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(54) LIGHTING DEVICE

(57) The lighting device relates to lighting engineering and can be used in the manufacture of lighting engineering equipment for general outdoor and indoor lighting and task lighting. The technical result of the invention consists in increasing the lighting comfort, improving the uniformity of the luminance of the light-exit surface, and providing the working temperature for the light-emitting diodes. The lighting device comprises: a housing with an emitter; blue light-emitting diodes mounted in such a way as to provide the possibility of illumination of a first remote radiation converter in the form of phosphor particles arranged on or in the material of a first optically transmissive envelope; a second radiation converter which selects or changes the direction of radiation and surrounds the first remote radiation converter; an electronic electrical-energy converter, which is electrically connected to the light-emitting diodes; and means for connection to an electric circuit.

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Description

· *Related art*

[0001] The invention relates to lighting engineering and can be used to manufacture lighting equipment for general outside, inside and special illumination.

· *State of the Art*

[0002] Light diodes are an efficient source of light and feature low electric power consumption and long life. Light diodes feature high brightness and small angular size. Light diodes used for light sources without special high-light protection results in considerable visual load, a sense of discomfort and subconsious wish to escape from the operating zone of such lighting device.

[0003] Many countries have introduced blindness measure standardizing impact of bright sources of light on human vision. Most frequently this problem is solved by dispersing the light flux from a light source by different means, frequently combining both protective-decorative functions and light dispersion function. An other avenue of attack on the problem is to distribute primary emission over extensive surface whose brightness does not cause discomfort and is sufficient to produce normalized level of illumination.

[0004] On the other hand, transformation of electric power by light diodes into light emission is attended by heat generation. The brightness maintenance factor of light diodes notably depends, at that, on the temperature of light diode crystal. Quantum efficiency of the crystal decreases with increase of temperature. The problem of establishing thermodynamic equilibrium is the more important the more powerful is the light flux required for normalized illumination. The problem is especially topical when light diodes are used in equipment intended for general illumination.

[0005] Known is an device comprising body; source of light installed on a circuit board; optically transparent plate comprising lumiphor particles and installed before the source of light; light dispersing enclosure enveloping the said plate; electronic converter; means of connection with electric circuit (petent US2009141474, IPC[9] F21 V9/160, published on 04.06.2009).

[0006] Defective feature of the known solution is inefficient use of considerable part of the light-dispersing envelope partly used to create ventilation ducts - this is undoubtedly necessary for normal operation of the light diodes, but decreases the light emission area of the lamp. In the applicant's opinion the solution known for light diode cooling system cannot be efficient and most likely has been designed for the lamps producing small light flux, e.g. for decorative lighting and is not suitable for general illumination.

[0007] Known is a lighting device comprising body with cooling function; light diodes on a circuit board; light dispersing encasement with textured surface in the form of relief lens enveloping the said circuit board; electronic converter located in the body cavity; means of connection with electric circuit (patent CN201106805, IPC[9] F21 V9/00, published on 27.08.2008).

[0008] In the known solution the light diodes are in direct optical contact with light dispersing encasement which is much bigger than the light diode emission surface. In the oberver's line of vision the light diode image is blurred, but its reflection is still unbearable.

[0009] Known is a light diode lamp comprising body with cooling function; source of light located on a circuit board; light emitting encasement enveloping the circuit board with light diodes; electronic converter located in the base to connect with electric circuit (patent W02009087897, IPC F21S2/00, published on 16.07.2009).

[0010] Known is a lighting device comprising body with cooling function; source of light located on a circuit board; light emitting encasement enveloping the circuit board with light diodes and coated with luminophor layer; electronic converter located in the body cavity; means of connecting with electric circuit (patent JP2009170114, IPC F21 S2/00, published on 30.07.2009).

[0011] In the known solution the light diodes are in direct optical contact with luminophor-coated surface of light dispersing encasement which is much bigger than the light diode emitting surface. Uniformity of brightness of the encasement surface depends on the uniformity of luminophor particles' arrangement in the coating which is technologically difficult to implement.

[0012] The engineering result of the invention is improved comfort of illumination, improved uniformity of brightness of the light emitting surface, maintenance of operational temperature of the light diodes.

· *Disclosure of Invention*

[0013] The invention is specified by the following combination of essential features:

[0014] Lighting device comprising body with radiator; light diodes installed to illuminate the first remote emission converter comprising luminophor particles; second emission converter enveloping the first remote emission converter; electronic converter of electric power electrically connected with light diodes; means of connection with electric circuit.

[0015] Design feature «remote», as applied to specification of the first emission converter is understood as arrangement of luminophor particles at a distance to prevent overheating and deterioration of the generating capacity of the luminophor. It is the Applicant's knowledge that this distance ranges from 6 to 50 mm.

[0016] For additional and developing features it is necessary to point out the following:

- the body may have cylindrical cavity;
- the radiator of the body can be made as longitudinal

and/or transversal cooling fins with total surface area dependent on the amount of heat generated by the light diodes. To intensify cooling the longitudinal fins can be made on the inner cylindrical surface of the body;

- cylindrical surface of the body cavity can additionally have at least two longitudinal guides to install the ciruit board of the electric power electronic converter;
- to produce light emission it is possible to use light diode crystals to generate indigo emission which is subsequently transformed by the luminophor particles to regulate spectral characteristics of emission;
- to produce light emission it is possible to use diodes producing white light flux with color temperature more than 6000 K, in which the indigo component can be converted by the first remote converter into emission with different wavelength, making possible to correct color characteristics of the resulting light flux;
- the light diodes can form a cluster, and can be arranged on the plane linearly or regularly;
- the luminophor particles of the first remote emission converter are on the surface and/or in the material of the first optically transparent encasement installed at a distance from the light diodes and made, e.g. from polycarbonate or polymethyl methacrylate;
- the first remote emission converter can comprise luminophor particles of the same illumination color or luminophor particles of different illumination color, depending on desired spectrum of total light emission;
- the first remote emission converter can comprise long after-glow luminophor particles, this makes possible to use such a ligh-diode lamp to create emergency or escape illumination;
- the second emission converter selecting or changing emission direction made as a totality of elements on the surface and/or in the material of the second optically transparent encasement enveloping the first optically transparent encasement and distant from it and made, e.g. from polycarbonate, polymethyl methacrylate or glass;
- for the element transforming the emission direction in the second converter it is possible to use a relief element on the surface of the second optically transparent encasement, e.g. a set of regularly arranged small lenses;
- for the element of the second emission conveter it is possible to use disperse phase of substance with high reflectance and integrated with material of the second optically transparent envelope;
- the first and the second emission converters can be combined in one structural member made as an optically transparent encasement enveloping the light diodes, the wall thickness of such an encasement should be sufficient to efficiently disperse the light flux emitted from the surface of the encasement;
- for the element of the second emission conveter it is possible to use metal oxides integrated into the material of the encasement made of glass to form an optical filter;
- the electronic converter of electric power can be located both inside and outside the device. Design of such a conveter is of no principal importance. Important for the output electric specifications of such a converter is to provide for light diode operation and to meet design specifics of lighting device implementation.

·List of drawings

[0017] The invention is illustrated by the following drawings:

Fig. 1 shows axial section of the version of lighting device made in the form of conventional incandescent lamp with cylindrical cavity in the body and a threaded base for means of connection with electric power supply circuit;
Fig. 2 shows axonometric drawing of the version of lighting device with the first and second optical encasements of linear form;
Fig. 3 shows axonometric drawing of the version of lighting device with the first and second optical encasements of spherical form.

[0018] The lighting device comprises body 1 with radiator 2; light diodes 3, installed to illuminate the surface of the first optically tansparent encasement 4 fitted with the first means of emission conversion made as luminophor particles; second optically transparent encasement 5 selecting and/or changing direction of the light flux; electronic converter 6 of electric power; means 7 of connection with electric circuit.

[0019] Fig. 1 shows one of preferred design versions of the lighting device in the form of conventional incandescent lamp having in body 1 cylindric cavity 8, and threaded base 7 for means of connection with electric circuit. Electronic converter 6 of electric power (shown by dash line) in cavity 8 of body 1 and fixed by longitudinal guides (not shown in Fig. 1) on the surface of cavity 8.

[0020] Fig. 2 shows axonometric drawing of the second version of preferred implementation of the lighting device.

First optical encasement 4 and second optical encasement 5 are cylindrical and located along linearly installed light diodes 3 on the surface of body 1. The electronic converter of electric power (not shown in Fig. 2) can be outside the lighting device and made as standalone device electrically connected with light diodes 3 and the electric circuit (not shown).

[0021] Fig. 3 shows axonometric drawing of the third version of preferred implementation of the lighting device mounted on round body 1 with radiators 2 along its perimeter. For illustrative purposes a part of each encasement is shown with a cutout. Light diodes 3 are on the plane of circular body 1, at this, first optical encasement 4 and second optical encasement 5 have spherical surface and are arranged one over the other. The electronic converter of electric power (not shown in Fig. 3) can be outside the lighting device as a standalone unit electrically connected with light diodes 3 and electric power supply circuit (not shown).

·Industrial Applicability

[0022] Design versions of lighting device given in the description are not exhaustive. They can be altered to realize specific illumination purposes. Structural elements of the lighting device are of simple forms which can be manufactured by known manufacturing facilities with automated control.

Claims

1. Lighting device comprising a body with radiator; light diodes installed to illuminate the first remote emission converter comprising luminophor particles 6-50 mm from the light diodes; the second emission converter enveloping the first remote emission converter made as a totality of elements changing illumination direction and installed on the surface and/or inside optically transparent encasement; electronic converter electrically connected with the light diodes; means of connection with electric circuit.

2. Lighting device as set forth in claim 1 distinct in that the body has a cylindrical cavity.

3. Lighting device as set forth in claim 1 distinct in that the body radiator comprises longitudinal and/or transversal cooling fins with total surface area dependent on the amount of heat released by the light diodes.

4. Lighting device as set forth in claim 2 distinct in that the surface of the body cavity has longitudinal fins.

5. Lighting device as set forth in claim 2 distinct in that the surface of the body cavity has at least two longitudinal guides.

6. Lighting device as set forth in claim 1 distinct in that for the source of emission it uses light diode crystals producing indigo emission.

7. Lighting device as set forth in claim 1 distinct in that for the source of emission it uses white light emitting diode crystals with color temperature more than 6000 K.

8. Lighting device as set forth in claim 1 distinct in that the luminophor particles of the first remote emission converter are on the surface and/or inside the material of optically transparent envelope.

9. Lighting device as set forth in claim 8 distinct in that the first remote emission converter comprises luminophor particles of one or different emission colors.

10. Lighting device as set forth in claim 8 distinct in that the first remote emission converter comprises luminophor particles of different emission color.

11. Lighting device as set forth in claim 8 distinct in that the first remote emission converter comprises long after-glow luminophor particles.

12. Lighting device as set forth in claim 1 distinct in that the second emission converter is made as a totality of elements changing emission direction and installed on the surface and/or inside the optically transparent encasement.

13. Lighting device as set forth in claim 11 distinct in that for the element of the second emission converter a relief element is used on the surface of optically transparent encasement.

14. Lighting device as set forth in claim 11 distinct in that for the element of second emission converter is used dispersed phase of substance with high reflectivity and integrated with the material of optically transparent encasement.

15. Lighting device as set forth in claim 1 distinct in that the second emission converter is made as a totality of elements to form an optical filter.

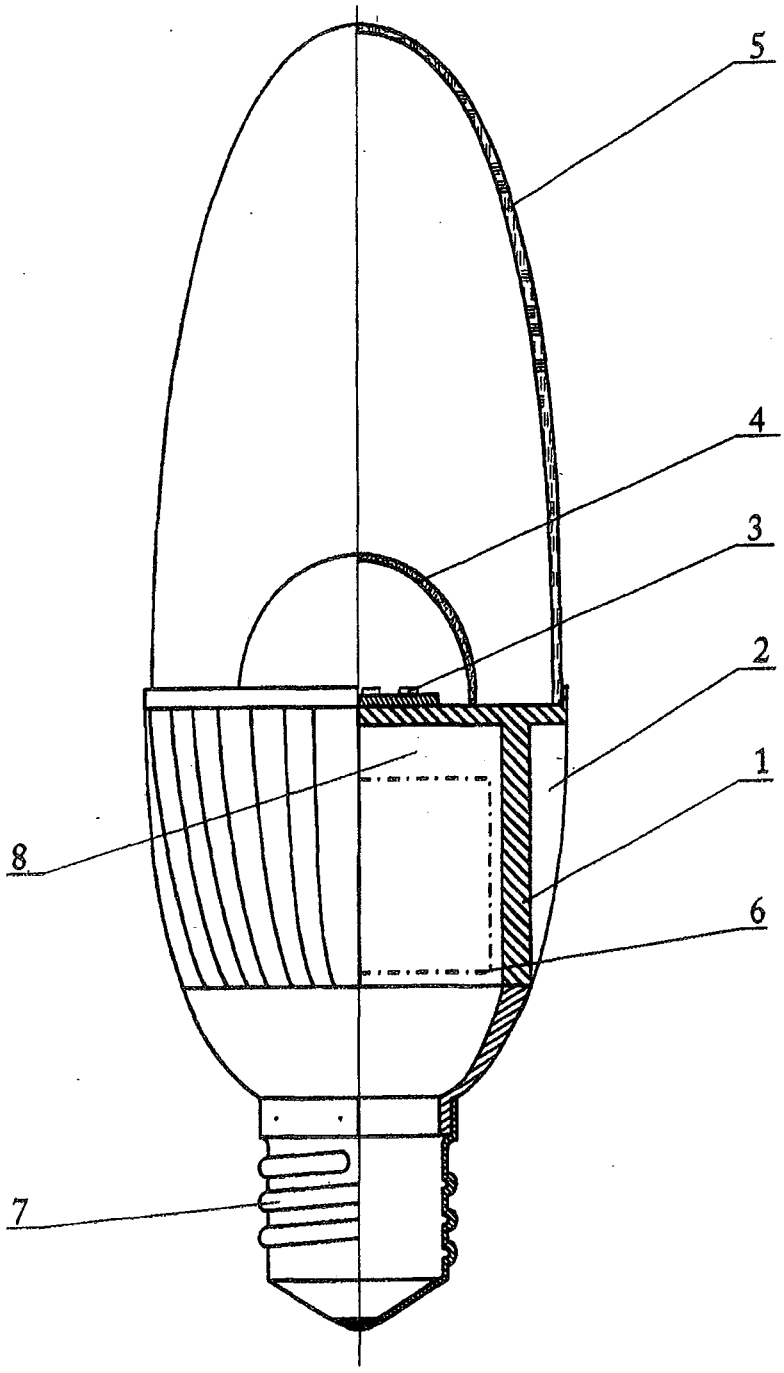

Fig .1

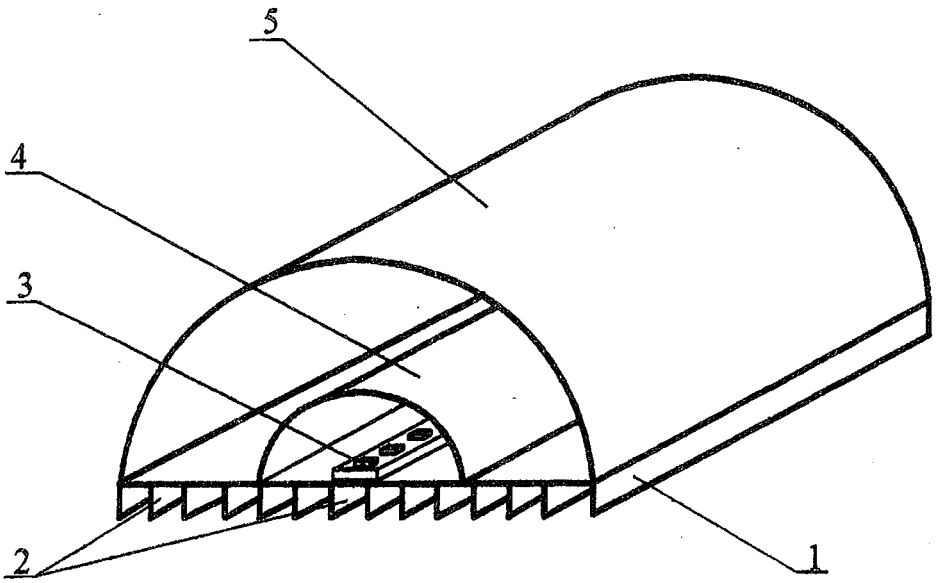

Fig .2

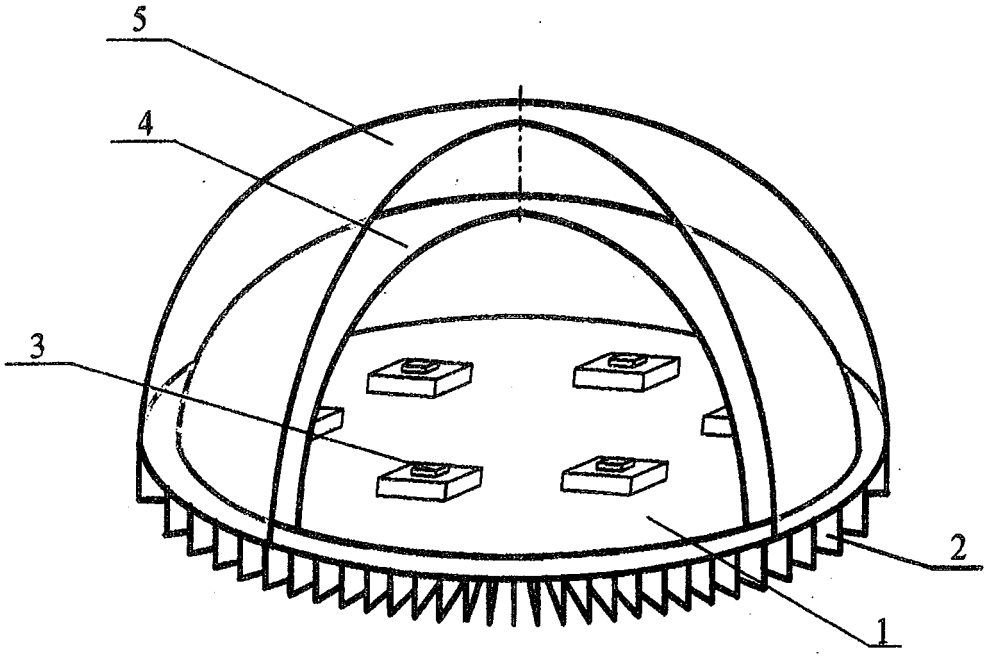

Fig .3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/RU 2010/000431

A. CLASSIFICATION OF SUBJECT MATTER
F21V 29/00 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F21K 7/00, F21S 2/00, 8/04, F21V 15/01, 19/00, 29/00, 7/20, 8/00, G08G 1/095, H01L 33/58, 33/60, H01L 33/64, F21Y 101/02

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2006/0198147 A1 (SHICHAO GE) 07.09.2006, col. 3, [0065], [0068], fig. 6, 9, 1	1-5, 8 6-7, 9-15
Y	RU 2251761 C2 (TRIDONIK OPTOELEKTRONIK GMBKH et al.) 10.05.2005, the abstract, p. 8, 3 upper par.	6, 12
Y	RU 2359362 C2 (SEUL SEMIKONDAKTOR KO., LTD.) 20.06.2009, p. 3, par. 6, 9 upper, p. p. 1, 2	7, 9-10
Y	RU 2194736 C2 (SOSCHIN NAUM PINKHASOVICH) 20.12.2002, p. 2	11

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
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"P" document published prior to the international filing date but later than the priority date claimed
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 April 2011 (04.04.2011)	07 April 2011 (07.04.2011)
Name and mailing address of the ISA/ RU Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/RU 2010/000431

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 201106805 Y (SHENZHEN BANG BELL ELECTRONICS) 27.08.2008, fig. 4-7, 13, 14	13
Y	RU 2065639 C1 (MALOE PREDPRIYATIE "EKOMERKUR") 20.08.1996, point 23 of the claims, p. 4, 2 par. Upper	14
Y	SU 1787963 A1 (TSENTRALNOE KONSTRUKTORSKOE BJURO "PELENG" et al.) 15.01.1993, the abstract	15

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2009141474 A **[0005]**
- CN 201106805 **[0007]**
- WO 2009087897 A **[0009]**
- JP 2009170114 B **[0010]**