat conductivity for dispersing heat generated within the at least one LED-module.

[0032] In an embodiment, the seal comprises a compressible adhesive material.

[0033] This provides good sealing properties to maintain the LED lighting device explosion proof, while preserving impact resistance of the LED lighting device after curing of the seal during at least 100000 operation hours and life time of at least 10 years and temperature range -40 °C to 55 °C.

[0034] The seal can for example be made from polyurethane, which can be applied as resin in liquid form and cured to obtain the required compressible and adhesive sealing properties.

[0035] In an embodiment, the compressible spacer means comprise a at least one strip of resilient material. The strip material can be a rubberlike material such as ethylene propylene diene monomer (EPDM).

[0036] The at least one strip can be arranged easily arranged around or adjacent to the at least one LED-module to provide support for the glass cover. The at least one strip is to be arranged to allow support of the glass cover on at least 3 locations of the carrier to avoid tilting of the glass cover relative to the carrier. Using resilient material such as EDMS provides compressibility to allow impact resistance and absorbance for the LED lighting device.

[0037] In an embodiment, said at least one strip is arranged adjacent to the LED-module arranged in a longitudinal direction of the LED-module within the gas-tight chamber between the seal and the at least one LED-module.

[0038] This allows the compressible spacer means to be encapsulated in the gas-tight chamber, providing protection of the compressible spacer means from corrosion and ingress of corrosive gases, thereby enhancing lifespan of the LED lighting device.

[0039] In an embodiment, the LED lighting device further comprises LED-module supply lines for electrically supplying the at least one LED-module, wherein said supply lines are arranged through the seal.

[0040] No additional seal is required to seal off the supply lines. By using for example a curable adhesive material, which has initially a viscous property, the supply lines may be disposed on the carrier while the seal is applied on the carrier and supply lines. After curing the supply lines are kept in place by the seal in an gas-tight manner. Thus, flexible wiring is of the LED lighting device while maintaining the device gas-tight and explosion proof.

[0041] The object is further achieved in a luminaire, the luminaire comprising a housing, and at least one LED lighting device according to an embodiment of the invention as described, and wherein the at least one LED lighting device is arranged at an opening of the housing using the glass cover.

[0042] The edge of the glass cover can advantageously be used to provide support for the at least one LED lighting device with a corresponding supporting structure of the housing.

[0043] This allows for maintenance free explosion proof and impact resistant luminaire to be created, having long lifespan.

BRIEF DESCRIPTION OF THE DRAWINGS

[0044] Further features and advantages of the invention will become apparent from the description and drawings of the invention by way of exemplary and non-limiting embodiments of a system for additive manufacturing according to the invention.

[0045] The person skilled in the art will appreciate that the described embodiments of the system for additive manufacturing are exemplary in nature only and not to be construed as limiting the scope of protection in any way. The person skilled in the art will realize that alternatives and equivalent embodiments of the system for additive manufacturing can be conceived and reduced to practice without departing from the scope of protection of the present invention.

[0046] Reference will be made to the figures on the accompanying drawing sheets. The figures are schematic in nature and therefore not necessarily drawn to scale. Furthermore, equal reference numerals denote equal or similar parts. On the attached drawing sheets:

Fig. 1a shows an isometric view of a LED lighting device according to an embodiment of the invention.
Fig. 1b shows a detail B of the LED lighting device of fig. 1a.

Fig. 2a shows a cross section along the line A - A' of the LED lighting device of fig. 1a.

Fig. 2b shows a detail C of the LED lighting device of fig. 2a.

Fig. 3 shows a luminaire having a LED lighting device according to an embodiment of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0047] The invention will be further elucidated in exemplary embodiments thereof as described below.

[0048] In fig 1a an isometric view of a LED lighting device (100) is shown, having a carrier 101, two LED-modules 103, a compressible spacer 102, and a glass cover 104. The LED lighting device 100 may comprise one or more LED-modules 103, which can be electrically connected in series or in parallel as required. In fig. 1a the two LED-modules are shown mounted on the carrier 101 with a gap 107 in between.

[0049] The LED-modules 103 each comprise a substrate 106 and LED's 105. The LED-modules 103 are mounted with their substrate 106 on the carrier 101. The carrier 101 is made of heat conductive material such as metal. The carrier 101 thereby not only serves as support for the LED-modules 103, but also provide heat sink capacity for heat generated within the LED-modules 103. The metal of the carrier 101 can be preferably steel or more preferably aluminium. The LED-modules 103 can

be fixed to the carrier 101 using an adhesive, preferably a heat conductive adhesive. Alternative means for attaching the LED-modules 103 to the carrier can be considered, such as clamps and the like, whilst appropriate thermal contact between LED-modules 103, i.e. substrate 106 and carrier 101 is observed.

[0050] The glass cover 104 is attached to the carrier 101 using a seal, which will be explained in more detail with reference to fig. 2a. To preserve a distance between the LED's 105 and the glass cover 104, the glass cover 104 and carrier 101 are separated using the compressible spacer 102. The compressible spacer 102 can be made of a resilient material such as for example ethylene propylene diene monomer rubber (EPDM). Similar synthetic or non-synthetic rubber-like materials may be applied. The compressible spacer material 102 must be durable to sustain the resilient, compressible properties over a long lifespan of the LED lighting device. A lifespan of at least 100000 hrs. is preferred.

[0051] The compressible spacer 102 may be provided in the form of strips which can be fixed to at least one of the carrier 101 and the glass cover 104, preferably to the carrier 101. The compressible spacer 102 is preferably located adjacent the LED-modules 103. The compressible spacer 102 need not fully surround the LED-modules 103. Small openings may be provided for allowing wiring, i.e. supply lines to pass through.

[0052] The glass cover 104 is chosen flat to allow for optimal impact resistance. The flat shape spreads any incident force as evenly as possible over the glass cover surface. The glass is preferably laminated or hardened to allow high impact resistance even at low operating temperatures such as -30 °C, as required for explosion proof lighting equipment. The use of glass ensures high transparency of the LED lighting device over its life span without discoloration. Discoloration is common in plastic covers made from for example polycarbonate, which is undesirable for high performance LED lighting devices having a long lifespan.

[0053] The LED-modules 103 in fig. 1a are shown as rectangular oblong modules. The skilled person will understand that other shapes, round, ellipsoidal etc. may apply. Also, the LED-modules 103 are shown having LED's 105 in a straight line. Other LED configurations and distribution patterns on the substrate may apply as will be readily understood by the skilled person.

[0054] The LED lighting device shown in fig. 1a is intended for being mounted in a luminaire, wherein the glass cover 104 is exposed to the environment, and the carrier 101 having the LED-modules 103 is enclosed in the luminaire, as will be further detailed in relation to fig. 3.

[0055] In fig. 1b, a detail B is shown of the LED lighting device 100, wherein the glass cover 104 is provided with an opaque section 108 and transparent sections 109, which transparent sections overlap with the LED's 105 to expose the LED's, whilst the opaque section 108 covers the remaining underlying parts, such as the compressible spacer 102 and seal as will be further detailed

below in relation to fig. 2a and fig. 2b. By covering the compressible spacer 102 and seal, protection from radiation from the environment is achieved, thereby preserving long life span and durability of these parts.

[0056] Fig. 2a shows a cross section along the line A - A' of the LED lighting device of fig. 1a. The glass cover 104 is shown having its opaque section 108 and transparent section 109. At the surface of the glass cover 104 facing the carrier 101, a UV protective coating is provided to create the opaque section 108 of the glass cover 104. An opening 204 in the UV protective coating allows the LED's 105 to be exposed to the glass cover 104 and thereby allows in operation light to radiate from the LED's to the environment.

[0057] The glass cover 104 can be mounted in a frame of a luminaire using its edges 206 all around, which can be sealed using compressible adhesive material.

[0058] The carrier 101 is shown as a flat surface having an optional recess in a central portion 205 having the LED-module 103 fixed thereon and flaps 207 extending from the central portion 205. The optional recess in the central portion 205 allows easy alignment of the LED-modules 103 to be fixed on the carrier 101. It will be clear that the LED-module can also be fixed to the carrier 101 which is made flat. The flaps 207 extending from the central portion 205 may be curved or folded away from the glass cover 104. The size of the flaps may vary depending on the amount of heat to be dissipated in the carrier. The flaps 207 provide heat transfer surfaces to air surrounding the carrier 101. Additional fins attached to the flaps 207 or central portion 205 for improving heat transfer capabilities of the carrier 101 may be considered.

[0059] In fig. 2a the seal 202 is shown provided between the glass cover 104 and the carrier 101. The seal 202 can be made of a compressible adhesive material, such as for example polyurethane, which retains its resilient compressible properties after applying and curing.

[0060] The seal 202 completely surrounds the LED-modules 103. It may be considered to seal each LED-module 103 individually. Supply lines to the LED-modules 103 may be sealed by submerging the supply lines within the compressible adhesive material. This way a gas-tight chamber 203 is created. Using hydrophilic compressible adhesive material such as polyurethane, curing after applying the compressible adhesive material starts from the outer perimeter of the seal 202. The hydrophilic properties of the compressible adhesive material ensure that any humidity within the gas-tight chamber 203 is absorbed within the seal 202. Dimensions of the LED-modules 103, length, width and height are chosen such that a total volume of the gas-tight chamber 203 is maintained below 100 cm³. This way the LED lighting device 100 complies with international standards for explosion proof lighting devices. The gas-tight chamber 203 may be filled with a low reactive or inert gas, such as nitrogen or argon. However preferably the gas-tight chamber 203 is filled with dry air.

[0061] A UV protective coating 201 provides for the

opaque section 108 of the glass cover 104. In fig. 2a the UV protective coating 201 is shown being applied at the side of the glass cover 104 facing the carrier 101, whilst opening 204 allows emitted light 209 radiating from the LED 105 to escape through the transparent section 109 of the glass cover 104.

[0062] The transparent section 109 of the glass cover 104 may be structured or matted to allow dispersion of the light 209 emitted from the LED's 105.

[0063] Fig. 2b shows a detail C of fig. 1a. it is shown that to avoid contamination of the LED's 105, a distance d2 is observed between LED-module 103 and seal 202. The compressible spacer 102 can be advantageously disposed between the LED-module 103 and seal 202. In locations where the compressible spacer 102 is discontinuous, e.g. where supply lines are allowed to pass through, the distance d2 keeps the LED-modules 103 and LED's free from contamination by compressible adhesive material, i.e. the compressible adhesive material. Usually a distance of 3 mm or more is observed, depending on the presence of the compressible spacer 102.

[0064] To avoid high temperature of the glass cover 104, a distance d1 is observed between LED's 105 and glass cover 104. The distance d1 is chosen at least at least 1 mm, preferably in a range of 1 - 5 mm, more preferably 2 - 4 mm, most preferably 2,5 - 3,5 mm.

[0065] In fig. 2b it is shown that the UV protective coating 201 partly overlaps 208 with the LED-module substrate 106 in a radiation exiting direction of the emitted light 209. The overlap 208 prevents incident light entering at low angles to reach the compressible spacer 102 or the seal 202, thereby preserving its long life span of seal 202 and compressible spacer 102.

[0066] In fig. 3 a luminaire 300 is shown having a housing 301 and an opening (not shown in fig.3) for receiving the LED lighting device 100 as described above. The opening in the housing 301 can be provided with a frame 302a, 302b. The LED lighting device 100 may be sealed at its edges 206 within the frame 302a, 302b using for example a compressible adhesive material such as the polyurethane used for the seal 202 between the carrier 101 and the glass cover 104. The housing may be provided with cable entry 303 for supplying electrical power to the luminaire 300. The cable entry 303 can be sealed using the compressible adhesive material as described to maintain the luminaire explosion proof.

[0067] The luminaire 300 may comprise and accommodate at least one of a power supply and optional control unit for supplying the LED-modules 103 of the LED lighting device 100 via supply lines 304 as required and in compliance with standards for explosion proof equipment and lighting.

[0068] It will be clear to a person skilled in the art that the scope of the present invention is not limited to the examples discussed in the foregoing but that several amendments and modifications thereof are possible without deviating from the scope of the present invention as defined by the attached claims. Combinations of spe-

cific features of various aspects of the invention may be made. An aspect of the invention may be further advantageously enhanced by adding a feature that was described in relation to another aspect of the invention. While the present invention has been illustrated and described in detail in the figures and the description, such illustration and description are to be considered illustrative or exemplary only, and not restrictive.

[0069] The present invention is not limited to the disclosed embodiments. Variations to the disclosed embodiments can be understood and effected by a person skilled in the art in practicing the claimed invention, from a study of the figures, the description and the attached claims. In the claims, the word "comprising" does not exclude other steps or elements, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference numerals in the claims should not be construed as limiting the scope of the present invention.

REFERENCE NUMERALS

100	LED lighting device
101	Carrier
102	Compressible spacer
103	LED-module
104	Glass cover
105	LED
106	Substrate
107	Gap
108	Opaque section
109	Transparent section
201	UV protective coating
202	Seal
203	Gas-tight chamber
204	Opening
205	Central portion
206	Glass cover edge
207	Flaps
208	Overlap
209	Emitted light
300	Luminaire
301	Housing
302a, 302b	Frame
303	Cable entry
304	Supply lines

Claims

1. LED lighting device (100), comprising:

- a heat conductive carrier (101);
- at least one LED-module (103) attached to the heat conductive carrier (101), each of the at least one LED-module (103) comprising a substrate (106) and at least one LED (105) arranged on top of the substrate (106);
- compressible spacer means (102) being arranged on the heat conductive carrier (101);
- a glass cover (104) supported by the compressible spacer means (102) for covering the at least one LED-module (103);
- a seal (202), wherein

- the seal (202) is arranged between the glass cover (104) and the heat conductive carrier (101) for attaching the glass cover (104) to the heat conductive carrier (101);
- the seal (202) is arranged at a lateral distance (d2) from the at least one LED-module (103); and

- the seal (202) fully surrounds the at least one LED-module (103), thereby forming a gas-tight chamber (203) containing the at least one LED-module (103) between the heat conductive carrier (101) and the glass cover (104).

2. LED lighting device (100) according to claim 1, wherein said gas-tight chamber (203) has a volume of less than 100 cm³.

3. LED lighting device (100) according to claim 2, wherein said gas-tight chamber (203) is gas-filled.

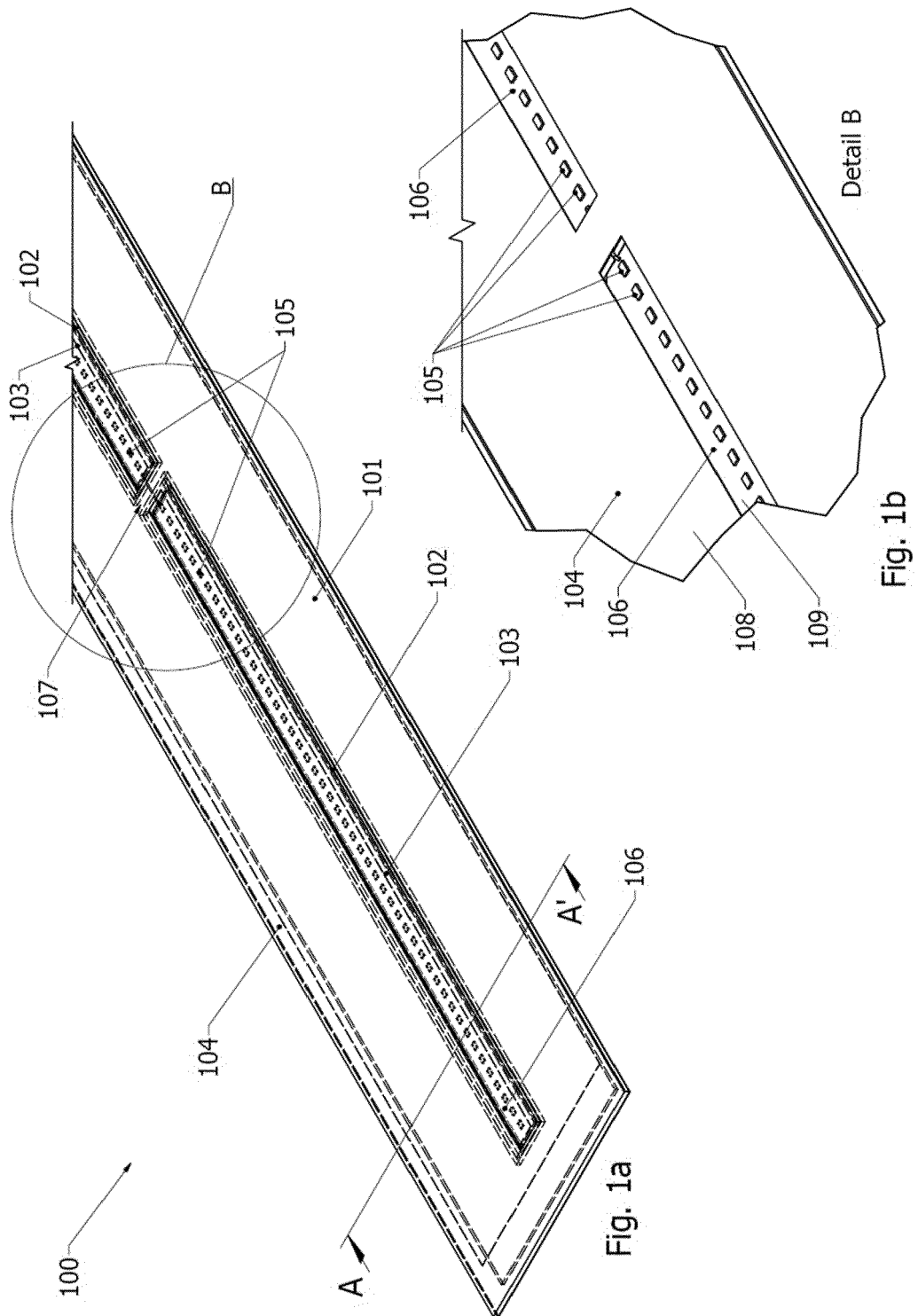
4. LED lighting device (100) according to claim 3, wherein said gas-tight chamber (203) is filled with dried air.

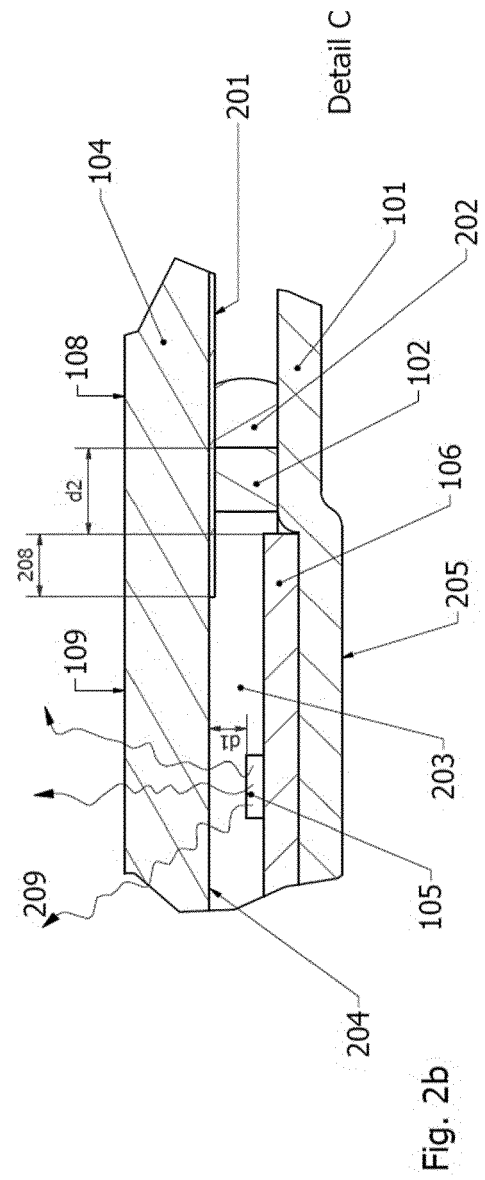
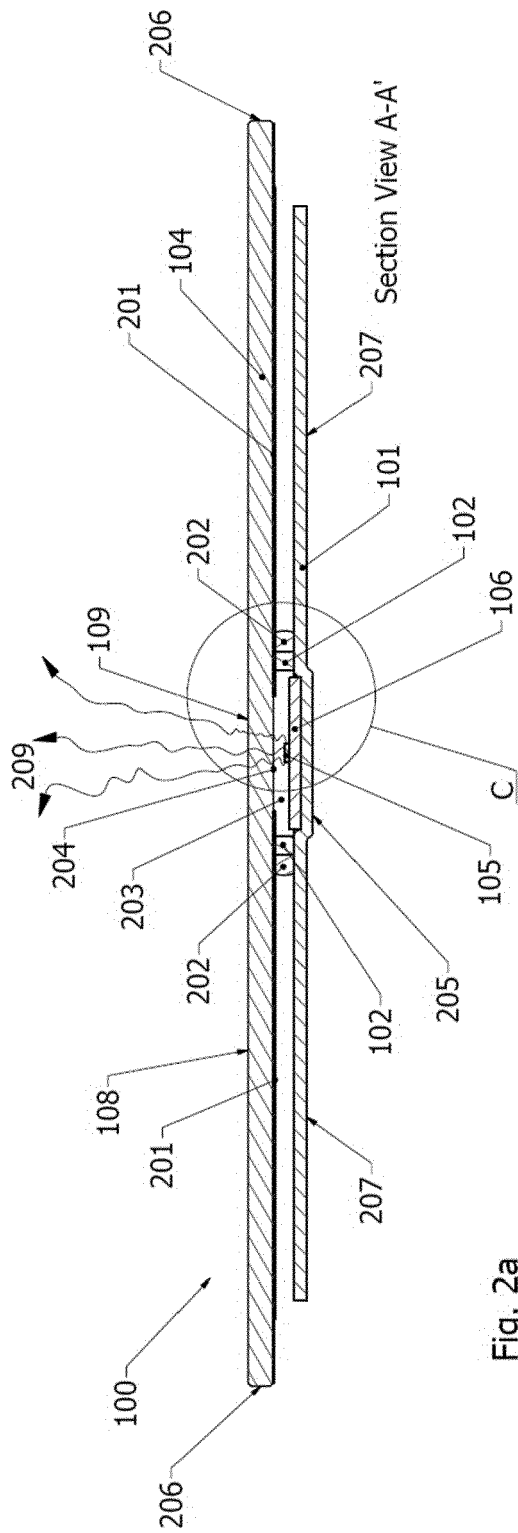
5. LED lighting device (100) according to any one of the claims 2 - 4, wherein the glass cover (104) is arranged at a distance (d1) from the at least one LED (105) of the LED-module (103), is at least 1 mm, preferably in a range of 1 - 5 mm, more preferably 2 - 4 mm, most preferably 2,5 - 3,5 mm.

6. LED lighting device (100) according to any one of the preceding claims, wherein glass cover (104) is provided with an opaque section (108) at least facing the seal (202), while and a transparent section (109) at least facing the LED's (105) of the at least one LED-module (103) for allowing light emitting from the LED-module (103) to escape from the glass cover (104).

7. LED lighting device (100) according to claim 6,
wherein the opaque section (108) is formed by a UV
protective coating (201) on a side of the glass cover
(104) facing the heat conductive carrier (101) and
wherein the transparent section (109) is formed by
an opening (204) in the UV protective coating (201)
at least facing the LED's (105). 5
8. LED lighting device (100) according to any one of
the preceding claims, wherein a section of the glass
cover (104) facing the LED-module (103) is provided
with a matted or structured surface. 10
9. LED lighting device (100) according to any one of
the preceding claims, wherein the seal (202) com-
prises a hydrophilic material. 15
10. LED lighting device (100) according to any one of
the preceding claims, wherein the heat conductive
carrier (101) is manufactured from a metal. 20
11. LED lighting device (100) according to any one of
the preceding claims, wherein the seal (202) com-
prises a compressible adhesive material. 25
12. LED lighting device (100) according to any one of
the preceding claims, wherein the compressible
spacer means (102) comprise at least one strip of
resilient material. 30
13. LED lighting device (100) according to claim 12,
wherein said at least one strip is arranged adjacent
to the LED-module (103) in a longitudinal direction
of the LED-module (103) within the gas-tight cham-
ber (203) between the seal (202) and the at least
one LED-module (103). 35
14. LED lighting device (100) according to any one of
the preceding claims, further comprising LED-mod-
ule supply lines for electrically supplying the at least
one LED-module (103), wherein said supply lines
are arranged through the seal (202). 40
15. Luminaire (300) comprising 45
 - a housing (301); and
 - at least one LED lighting device (100) accord-
ing to any one of the preceding claims, and
wherein
 - the at least one LED lighting device (100) is 50
arranged at an opening of the housing (301) us-
ing the glass cover (104).

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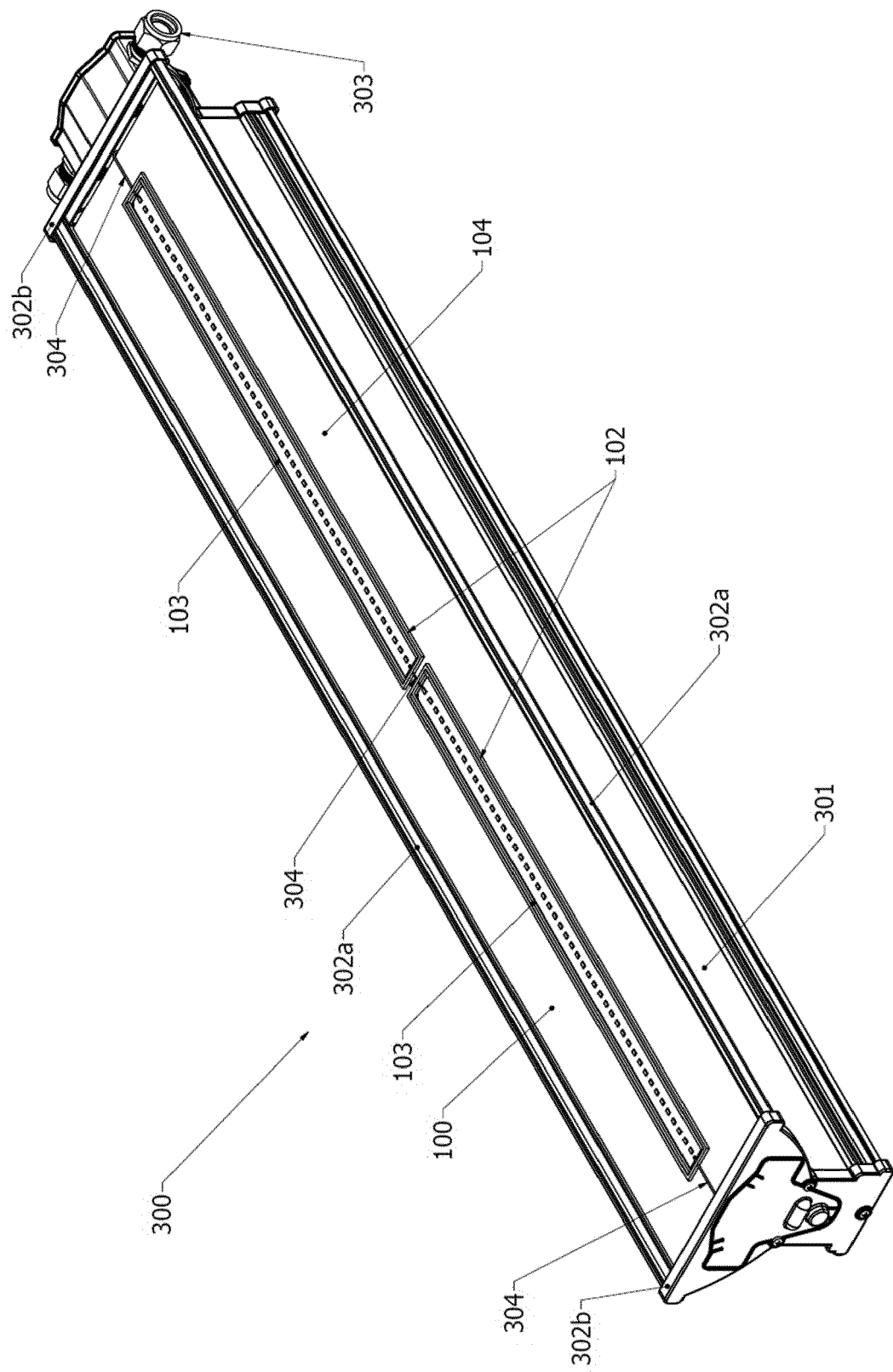


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 18 16 9397

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 10 2013 111374 A1 (STAHL SCHALTGERÄTE GMBH R [DE]) 16 April 2015 (2015-04-16)	1,2,5-15	INV. F21V25/12 F21V31/00 F21V31/04 F21V3/06
Y	* figures 1, 4 * * paragraphs [0011] - [0017], [0031] - [0035], [0046] - [0048], [0055] *	3,4	
X	GB 2 547 664 A (CONSTELLATION LIGHTING LTD [GB]) 30 August 2017 (2017-08-30) * figure 8 * * paragraphs [0022] - [0033] *	1-15	ADD. F21Y103/10 F21Y115/10
Y	US 6 501 084 B1 (SAKAI KAZUHIRO [JP] ET AL) 31 December 2002 (2002-12-31) * figures 12, 13, 14, 17 * * column 8, lines 21-49 * * column 9, line 65 - column 10, line 64 * * column 11, line 52 - column 12, line 22 *	3,4	
A	US 2015/267910 A1 (LAZALIER RAY M [US]) 24 September 2015 (2015-09-24) * figures 4-8 * * paragraphs [0032], [0037], [0045] - [0048] *	1-15	TECHNICAL FIELDS SEARCHED (IPC) F21V F21Y
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 30 May 2018	Examiner Vida, Gyorgy
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 16 9397

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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