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(54) **METHOD FOR PRODUCING A LIGHT-RADIATING SURFACE AND A LIGHTING DEVICE FOR IMPLEMENTING THE METHOD**

(57) A method for producing a light-radiating surface and a lighting device for implementing the method relate to lighting technology, specifically to LED lighting devices which are intended for producing external and internal lighting. The method for producing a light-radiating surface comprises operations for generating a stream of radiation; establishing the direction of flow of a light-reflecting structure; irradiating luminophore particles forming a first means for transforming the stream of radiation; and using a stream of light to irradiate a second means for transforming the stream of radiation, which means is pro-

duced from an optically transparent material and is equipped with scattering means. The lighting device comprises a radiation source in the blue and/or ultraviolet range of the spectrum; a first means for transforming the radiation, which means is equipped with luminophore particles; a light-reflecting structure which can change the radiation direction; and a second means for transforming the radiation, which means is equipped with light-scattering elements, is constructed from an optically transparent material and has a light-radiating surface.

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Description

Field of Invention.

[0001] The invention relates to lighting technology, specifically to LED lighting devices which are intended for producing external and internal lighting.

Prior Art.

[0002] To improve ergonomic characteristics, lighting devices shall not create glaring light, sudden jumps in brightness of the radiation surface, which may cause a feeling of discomfort. The mentioned effect results from a high level of brightness of the radiation source and its small angular dimensions. Most often this problem is solved by scattering the radiation using various means which mostly combine both protective-decorative functions and light scattering functions. The other way of approaching the mentioned problem is to distribute the primary radiation over the large light-radiating surface the surface brightness of which does not cause discomfort and is sufficient for establishing a standard lighting level.

[0003] There is known a method for producing a large light-radiating surface, which comprises the generation of the stream of spherical radiation containing an ultraviolet component; use of the stream to irradiate the luminophore layer applied to the internal surface of the ellipsoidal enclosure made from an optically transparent material; transformation of the ultraviolet part to the visible red light; radiation of the direct radiation stream and transformed radiation stream from the external surface of the enclosure ("Electric light sources" by Z. S. Voznesenskaya et al., published in Moscow by the Gosenergoizdat Publishing House, 1957, p.186).

[0004] The method of prior art has features similar to those of the invention and describes the manufacture of mercury-discharge lamps with corrected chromaticity. The application of luminophore particles to the internal surface of the enclosure has been dictated by the need to correct the spectrum of radiation produced by gas discharge. The method of prior art is energy- and labor-intensive process, besides associated with environmentally hazardous actions when measuring mercury in the cylinder of the gas-discharge light source.

[0005] There is known a method for producing a large light-radiating surface, which comprises the generation of the radiation stream by a plurality of single sources each of which directs the radiation stream to the space angle; use of the stream to irradiate the surface element of the luminescent coating applied to the plate from the optically transparent material; transformation of the wavelength of the radiation part by luminophores; radiation of the direct radiation stream and transformed radiation stream from the surface element dS of the plate; integration of the elementary streams of light from the whole light-radiating surface S of the plate (RF patent No. 2301475, IPC H01063/06 issued on June 20, 2007).

[0006] The method of prior art has been aimed at producing a uniform light intensity of the large planar surface. A light emitting diode (LED) has been used as a single radiation source in the method of prior art. The LED radiation scattering occurs in the luminophore layer, on which the area of the irradiated surface dS is determined by the value of the space angle $d\Omega$. After scattering of the incident radiation the surface brightness of the area dS remains non-uniform and decreases as the distance from LED optical axis increases, which results in a non-uniform luminous exitance of the whole light-radiating surface S . The precorrection of the radiation source distribution using a lens involves a rise in the cost of led-emitting diodes, complication of the lighting device manufacturing and is not always economically feasible.

[0007] There is known an appliance for producing a large light-radiating surface comprising of a case; a radiation source located inside the case; a plate from an optically transparent material located in front of the radiation source and provided with a luminophore covering (RF patent No. 2301475, IPC H01063/06 issued on June 20, 2007).

[0008] The disadvantage of the prior art method is a non-uniform luminous exitance of the light-radiating surface conditioned by the decrease of brightness as the distance from the axis of the radiation beam incident on the irradiated surface increases. In addition, the use of the plate limits substantially the possible scope of application of prior art appliance.

[0009] There is known a patent wherein a light-radiating appliance comprises a light-emitting diode (LED) source of light in the ultraviolet range of the spectrum and a planar body made from an optically transparent resin and containing dispersed luminophore particles and light-storing bodies together with light-transmitting inorganic particles (RF patent No. 2319063, IPC F21V9/00 issued on June 10, 2006).

[0010] The advantage of the prior art solution is the use of the radiation source invisible to the observer. As the disadvantage of this solution the design complexity of the multi-component panel may be mentioned, the fabrication of such a panel constitutes a complex engineering problem in itself, and it will most likely be an expensive article. In addition, the light intensity of 15.5 cd/m^2 declared in the description appears as clearly insufficient for manufacturing lighting devices intended for general lighting.

[0011] There is known a device for general and spot lighting, which contains ultraviolet light emitting diodes located along the axis of the optically transparent tube to the surface of which a layer of luminophore transforming the nonvisible radiation to the visible light is applied (Patent No. JP 2002133910, IPC F2158/04, issued on May 10, 2002).

[0012] The disadvantage of the prior art solution is the allocation of radiation sources in a narrow enclosed tube, which limits the selection of the light-radiating surface form. In addition, it is difficult to withdraw heat from LEDs

in the tube, whereas LEDs overheating reduces their light-radiating capacity. Most probably, the prior art assembly is intended to be used with low-power LEDs and is not capable of creating the light level required for general lighting.

[0013] There is known a lighting assembly comprising a housing, means for connecting with a source of electric power; a series of light emitting diodes mounted within the housing and sufficient in output wavelength for excitation of luminophore receptive to an ultra-violet region of the electromagnetic spectrum; electric power transforming means to convert power into a known voltage for use by said light emitting diodes; a transparent plate having an interior surface area covered with luminophore, through which a light excited by luminophore and visible to the naked eye is transmitted (U.S. patent No. 6068383, IPC E2158/04, issued on May 30,2000).

[0014] The disadvantages of the known analogue are losses of a light stream which is emitted by the light emitting diodes sideways from the optical axis, as well as a non-uniform exitance of the light-radiating surface conditioned by a decreasing intensity of the stream of light incident on the irradiated area as the distance from its optical axis increases and by a lack of means for smoothing the surface brightness of the light-radiating surface and the irradiance color.

[0015] The technical results of the invention are increases in uniformity of radiation color and in surface brightness of the light-radiating surface, enhancement of processing capabilities for designing lighting devices with that kind of surface.

[0016] The method for producing a light-radiating surface is characterized by the following essential features:

The method for producing a light-radiating surface comprising the generation of a stream of radiation by a light-emitting diode (LED) emitter; establishment of the direction of the radiation stream by a surface of a light-reflecting structure; irradiation of luminophore particles forming a first means for transforming the stream of radiation using the established radiation stream; radiation of a visible stream of light by luminophore particles; irradiation by a visible stream of light of the second means for transforming the stream of radiation, which means is capable of scattering the stream of light and is produced from an optically transparent material; radiation of the visible stream of light from the surface of the second means for transforming.

[0017] The alternative form of the method provides the change in the sequence of transforming the radiation stream whereby first the wavelength of the LED radiation stream is transformed, and then the direction of the radiation stream is established by the surface of the light-reflecting structure. In this last embodiment the change in the sequence of transforming the LEDs radiation has no influence on the claimed technical result.

[0018] The lighting device which implements the method for producing a light-radiating surface is characterized by the following essential features:

5 The lighting device comprising a light source which includes at least one light-emitting diode (LED) emitter mounted on the board and generating a radiation stream in the blue and/or ultraviolet range of the spectrum; a first means formed by luminophore particles for transforming the stream of radiation; a light-reflecting structure which can establish the direction of the radiation stream; a second means for transforming the radiation, which means is equipped with light-scattering elements, is made from an optically transparent material and has a light-radiating surface.

[0019] The essential feature of this invention stated as "a first means for transforming the stream of radiation" shall be understood to mean a plurality of luminophore particles the spatial arrangement of which is determined by the configuration of that part on the surface or in the volume of which are contained said particles.

[0020] The following features of the invention shall be pointed out as ampliative and/or specifying ones:

- the composition of luminophore particles of the first means for transforming the radiation makes it possible to create a stream of light in the visible-light spectrum;
- the first means for transforming the radiation includes luminophore particles having the effect of afterglow, which particles not only contribute to smoothing the stream of light but make it possible to obtain an additional technical result in the form of emergency rescue lighting;
- the first means for transforming the radiation stream is located on the surface and/or in the material of the optically transparent substrate which is one of the embodiments of said means.

[0021] The term "substrate" is meant by the applicant to be understood as a detail of design made from optically transparent material capable of establishing both rigid and flexible surfaces;

- the first means for transforming the radiation is located on the surface and/or in the material of the optically transparent substrate which covers the light-emitting diode (LED) emitter and is the carrier of the first means for transforming the radiation;
- a substrate covering the light-emitting diode is made as a hollow three-dimensional figure, the thickness of its wall depends on optical properties of the material and is determined based on minimum possible losses of the radiation stream and available processing capabilities for its manufacturing, the optimal em-

- bodiment of the substrate shall be in the form of a hemisphere or paraboloid of rotation;
- the surface of the optically transparent substrate is patterned, which makes it possible to perform a preliminary scattering of the stream of light and contributes to the improvement of the conditions for obtaining the uniformity of light-radiating surface brightness;
 - the first means for transforming the radiation stream is applied to the patterned surface of the substrate, thus increasing the area for transforming the radiation;
 - the first means for transforming the radiation stream is applied to the surface of the optically transparent planar substrate located at distance h_1 (given in mm) from the light-reflecting structure, this value is taken in the range of $0 \leq h_1 \leq 40$, to smooth the brightness of adjacent areas of the light spots using both the superposition and interference of light waves;
 - the second means for transforming the radiation is made in the form of the plate inside or on one of the surfaces of which light-scattering elements are located, and this plate serves as a protective element of the lighting device while scattering the stream of light and performing the light-radiating function;
 - surface light-scattering elements are made in the form of regular relief without sharp edges, for example, in the form of hemispheres;
 - the plate of the second means for transforming the radiation is located at distance h_2 from the first means for transforming the radiation the carrier of which is a transparent planar substrate, with h_2 not exceeding 50 mm, and the selection of the distance based on the specified conditions makes it possible to smooth the light intensity of the plate surface and to level differences in the radiation color;
 - the plate of the second means for transforming is equipped with luminophore particles and is located at distance H from the light-reflecting structure, with H not exceeding 50 mm, and the selection of the distance based on the specified conditions makes it possible to smooth the light intensity of the plate surface and to level differences in the radiation color;
 - the light-reflecting structure is formed by reflectors provided with a light-scattering surface, each of the reflectors is located around one of the light-emitting diode (LED) emitters;
 - the light-reflecting structure comprises regularly spaced reflectors the surface of which is recessed into the board; and the light-emitting diode is located in said recess and is equipped with the first means for transforming the radiation, while the second means for transforming the radiation is made in the form of the plate mounted at distance H from the board, with H not exceeding 50 mm;
 - the surface of the reflectors is made in the form of a cone, and its guide represents a polygon of n sides, where $4 \leq n \leq \infty$;

- the guide of the reflectors is made in the form of an equilateral tetragon, or a hexagon, or a circle, what is the most convenient embodiment of the light-reflecting structure from a technological point of view;
- light-emitting diode (LED) emitters are grouped together as linear clusters equipped with linear reflectors which form a light-scattering structure, and the linear embodiment of clusters makes it possible to increase possible embodiments of the invention and to improve the ease of manufacture;
- the linear reflector has a trapezoidal, parabolic or semicircular profile, what is the most convenient embodiment of the light-reflecting structure from a technological point of view when the light-emitting diode (LED) emitters are arranged in the form of linear clusters.

[0022] The invention is illustrated by the following drawings that demonstrate the method for producing a light-radiating surface and embodiments of the method in particular lighting devices:

Fig. 1 is a schematic view illustrating the method for producing a light-radiating surface when the first means for transforming the radiation is located on the planar optically transparent substrate;

Fig. 2 is a schematic view illustrating the method for producing a light-radiating surface when the first means for transforming the radiation is located in the three-dimensional optically transparent enclosure;

Fig. 3 is a fragmented top plan view of the lighting device, the schematic view of which is shown in Fig. 1, wherein a light-reflecting structure is formed by reflectors in the form of a tetrahedral equilateral pyramid;

Fig. 4 is a fragmented top plan view of the lighting device, the schematic view of which is shown in Fig. 2, wherein a light-reflecting structure is formed by reflectors in the form of a right circular cone;

Fig. 5 is a top plan view of the lighting device with linear clusters of light-emitting diodes and a light-reflecting structure in the form of linear reflectors;

Fig. 6 is a top plan view of the lighting device with a linear cluster of light-emitting diodes in the three-dimensional substrate and a light-reflecting structure in the form of linear reflectors;

Fig. 7 is a side view of an embodiment of the lighting device which comprises reflectors located in the recesses of the board around light-emitting diode (LED) emitters.

Brief Description of Drawings.

[0023] The lighting device (Fig.1) comprises a light-emitting diode (LED) emitter 1 located on the board 2, a light-reflecting structure 3, a planar substrate 4 located at distance h_1 from the light-reflecting structure 3 and equipped with the first means for transforming the radiation in the form of luminophore particles 5 applied to the surface of the substrate 4, the second means for transforming the radiation in the form of the plate 6 located at distance h_2 from the planar substrate and equipped with a patterned surface 7.

[0024] The lighting device (Fig.2) comprises a light-emitting diode (LED) emitter 1 located on the board 2; the first means for transforming the radiation in the form of luminophore particles 5 (not shown in Fig.2) contained in the material of the three-dimensional substrate 8 which covers the light-emitting diode source 1; a light-reflecting structure 3; the second means for transforming the radiation in the form of the plate 6 located at distance H from the light-reflecting structure 3 equipped with a patterned surface 7.

[0025] The lighting device (Fig.3) which implements the method for producing a light-radiating surface according to the schematic view in Fig. 1 comprises a light-emitting diode (LED) emitter 1, for example, in the form of semiconductor chips mounted on the board 2. Located along the stream of radiation being transformed, a light-reflecting structure 3 which includes reflectors 9 at each group of radiation sources 1; an optically transparent substrate 4 equipped with the first means for transforming the radiation in the form of luminophore particles (not shown in Fig.5); a light-scattering plate 6 having a light-radiating surface 7 provided with a regular relief.

[0026] The lighting device (Fig.4) which implements the method for producing a light-radiating surface according to the schematic view in Fig. 2 comprises light-emitting diode (LED) emitters (not shown in Fig.4) mounted on the board (not shown in Fig.4) and located along the stream of radiation being transformed: an optically transparent three dimensional substrate 8 equipped with luminophore particles (not shown in Fig.4); a light-scattering structure 3 equipped with reflectors 9 for each three dimensional substrate 8; a light-scattering plate 6 having a light-radiating surface 7 provided with a regular relief.

[0027] The lighting device (Fig.5) which implements the method for producing a light-radiating surface according to the schematic view in Fig. 1 comprises light-emitting diode (LED) emitters 1 which are grouped together as linear clusters mounted on the board 2 and are provided with a light-scattering structure 3 equipped with linear reflectors 9 which are located along the respective linear clusters of light-emitting diode (LED) emitters 1.

[0028] Further along the stream of radiation there are: an optically transparent substrate 4 with luminophore particles (not shown in Fig.5) which covers light emitting diode clusters 1 and a light-scattering plate 6 with a light-radiating surface 7 provided with a regular relief.

[0029] The lighting device (Fig.6) which implements the method for producing a light-radiating surface shown according to the schematic view in Fig. 2 comprises light-emitting diode (LED) emitters (not shown in Fig.6) located on the boards (not shown in Fig.6) in the cavity of the optically transparent three dimensional substrate 8 which includes the first means for transforming the radiation of the enclosure (the luminophore particles)(not shown in Fig.6). The group of said three dimensional substrates 8 is located in line and provided with linear reflectors 9 of the light-reflecting structure 3 which are mounted along the respective line of three dimensional substrates 8. Further along the stream of radiation reflected from the surface of reflectors 9 there is a light-scattering plate 6 having a light-radiating surface 7 and provided with a regular relief.

[0030] Two more embodiments of the lighting device that implement the method for producing a light-radiating surface are shown in Fig.7 and Fig.8.

[0031] In Fig.7 the light-reflecting structure 3 includes regularly spaced reflectors 9, the surface of each of the reflectors is recessed into the board 2; the first means for transforming the radiation (the luminophore particles) 5 located inside or on the surface of the planar substrate 4 which is located at distance h_1 not more than 40 mm from the surface of the light-reflecting structure 3. The second means for transforming the radiation in the form of the light-scattering plate 6 is located at distance h_2 from the planar substrate 4, with h_2 not exceeding 50 mm.

[0032] In Fig.8 the light-reflecting structure 3 includes regularly spaced reflectors 9, the surface of each of the reflectors is recessed into the board 2; the radiation source surrounded by the first means for transforming the radiation (the luminophore particles) is located on the board 2 in the recess of the reflector 9, and the second means for transforming the radiation in the form of the plate 6 is mounted at distance H from the light-reflecting structure 3, with the value H not exceeding 50 mm.

Industrial Applicability

[0033] Parts and assemblies for the lighting device may be manufactured using the known methods. The information provided in the description is sufficient for understanding the principle of operation and design of devices which implement the methods for producing a light-radiating surface.

Claims

1. The method for producing a light-radiating surface comprising the generation of the radiation by at least one light-emitting diode (LED) emitter, located on the board; establishment of the radiation direction by a surface of a light-reflecting structure; irradiation of the first means for transforming the radiation, which means is produced in the form of luminophore

particles; radiation of a visible stream of light by luminophore particles; scattering of the stream of light from luminophore by the second means for transforming the radiation, which means is produced from an optically transparent material; radiation of the stream of light from the surface of the second means for transforming the radiation.

2. The method for producing a light-radiating surface comprising: the generation of the radiation stream by at least one light-emitting diode (LED) emitter, located on the board; irradiation of the first means for transforming the radiation, which means is produced in the form of luminophore particles; radiation of a visible stream of light by luminophore particles; establishment of the direction of the radiation stream by a surface of a light-reflecting structure; scattering of the stream of light reflected from a light-reflecting structure by the second means for transforming the radiation, which means is produced from an optically transparent material; radiation of the scattered stream of light from the surface of the second means for transforming the radiation.
3. The lighting device comprising at least one light-emitting diode (LED) emitter mounted on the board; a first means for transforming the radiation formed by luminophore particles; a light-reflecting structure which can establish the direction of the radiation; a second means for transforming the radiation, which means is equipped with light-scattering elements, is produced from an optically transparent material and has a light-radiating surface.
4. The lighting device comprising at least one light-emitting diode (LED) emitter mounted on the board and generating a radiation stream in the blue and/or ultraviolet range of the spectrum; a light-reflecting structure which can establish the direction of the radiation; a first means for transforming the radiation formed by luminophore particles; a second means for transforming the radiation, which means is equipped with light-scattering elements, is produced from an optically transparent material and has a light-radiating surface.
5. The lighting device as claimed in claim 3 or claim 4 **characterized in that** the composition of luminophore particles of the first means for transforming the radiation makes it possible to create a stream of light in the visible-light spectrum.
6. The lighting device as claimed in claim 5 **characterized in that** the composition of luminophore particles includes additionally luminophore with the effect of afterglow.
7. The lighting device as claimed in claim 3 or claim 4

characterized in that luminophore particles are located in the material and/or on the surface of the optically transparent substrate.

8. The lighting device as claimed in claim 3 **characterized in that** luminophore particles are located in the material and/or on the surface of the optically transparent substrate produced in the form of the enclosure which covers a light-emitting diode (LED) emitter.
9. The lighting device as claimed in claim 4 **characterized in that** luminophore particles are located in the material and/or on the surface of the optically transparent substrate produced in the form of the sheet.
10. The lighting device as claimed in claim 8 **characterized in that** the enclosure is made as a hollow three-dimensional figure, for example, in the form of a hemisphere or paraboloid of rotation.
11. The lighting device as claimed in claim 7 **characterized in that** the substrate is provided with a patterned surface.
12. The lighting device as claimed in claim 11 **characterized in that** luminophore particles are applied to the patterned surface of the surface.
13. The lighting device as claimed in claim 9 **characterized in that** the substrate is located at distance h_1 (in mm) from the surface of the light-reflecting structure, the distance not exceeding 40 mm.
14. The lighting device as claimed in claim 3 or claim 4 **characterized in that** the second means for transforming the radiation is made in the form of the plate from an optically transparent material inside or on the surface of which light-scattering elements are located.
15. The lighting device as claimed in claim 3 **characterized in that** the second means for transforming the radiation is made in the form of the plate mounted at distance H (in mm) from the light-reflecting structure, with H not exceeding 50 mm.
16. The lighting device as claimed in claim 4 **characterized in that** the second means for transforming the radiation made in the form of the plate which is located at distance h_2 from the substrate in the form of a sheet equipped with the first means for transforming the radiation, with h_2 not exceeding 50 mm.
17. The lighting device as claimed in claim 3 or claim 4 **characterized in that** the light-reflecting structure is formed by reflectors equipped with a light-scattering surface, each of the reflectors is in line with one

of the light-emitting diode (LED) emitters.

18. The lighting device as claimed in claim 4 **characterized in that** the light-reflecting structure comprises regularly spaced reflectors, the surface of which is recessed into the board; and the second means for transforming the radiation made in the form of the plate which is equipped with luminophore particles and mounted at distance h_3 from the board, the distance not exceeding 50 mm.
19. The lighting device as claimed in claim 17 **characterized in that** the surface of the reflectors is made in the form of a cone, and its guide represents a polygon of n sides, where $4 \leq n \leq \infty$.
20. The lighting device as claimed in claim 19 **characterized in that** the guide of the reflectors is made in the form of an equilateral tetragon, or a hexagon, or a circle.
21. The lighting device as claimed in claim 3 **characterized in that** light-emitting diode (LED) emitters are grouped together as linear clusters, each of which is provided with a common linear reflector.
22. The lighting device as claimed in claim 21 **characterized in that** the linear reflector has a trapezoidal, parabolic or semicircular profile.

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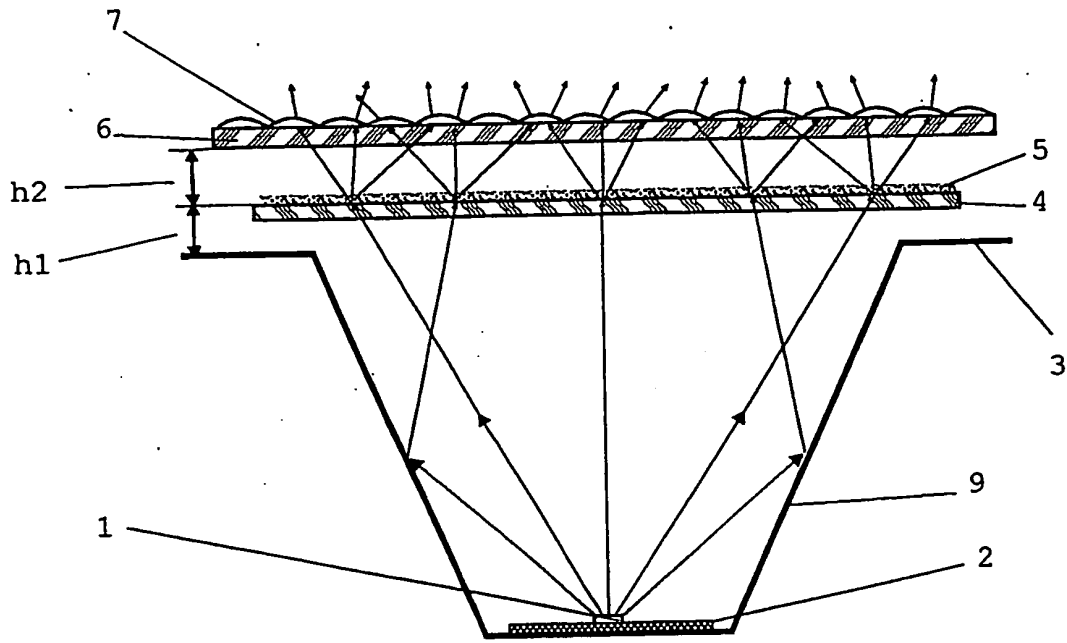


Fig .1

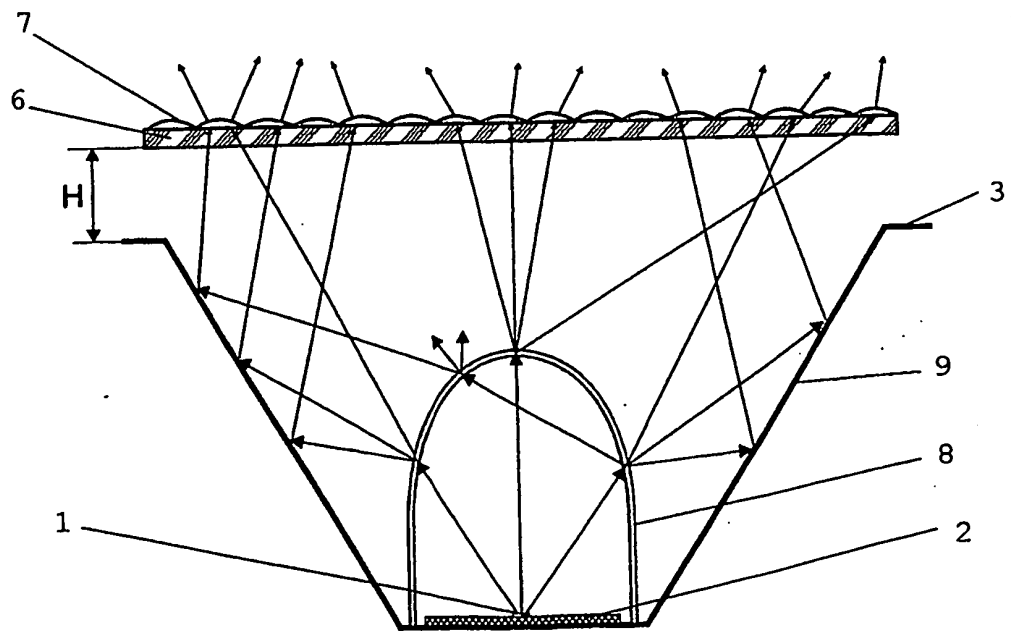


Fig 2

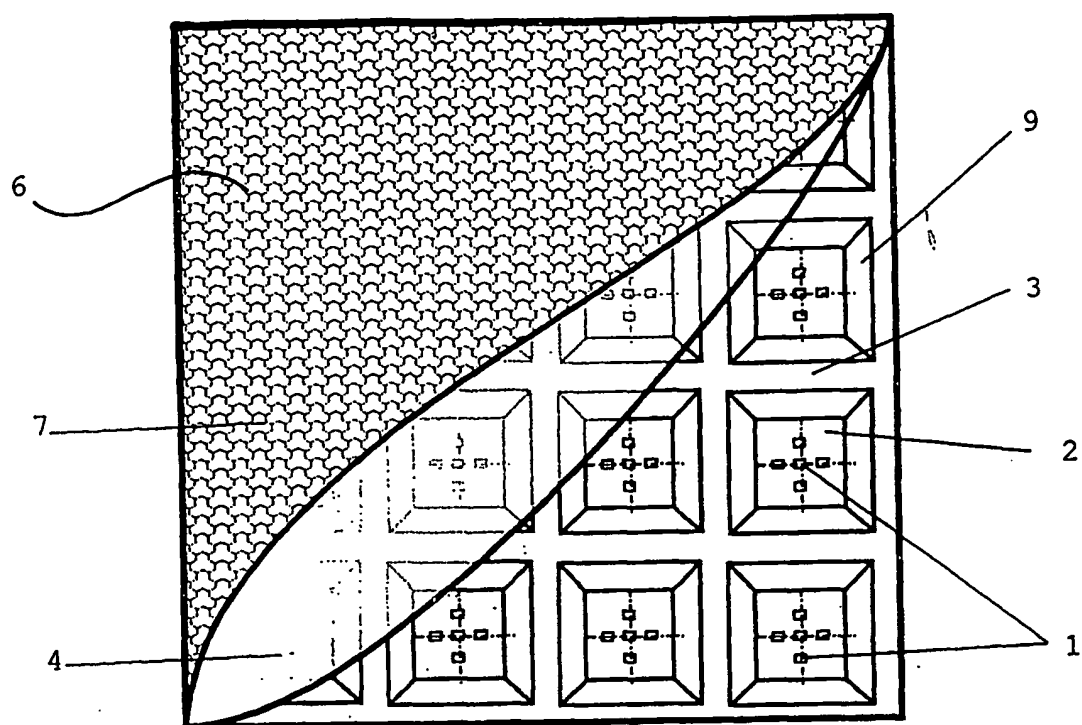


Fig. 3

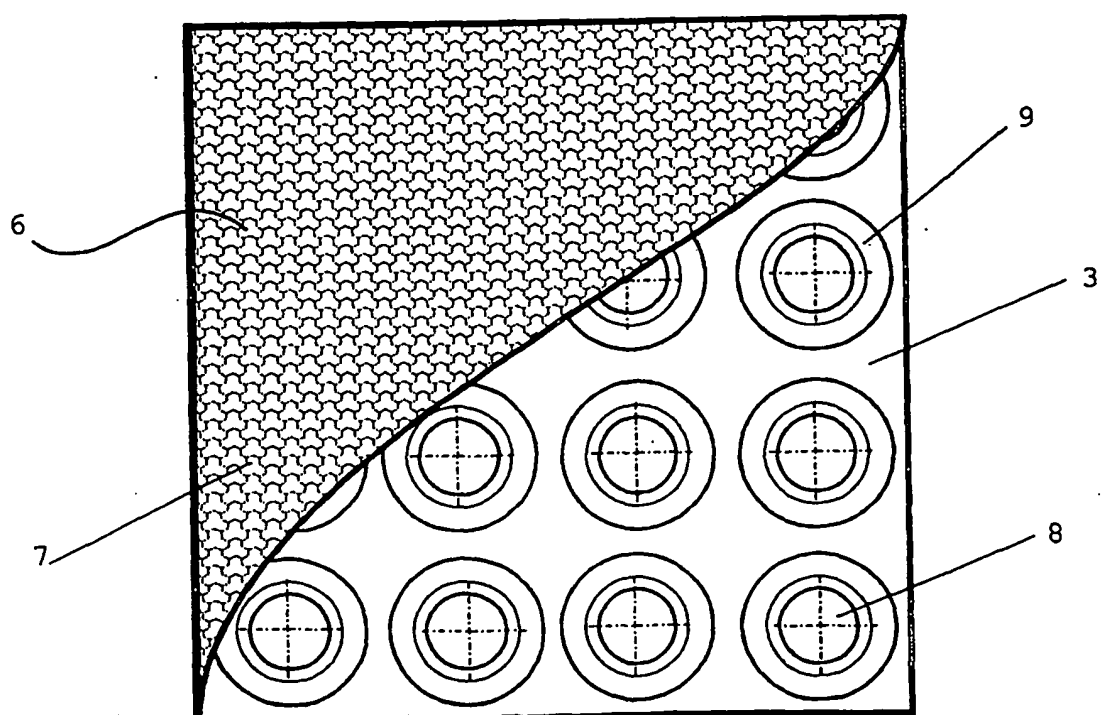


Fig. 4

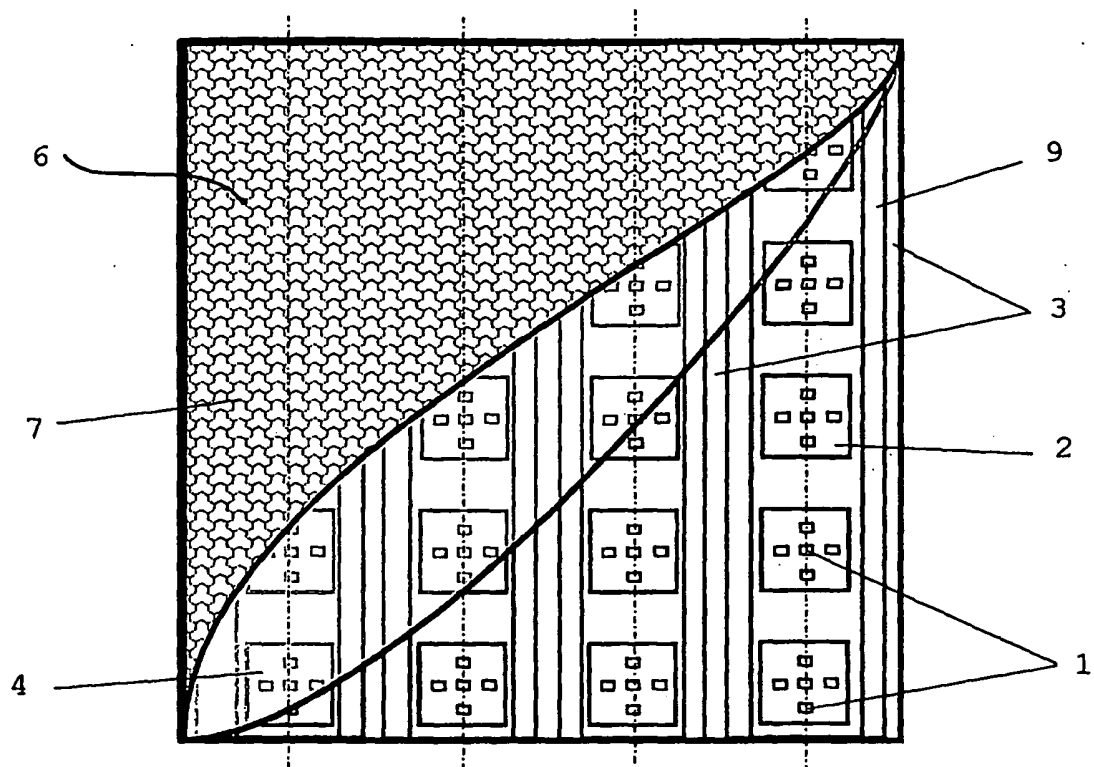


Fig. 5

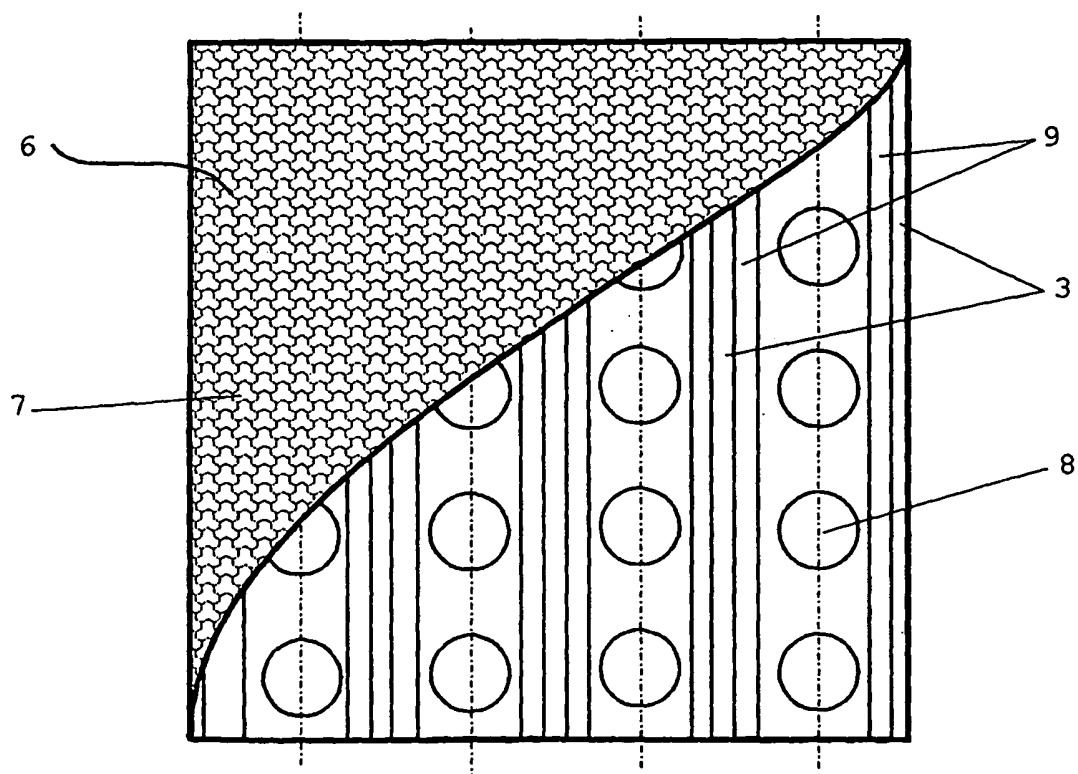


Fig. 6

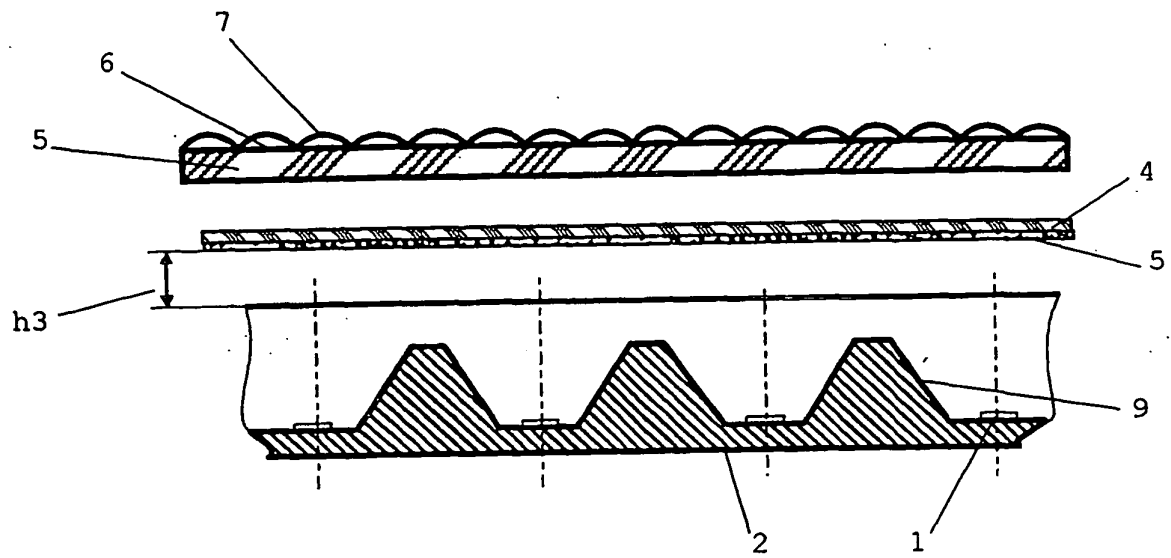


Fig .7

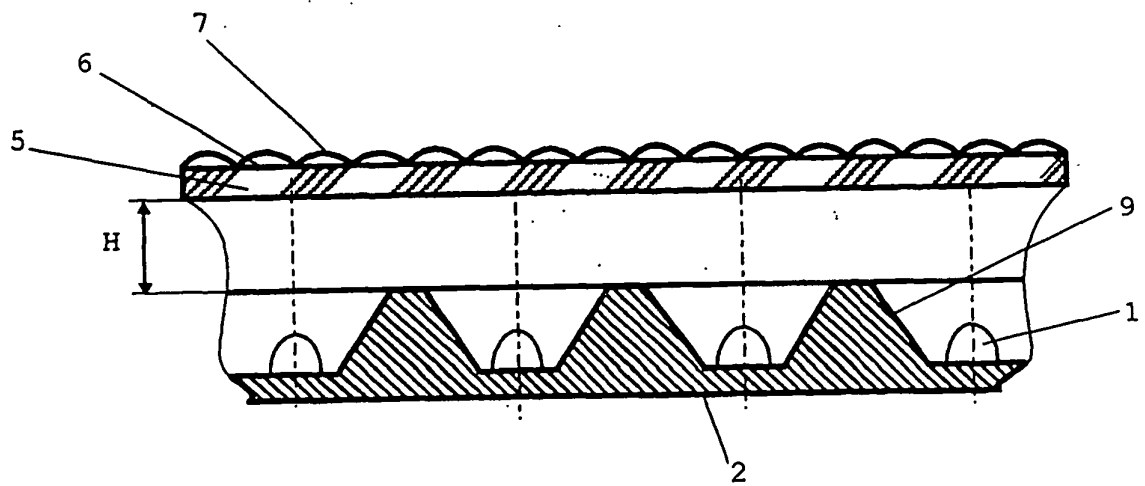


Fig.8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/RU 2010/000045

A. CLASSIFICATION OF SUBJECT MATTER		
F21S 8/00 (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)		
F21S 8/00, 8/04, 8/10, G08G 1/095, G09F 13/00, 13/20, F21V 5/00, 5/04, H01L 33/00, 33/64, 27/15, 33/50, C09K 11/08, H01J 63/06		
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	RU 2251761 C2 (TRIDONIK OPTOELEKTRONIK GMBH et al.) 10.05.2005, figures 7, 10, page 7, paragraph 3 from above	2-5, 7-8, 10, 13-16 1, 6, 9, 11-12, 17-22
Y	RU 2319063 C2 (AVAILVS KORPORATION) 10.03.2008, figure 1, pages 5, 8-10	1, 6, 9, 11-12, 17-22
Y	RU 2194736 C2 (SOSCHIN NAUM PINKHASOVICH) 20.12.2002, page 2	6
Y	RU 2265969 C1 (NOGINOV ALEKSANDR LEONIDOVICH) 10.12.2005, page 9, 3 paragraph from below, page 15, 3 paragraph from above	17
Y	RU 2204081 C2 (ZAKRYTOE AKTSIONERNOE OBSHCHESTVO "NITRANSS") 10.05.2003, the abstract, page 3, figures 2, 3	19-20
☒ 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 "E" earlier application or patent but published on or after the international filing date "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) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "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 21 October 2010 (21.10.2010)		Date of mailing of the international search report 02 November 2010 (02.11.2010)
Name and mailing address of the ISA/ RU		Authorized officer
Facsimile No.		Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/RU 2010/000045

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	RU 2276113 C2 (SAINT-GOBAIN GLASS FRANCE) 10.05.2006, the abstract	11-12

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REFERENCES CITED IN THE DESCRIPTION

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