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(54) **LED CLUSTER**

(57) The solution relates to LED lighting devices for indoor and outdoor lighting of objects, such as parks, squares, pedestrian and bicycle paths, parking lots, industrial facilities and residential complexes. The objective of the declared solution is to create a compact high-power LED cluster for universal use. The technical result obtained is to improve heat dissipation and a relative reduction in the size of lighting devices with a power of 100 W or more, while increasing the safety of their use, which is achieved by placing the driver (8) in under the lens (4) of the LED cluster and creating an effective heat sink to the external radiator.

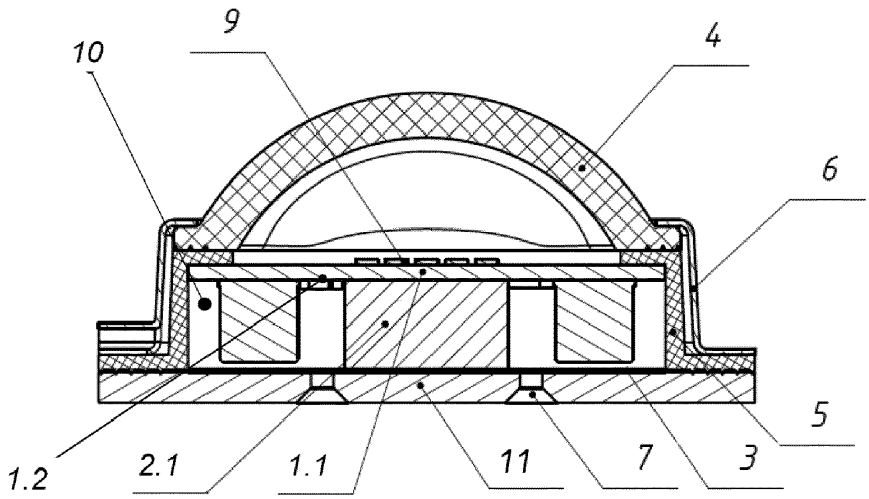

Fig.1

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The solution relates to LED lighting devices for indoor and outdoor lighting, such as parks, squares, pedestrian and cycle paths, parking lots, industrial facilities and residential complex.

BACKGROUND OF THE INVENTION

[0002] Currently, to create direct radiation, optically transparent lenses of large size with a diameter of up to 110 mm and more are used, which make it possible to create emitters based on LEDs or COB-LEDs with the power up to or more than 100 W. For such emitters, a bulky power supply (driver) is needed, which is usually located outside of these emitters, the connection of which requires additional structures and connection devices, expensive connectors, especially for street lights with IP67.

[0003] On the other hand, driver designs are known with small dimensions and without bulky transformers and filters, and which can be located on a printed circuit board with fully automated SMT component installation without manual labor application (the so-called AC-direct drivers).

[0004] However, the presence of a significant number of components and, especially, the presence of electrolytic capacitors, floating over the board, does not allow these power supplies (drivers) to be placed in the under-lens space together with the LEDs.

[0005] A lighting device is known that contains a hollow glass body, a printed circuit board of LEDs, a lens covering the LED board and a printed circuit board of the driver, the components of which are mounted on the printed circuit board so that the hinged elements are located in the cavity of the glass body (patent EP2959209, IPC F21K 9/233, published on 12.09.2018).

[0006] A lighting device is known that contains a cooling radiator 1, an insulation layer 4 on a cooling radiator 1, a printed circuit board 5 located on an insulation layer 4, LEDs 24 mounted on a high metal base 22 passing through a hole 41 in a printed circuit board 5 and having thermal contact with a radiator 1 cooling and a lens 31 of the optical system. The composition and thermal properties of the insulating layer 4 are not disclosed in this solution (CN 202419582 U, IPC F21V29 / 00, published on 05.09.2012).

[0007] An optical module is known that includes a radiator 1 in the form of a plate with a surface equipped with a dielectric layer 7 and a hole for a sealed current lead 8, a printed circuit board 7 with LEDs mounted on the dielectric layer 7 of the radiator 1 and with the possibility of heat exchange, an optical system having a lens 4, equipped by means of fastening to the surface of the radiator 1 (RU 166981, the applicant-author is Yu.B. Sokolov, IPC F21S2/00, published on 20.12.2016).

[0008] Also known is a light-emitting structure containing a cooling radiator, an aluminum printed circuit board 1 mounted on the radiator with the possibility of heat exchange, an optical system including a group of LEDs 8 and a lens 6 fixed on the mounting surface of the printed circuit board 1, while both sides of the board 1 are provided with an insulating film 9, excluding electrical contact with the elements of the light-emitting structure (RU 196224, the applicant is Sokolov Yu.B., IPC F21K9/00, published on 21.02.2020).

[0009] The disadvantage of the known solutions is the limited heat sink, which prevents the creation of light-emitting structures with a power of the order of around 100 W and having relatively small dimensions.

[0010] The closest one to the claimed is the solution disclosed by the applicant of this invention in patent RU 166981.

[0011] The goal of the submitted solution is to create a compact high-power multi-purpose LED cluster, which can be used in lighting devices for various purposes. In the case of using the AC-direct driver (sometimes it is called the sequential one), all cluster manufacturing operations can be automated. At the same time, in spite of the galvanic connection of all under-lens circuit technology, including LEDs and a driver, the cluster has double isolation from the network, exceeding the requirements of all world standards.

[0012] The technical result of the invention is an improvement in heat dissipation and a relative reduction in the size of lighting devices while increasing the safety of their use.

SUMMARY OF THE INVENTION

[0013] Within the framework of this solution, options for constructing an LED cluster combined by a single inventive concept are proposed, in which a group of LEDs (or a group of COBs) and driver components are mounted on a printed circuit board, separated from the cooling radiator. In all versions, the heat from the LEDs and the driver is transferred through a volumetric heat sink, which is thermally connected to the cooling radiator.

[0014] The submitted solution can be characterized by the following features:

An LED cluster incorporating a metal plate radiator; dielectric layer on the surface of a flat radiator; a printed circuit board, on the mounting surface of which light-emitting diodes are mounted, a lens for converting light-emitting diodes; driver components. The LED printed circuit board is located above the dielectric layer of the plate radiator, while a cavity is formed between the LED printed circuit board and the plate radiator, in which the driver components are located, as well as a heat sink that has thermal contact with the LED board and the thermally conductive dielectric layer of the plate radiator. The driver components can be mounted on the back of an LED printed circuit board or on an optional board mounted on the dielectric surface of the plate radiator. The shape and

location of the heat sink in the space under the LED printed circuit board is selected depending on the thermal conductivity of the heat sink material, the size and layout of the driver elements.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] In graphic illustrations, the structural elements are indicated as follows:

1.1 - an LED printed circuit board,
1.2 - a driver printed circuit board,
2.1 - a heat sink made of solid aluminum round profile,
2.2 - a heat sink made of an aluminum hollow ring profile,
3 - a heat-conducting dielectric layer,
4 - a lens,
5 - a silicone ring,
6 - a mounting flange,
7 - technological holes for compound,
8 - driver circuit component,
9 - light emitting diodes (LEDs),
10 - a cavity between the LED board 1 and the radiator 11,
11 - a flat cooling radiator.

DETAILED DESCRIPTION OF THE INVENTION

[0016] Figure 1 shows one of the cluster designs with a double-sided printed circuit board 1.2 with light emitting diodes 9 on the mounting side and driver components on the back of the board. An insulating layer is fixed on the flat cooling radiator 11, which contains a polyimide film 3 with a high breakdown voltage > (100 kV/mm) with a thickness of 40 μm or more, on which the 2.1 heatsink is installed, made of extruded aluminum of a round profile, for transferring heat from an LED printed circuit board 1.1 to a flat cooling radiator 11, which has a surface sufficient for heat exchange, while the heat sink 2.1 profile can have any form that is most convenient in each case.

[0017] At the end of the heatsink 2.1 there is a double-sided printed circuit board with LEDs 9 on the upper mounting surface. The lens 4 is fixed to the board 1.2 by means of a shaped ring 5 made of silicone, and the whole structure is fixed to a flat cooling radiator 11 by means of a flange 6 and self-tapping screws or rivets (not shown). Holes 7 serve for pouring a sealing heat-conducting compound (liquid is poured into one hole, and air comes out of the other).

[0018] Figure 2 shows a similar cluster design, with heat transfer from the LED board 1.1 to the 11 flat cooling radiator 11 through the aluminum heatsink 2.1. The additional lower printed circuit board 1.2 with driver components 8 is in the form of a ring that encloses the round aluminum profile of the heatsink 2.1 and is located on a flat cooling radiator 11. The heatsink 2.1 and the additional lower printed circuit board 1.2 of the driver are insulated with a polyimide film 3 from the plate heatsink 11. Flange 6, lens 4 and silicone ring 5 are fixed to the flat cooling radiator 11 using self-tapping screws or rivets with screws (not shown). As in the first version, holes 7 are intended for pouring the compound.

[0019] Figure 3 shows the design of a cluster with two printed circuit boards: the upper one 1.1 with LEDs and the lower one 1.2 with the driver. In this case, the heat transfer from the LEDs' board 1.1 is carried out by an aluminum heat sink 2.2 with an aluminum hollow ring profile, and the lower driver board 1.2 and the heat sink 2.2 are located on a polyimide film 3 of a plate radiator 11.

[0020] The above versions of the device have double electrical isolation of the entire internal circuitry from the plate radiator 11. The first insulation level is prepreg on printed circuit boards, which, depending on the type of boards, has a value of up to 5 kV, and the second insulation level is a polyimide film that insulates the plate radiator from all electronic components, which has a breakdown voltage of ~ 4 kV at a thickness of 40 microns.

[0021] The holes 7 in the radiator 11 are used for pouring of a heat-conducting electrically insulating compound, which improves heat transfer and insulates the holes for entering the wires of the electrical network.

[0022] Figure 4 shows a combined version with a double-sided board 1.2, containing LEDs on the upper mounting surface, and the driver components mounted on the back side the and heat sink 2 are located in the cavity 10 of the LED cluster. The heat sink 2.2 in the form of an aluminum ring, as in the previously considered versions, is located on a polyimide film 3 of the plate radiator 12.

[0023] The version shown in Figure 3 is preferred because it uses the entire space under the printed circuit board 1 for driver and heat sink components, and provides efficient cooling of the LEDs and reliable electrical insulation.

Claims

1. A LED cluster including

a flat cooling radiator;
a dielectric layer on the surface of the flat cooling radiator;
a printed circuit board on the mounting surface of which light emitting diodes are mounted;
a lens for converting radiation from light-emitting diodes;
driver components,
wherein the LED cluster has a cavity, located between printed circuit board light emitting diodes and the surface of the cooling radiator,
this cavity contains the driver components, as well as a heatsink for transferring heat from the LED board to the flat cooling heatsink.

2. The LED cluster of claim 1, wherein the dielectric layer of the flat cooling radiator contains a polyimide film having a breakdown voltage of at least ~ 4 kV.

3. The LED cluster of claim 1, wherein the driver components are mounted on the back of the LED printed circuit board.

4. The LED cluster of claim 1, wherein the driver components are mounted on an additional board installed on the dielectric layer of the flat cooling radiator.

5. The LED cluster of claim 1, wherein the heat sink has an aluminum round profile.

6. The LED cluster of claim 1, wherein the heat sink has an aluminum hollow round profile.

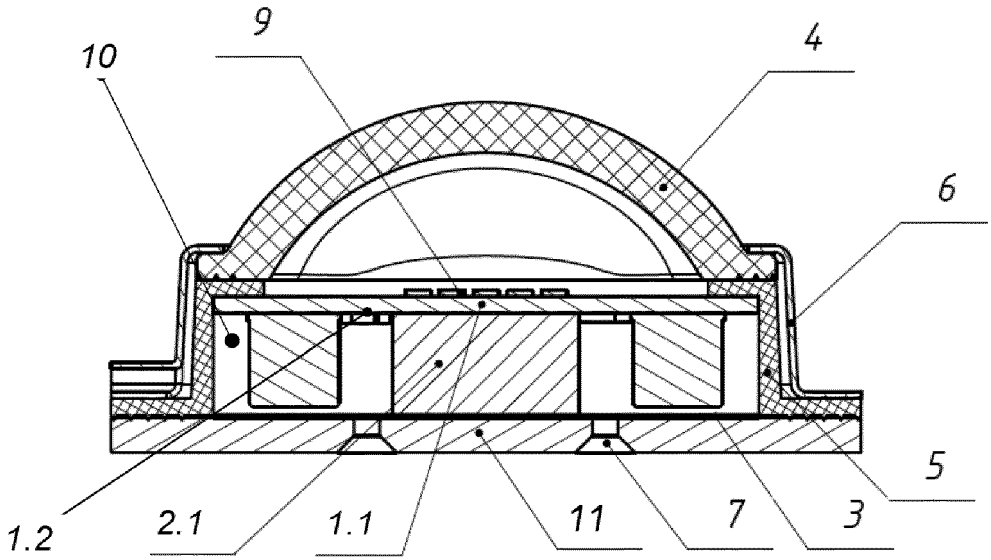

Fig.1

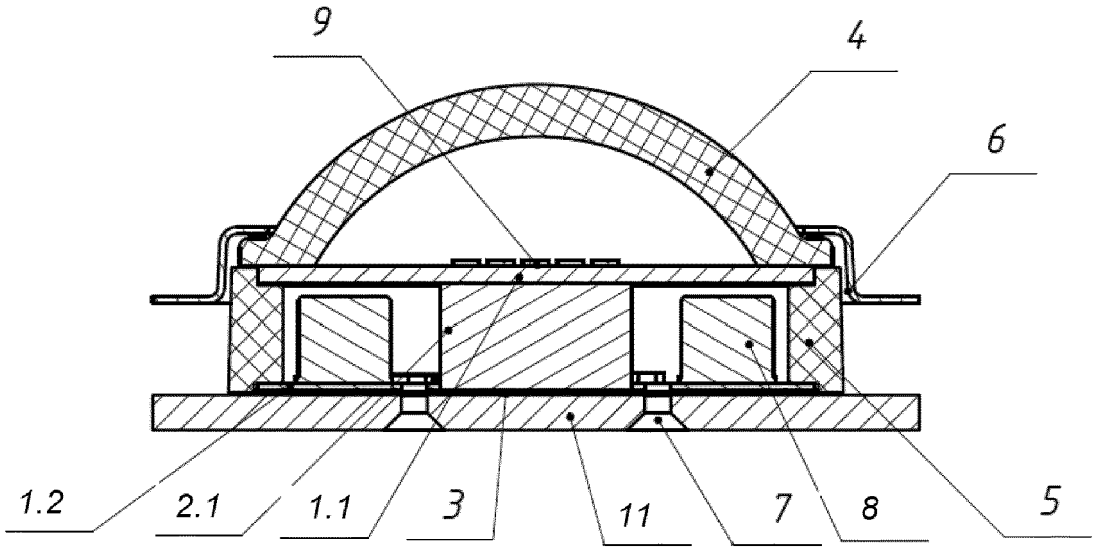

Fig.2

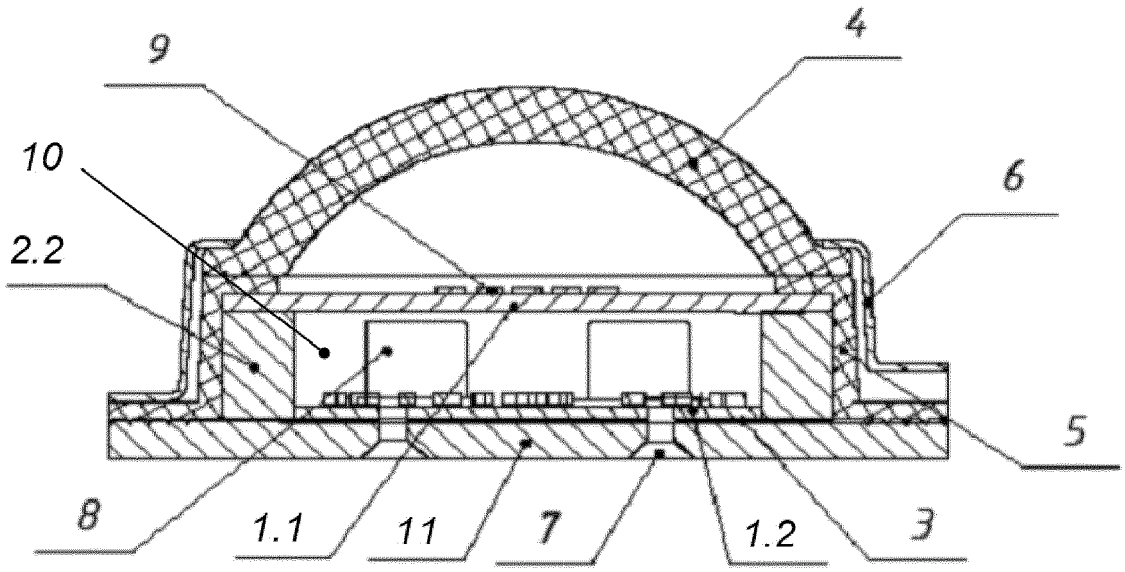

Fig.3

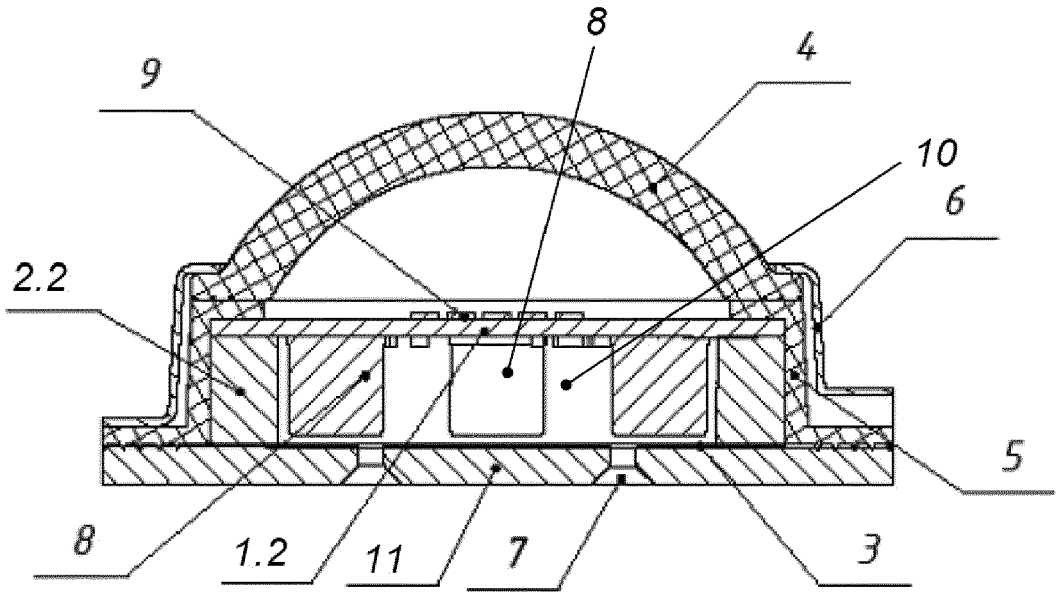

Fig.4

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EUROPEAN SEARCH REPORT

Application Number
EP 21 21 0445

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 2015/330617 A1 (HOETZL GUENTER [DE] ET AL) 19 November 2015 (2015-11-19) * paragraphs [0035] - [0048]; figures 1-8 * -----	1-6	INV. F21K9/00 F21V29/71 ADD. F21V23/00 F21Y105/10 F21Y115/10 F21W131/10 F21W131/103 F21W131/105 F21W131/109 F21W131/402 F21W131/407
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Y,D	RU 166 981 U1 (SOKOLOV YU.B.) 20 December 2016 (2016-12-20) * the whole document * -----	1-6	
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TECHNICAL FIELDS SEARCHED (IPC)

F21K
F21V
F21Y
F21W

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 May 2022	Menn, Patrick

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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