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(71) Applicant: **KONINKLIJKE PHILIPS N.V.** [NL/NL];
High Tech Campus 5, NL-5656 AE Eindhoven (NL).

(72) Inventors: **BOREL, George Hubert**; c/o High Tech Campus, Building 44, NL-5656 AE Eindhoven (NL).
MEEUSEN, Jorgen; c/o High Tech Campus, Building 44, NL-5656 AE Eindhoven (NL).

(74) Agents: **VAN EEUWIJK, Alexander Henricus Walterus** et al; High Tech Campus, Building 44, NL-5656 AE Eindhoven (NL).

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[Continued on nextpage]

(54) Title: A LIQUID MOTION LAMP COMPRISING AN LED LIGHT SOURCE

(57) Abstract: A liquid motion lamp comprises a container (1) containing a contained liquid material (13), which at least at an operative temperature is liquid, and a light source comprising at least one light emitting diode (9). At least a light emitting part (11) of the light emitting diode (9) is positioned in the container (1) to be in heat conductive connection with the contained liquid material (13).

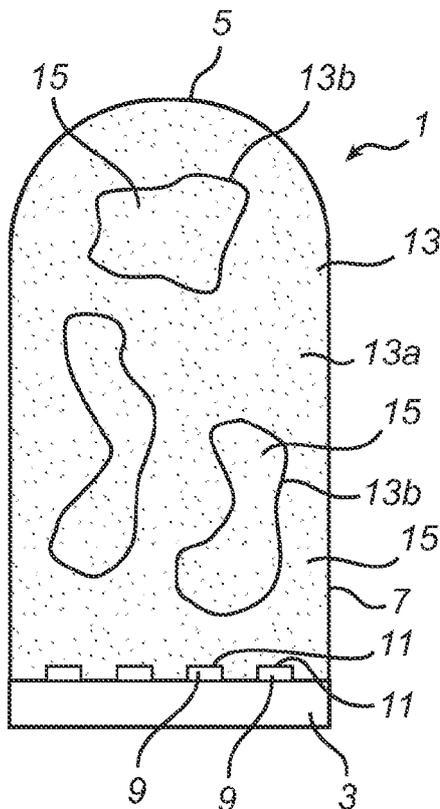


Fig. 1



WO 2013/136236 A1

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TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA,
ZM, ZW.

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EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, ML, MR, NE, SN, TD, TG).

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A liquid motion lamp comprising an LED light source

FIELD OF THE INVENTION

The present invention relates to a liquid motion lamp comprising a container containing a contained liquid material, which at least at an operative temperature is liquid, and a light source comprising at least one light emitting diode.

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BACKGROUND OF THE INVENTION

A liquid motion lamp comprising light emitting diodes for providing the light to be emitted by the lamp is known from US 2008/0239705 A1.

Light emitting diodes will in the following i.a. be referred to as LEDs.

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Generally as used herein a liquid motion lamp is defined as a lamp comprising a light source and a container containing a liquid, the light source illuminating the liquid, said container having transparent or at least translucent side walls allowing an observer to watch motions of the liquid due to convection, when the lamp is turned on for the observer to have an aesthetic experience.

15

Common embodiments of a liquid motion lamp comprise a container containing two liquids one of which provides a body of a primary liquid substantially filling the container the second liquid being provided as oozing blobs, goo, liquid globules, etc. drifting around in the body of the primary liquid when the lamp is turned on. A heat source is provided at the bottom of the container, and usually the second liquid features different heat expanding properties than the first liquid. Thereby the blobs or globules of the second liquid raises through the first liquid when heated at the bottom of the container by the heat source, and when the second liquid subsequently is cooled at a higher level in the container the blobs or globules of the second liquid sink towards the bottom. The first and the second liquids are immiscible and the body of the primary liquid and the blobs or globules of the second liquid feature different optical properties and thus the blobs or globules of the second liquid drifting around in the body of the first liquid are visible and provide aesthetic effects such as a pleasant view. Generally for known liquid motion lamps the light source is provided below the container.

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25

The liquid motion lamp according to US 2008/0239705 A1 comprises a lighting device comprising light emitting diodes (LEDs) positioned at a distance below the container and emitting only a low level of heat. To provide a heat source for driving the motion of the second liquid inside the container a separate heating element is provided.

5 However though emitting only a low level of heat, especially as compared with an incandescent lamp, the light emitting diodes, especially high power light emitting diodes, still need to have heat drained.

Other liquid motion lamps are known from e.g. US-A-3 387 396, US-B-6 746 131 and US-B-7 478 914.

10

SUMMARY OF THE INVENTION

It is an object of the present invention to overcome the above problem, and to provide a liquid motion lamp comprising a light emitting diode light source with provisions for cooling the light emitting diode or diodes.

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According to a first aspect of the invention, this and other objects are achieved in that at least a light emitting part of the light emitting diode is positioned in the container to be in heat conductive connection with the contained liquid material. Hereby is obtained that heat from the light emitting diode is effectively transferred to the contained liquid material by heat conduction to be carried away by convection of the contained liquid material.

20

It is noted that generally heat is transferred in three different ways, namely by (electromagnetic) radiation, by convection of a fluid material, and by conduction (through a material). The invention utilises the latter to transfer heat from the LED to the contained liquid material. Once the heat has entered the liquid material the heat is carried away from the LED by convection of the liquid.

25

In an embodiment particles of a contained phosphor material are suspended in the contained liquid material. Hereby is obtained that light emitted from the LED will be converted to different wavelengths as it is well known in the art to provide light of an intended color distribution.

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In an embodiment the contained phosphor material has a non homogeneous distribution in the container whereby the contained phosphor material will support the visibility of the movement of the contained liquid material in the container thereby supporting the provision of aesthetic effects. The non homogeneous distribution of the contained phosphor material may be established by providing particles or agglomerated particles of different sizes or size distributions extending from very small particles that will

provide a uniform look to the respective liquid material to coarse particles or agglomerates of particles, e.g. of a diameter of more than 0.5 mm, that will be individually visible as they float around in the container.

5 In an embodiment the contained liquid material comprises at least a first and a second liquid material, said first and second liquid materials being immiscible. This supports the known aesthetic effects discussed above.

10 In an embodiment the contained phosphor material comprises particles of a first phosphor material suspended in the first liquid material, and particles of a second phosphor material suspended in the second liquid material. This supports the known aesthetic effects discussed above. The first and the second liquid material being immiscible the phosphor materials suspended in the respective liquid materials will not mix.

It should be noted that generally a phosphor material or a phosphor, is a substance that exhibits the phenomenon of luminescence.

15 In one embodiment the first phosphor material and the second phosphor material are identical.

20 In another embodiment the first phosphor material and the second phosphor material are different in terms of at least one parameter selected from a group comprising: composition, concentration, and particle size distribution. Thus the composition of the first and the second phosphor material may be different by being or comprising different phosphors, by being different blends of phosphors comprising different phosphors or comprising similar phosphors in different mutual relationship of concentrations, etc. The concentration of the respective phosphor materials in the first and the second liquid material may be different, and the phosphor materials in the respective liquid materials may comprise particles or agglomerated particles of different sizes or size distributions extending from very
25 small particles that will provide a uniform look to the respective liquid material to coarse particles that will be individually visible as they float around in the container. This provides for creating different aesthetic effects.

30 In an embodiment the container has an elongate upright configuration, in an operative position, with a bottom and a top, the at least one light emitting diode being positioned at the bottom to be in physical contact with the contained liquid material. This facilitates the conduction of heat from the LED to the contained liquid material.

In another embodiment the container has an elongate upright configuration, in an operative position, with a bottom and a top, the at least one light emitting diode being positioned at the bottom, a layer of solid material isolating the light emitting diode from

physical contact with the contained liquid material, said layer providing for conduction of heat between the light emitting diode and the contained liquid material. This may facilitate isolating the contained liquid material from the surroundings. The solid material may comprise a silicone material.

5 In an embodiment the container is moisture proof sealed.

The light emitting diode being positioned at the bottom should be construed as the light emitting diode being positioned in the lower half of the container.

In an embodiment the light emitting diode is supported by a supporting structure raised from the bottom. Hereby a different distribution of the light emitted is
10 obtained compared to an embodiment in which the light emitting diode is positioned e.g. flat on the bottom.

In an embodiment a hollow space accessible from a surrounding of the container and isolated from the contained liquid material is provided internally in the liquid motion lamp. Hereby is obtained a possibility of placing different items internally of the
15 liquid motion lamp in the hollow space to provide additional aesthetic effects.

The contained liquid material may comprise a number of liquid components selected from a group comprising oils, waxes, paraffin, and chlorinated paraffin. Such liquid components are known in the art of liquid motion lamps.

In an embodiment wherein the contained liquid material comprises a liquid
20 component selected from a group comprising paraffin and chlorinated paraffin, the container comprises a binder to prevent the paraffin or chlorinated paraffin from separating.

The contained phosphor material may comprise at least one phosphor component selected from a group comprising organic phosphors, inorganic yellow-green phosphors, and reddish inorganic phosphors. Such inorganic yellow-green phosphors may be
25 selected from a group comprising YAG and Luag SSONe, and the reddish inorganic phosphors may be selected from a group comprising ECAS101, ECAS102, and BSSNe. Such phosphors are known in the art of LED lighting.

In an embodiment the container contains a surfactant for reducing surface tension of the contained liquid material. This facilitates formation of large blobs of the
30 second liquid material, thereby providing an aesthetic effect.

It is noted that the invention relates to all possible combinations of features recited in the claims.

Nothing according to the invention shall exclude use of such features which are known from the art of liquid motion lamps, e.g. the provision of an additional heating

element in case the heat provided by the LED or LEDs is not sufficient to provide the pursued aesthetic effect, and the provision of a temperature control system.

BRIEF DESCRIPTION OF THE DRAWINGS

5 This and other aspects of the present invention will now be described in more detail, with reference to the appended schematic drawings showing embodiments of the invention. In the drawings

Fig. 1 shows a vertical section of an embodiment of a liquid motion lamp;

10 Fig. 2 shows a vertical section of a second embodiment of a liquid motion lamp;

Fig. 3 shows a vertical section of a detail of a variant of a liquid motion lamp;

and

Figs. 4 to 7 illustrate vertical sections of different embodiments of the liquid motion lamp.

15

DETAILED DESCRIPTION

In the description of the different embodiments similar elements are referred to by similar reference numerals.

20 Figs. 1 and 2 show a liquid motion lamp in an upright operative position, said lamp comprising a container 1 with a bottom 3, a top 5 and a transparent side wall 7. The side wall 7 may e.g. have a circular horizontal cross section. In the shown embodiments the top 5 merges with the side wall 7.

25 At the bottom 3 light emitting diodes (LEDs) 9 are provided as a light source of the lamp, light emitting parts 11 of the LEDs 9 facing upwards. The LEDs 9 may e.g. be of InGaN-type providing light of Royal Blue color.

30 In the embodiment shown in Fig. 1 the container 1 is filled with a contained liquid material 13 comprising a first liquid material 13a provided as a body substantially filling the container 1 and a second liquid material 13b provided as oozing blobs, goo, or liquid globules in the body provided by the first liquid material 13a. The actual materials of the first liquid material 13a and the second liquid material 13b are chosen so that the first liquid material 13a and the second liquid material 13b are immiscible. Thereby the second liquid material remains as blobs etc. in body of the first liquid material 13a as it is generally known in the art of liquid motion lamps, cf. e.g. the prior art documents mentioned above. The materials of the first and the second liquid materials may be chosen from a group

comprising oils, waxes, paraffin, and chlorinated paraffin. When paraffin or chlorinated paraffin is used a binder may be added to prevent the paraffin or chlorinated paraffin from separating. Such measure is per se known in the art. Further the container may contain a surfactant for reducing surface tension of the liquid materials, thereby allowing separate
5 blobs or globules of the second liquid material to merge into larger blobs.

Further in the embodiment shown in Fig. 1 particles of phosphor material are suspended in the first and the second liquid material 13a, 13b, respectively, as indicated by dots 15 in Fig. 1. A great number of variants are envisaged in respect of composition, concentration, size distribution, etc. of the phosphor material particles.

10 The LED's 9 illuminate the contained liquid material 13 and the phosphor material 15 convert the light of the LED's 9 as it is generally known in the art of LED lighting.

The phosphor material in either liquid material may comprise a single phosphor or a mixture of more phosphors. If the phosphor material in a liquid material is a
15 mixture of more phosphors the phosphor material may comprise separate sets of particles of the different phosphors or the particles of phosphor material may comprise agglomerates of smaller particles of different phosphors. The phosphor materials suspended in the different liquid materials may be identical, whereby other features will provide for optically distinguishing the different liquid materials, such as interfaces therebetween, reduced
20 transparency of the second liquid material, etc., to provide an intended aesthetic experience for an observer.

Alternatively the phosphor materials suspended in the two liquid materials are different in terms of composition, concentration and/or size distribution, etc. to provide for the phosphor material to support the optical distinguishing of the different liquid materials.

25 The phosphor materials being different in the different liquid materials entails that the distribution of the contained phosphor material in the container is non homogeneous.

A number of different phosphors are known in the art and the phosphor materials may e.g. be chosen from group comprising organic phosphors, inorganic yellow-green phosphors, i.e. phosphors emitting light in the yellow-green range, such as e.g. YAG and Luag SSONE, and reddish inorganic phosphors, i.e. phosphors emitting reddish light,
30 such as e.g. ECAS101, ECAS102, and BSSNe. Thus it is possible to provide for the liquid material to display different colors.

The size distribution of the particles of phosphor material may vary from microscopic particles that will give the respective liquid material a uniform diffuse glow

when illuminated by the LED's, to macroscopic particles that will be individually visible. Microscopic particles may have sizes ranging from nano-scale to e.g. 100 μm .

Fig. 2 shows an embodiment in which the contained liquid material 13 is a single liquid material present in the container. In this liquid material 13 a contained phosphor material is suspended. The contained phosphor material comprises macroscopic particles 15a indicated by spots in Fig. 2. The macroscopic particles 15a may e.g. have diameters larger than 0.5 mm. Being concentrated in macroscopic particles, which are individual visible, the distribution of the phosphor material is non homogeneous. Apart from the macroscopic particles the contained phosphor material may comprise microscopic particles 15 indicated by dots as described with reference to Fig. 1.

In the embodiments shown in Figs. 1 and 2 the light emitting parts 11 of the LEDs 9 are in physical contact with the contained liquid material 13. Thereby the light emitting parts 11 of the LEDs 9 are in heat conductive connection with contained liquid material 13, which thus provides for cooling the LED's 9.

Fig. 3 shows a different embodiment in which a thin layer 17 of solid material, such as a sheet of silicone material, is isolating the LED's 9 from physical contact with the contained liquid material 13. In this embodiment the light emitting parts 11 of the LEDs 9 are in heat conductive connection with the contained liquid material 13, the layer 17 of solid material conducting heat from the LED's 9 to the contained liquid material 13, which thereby provides for cooling the LED's 9. The layer 17 of e.g. silicone material facilitates the provision of a sealed, especially moisture proof sealed container, which is beneficial if the phosphor material used is degradable by moisture.

In use heat from the LED's 9 will provoke convectional movements in the contained liquid material 13, which consequently will cool the LED's 9 and carry the heat to the top 5 and side wall 7 of the container 1 from where it is transmitted to the surroundings. The convectional movements will be visible to an observer due to the differences of more liquid materials present in the container 1 and/or the non homogeneous distribution of a contained phosphor material, thereby providing an aesthetic experience for the observer.

The first and second liquid material 13a, 13b and the phosphor material 15 may be chosen to have similar densities to provide for the particles of phosphor material 15 to float in the liquid material 13a, 13b. However the convectional movement of the first and second liquid material 13a, 13b will provide for stirring up the particles of phosphor material 15 facilitating their suspension in the first and second liquid material 13a, 13b. Particles of phosphor material, especially macroscopic particles of phosphor material descending through

the respective liquid material after having been stirred up by convectional movement may provide an additional aesthetic effect.

Figs. 4 to 7 illustrate a number of different embodiments of the liquid motion lamp of the invention. The liquid motion lamps shown in Figs. 4 to 7 are all shown to contain a liquid material similar to the liquid material contained in the embodiment shown in Fig. 2. However it should be understood that Figs. 4 to 7 show different embodiments of the parts of the liquid motion lamp enclosing the contained liquid material, which might as well be similar to the liquid material contained in the embodiment shown in Fig. 1. Thus in all of the embodiments shown in Figs. 4 to 7 the liquid motion lamp has a contained liquid material containing a phosphor material comprising microscopic particles and macroscopic particles.

Whereas in Figs. 1 and 2 the LEDs 9 are placed on the bottom 3 in the embodiment shown in Fig. 4 the LED's 9 are placed on a supporting structure 19 extending from the bottom 3 towards the center of the container 1 the light emitting parts 11 of the LEDs 9 facing away from the supporting structure 19. This provides for a different distribution of the light emitted by the LEDs 9 compared to the embodiments of Figs. 1 and 2.

In the embodiment shown in Fig. 5 the LEDs 9 are placed on the bottom 3 but the side wall 7a is curved to provide a decorative overall shape of the liquid motion lamp.

In the embodiment shown in Fig. 6 an annular supporting structure 21 is extending along the inner surface of the side wall 7. The LED's 9 are placed on the supporting structure 21 and the light emitting parts 11 of the LEDs 9 are facing towards the central parts of the container 1. This provides for yet a different distribution of the light emitted by the LEDs 9 compared to the embodiments of Figs. 1, 2 and 4.

In the embodiment shown in Fig 7 the LED's 9 are placed on the bottom 3a the light emitting parts 11 facing upwards like in the embodiments shown in Figs. 1, 2 and 5 but the central part of the bottom 3a is removed and a transparent inner side wall 23 raises from the bottom 3a in parallel with the (outer) side wall 7 to merge with a top 25 thereby providing a U-shaped cross section of the container 1a. Hereby a hollow space 27 is provided internally in the liquid motion lamp or in the container 1a, in which hollow space 27 e.g. different items may be placed for decorative purpose. The hollow space 27 is accessible from the outside of the container 1a and it is isolated from the contained liquid material 13.

Like the embodiments shown in Figs. 1 and 2 the embodiments shown in Figs. 4 to 7 may have circular horizontal cross sections of their side walls and bottoms but different

shaped cross sections are possible as well. Especially the embodiment shown in 7 may be shaped as a tunnel possibly open at both ends and having the U-shaped cross section shown in Fig. 7 perpendicular to a longitudinal direction of the tunnel shape.

The person skilled in the art realizes that the present invention by no means is limited to the preferred embodiments described above. On the contrary, many modifications and variations are possible within the scope of the appended claims. For example the shape of the container may be varied, the top may be an independent member connected to the side wall, etc. The side wall may be translucent rather than transparent and the top may be transparent or translucent depending on aesthetic considerations. Other types of LEDs, other types of liquid material and other types of phosphor material than the types specifically mentioned may be used.

CLAIMS:

1. A liquid motion lamp comprising a container (1) containing a contained liquid material (13), which at least at an operative temperature is liquid, and a light source comprising at least one light emitting diode (9), characterized in that at least a light emitting part (11) of the light emitting diode (9) is positioned in the container (1) to be in heat
5 conductive connection with the contained liquid material (13).

2. A liquid motion lamp according to claim 1, characterized in that particles of a contained phosphor material (15) are suspended in the contained liquid material (13).

10

3. A liquid motion lamp according to claim 2, characterized in that the contained phosphor material (15) has a non homogeneous distribution in the container (1).

4. A liquid motion lamp according to any of the claims 1 to 3, characterized
15 in that contained liquid material (13) comprises at least a first and a second liquid material (13a, 13b), said first and second liquid materials (13a, 13b) being immiscible.

5. A liquid motion lamp according to claim 2 and 3 or claim 2 and 4, characterized
20 in that the contained phosphor material (15) comprises particles of a first phosphor material suspended in the first liquid material (13a), and particles of a second phosphor material suspended in the second liquid material (13b).

6. A liquid motion lamp according to claim 5, characterized in that the first phosphor material and the second phosphor material are identical.

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7. A liquid motion lamp according to claim 5, characterized in that the first phosphor material and the second phosphor material are different in terms of at least one parameter selected from a group comprising: composition, concentration, and particle size distribution.

8. A liquid motion lamp according to any of claims 1 to 7, characterized in that the container (1) has an elongate upright configuration, in an operative position, with a bottom (3) and a top (5), the light emitting diode (9) being positioned at the bottom (3) to be in physical contact with the contained liquid material (13).

9. A liquid motion lamp according to any of claims 1 to 7, characterized in that the container (1) has an elongate upright configuration, in an operative position, with a bottom (3) and a top (5), the light emitting diode (9) being positioned at the bottom (3), a layer (17) of solid material isolating the light emitting diode (9) from physical contact with the contained liquid material (13), said layer (17) providing for conduction of heat between the light emitting diode (9) and the contained liquid material (13).

10. A liquid motion lamp according to any of the preceding claims, characterized in that the light emitting diode (9) is supported by a supporting structure (19; 21) raised from the bottom (3).

11. A liquid motion lamp according to any of the preceding claims, characterized in that a hollow space (27) accessible from a surrounding of the container (1a) and isolated from the contained liquid material (13) is provided internally in the liquid motion lamp.

12. A liquid motion lamp according to any of the preceding claims, characterized in that contained liquid material (13) comprises a number of liquid components selected from a group comprising oils, waxes, paraffin, and chlorinated paraffin.

13. A liquid motion lamp according to claim 12, wherein the contained liquid material (13) comprises a liquid component selected from a group comprising paraffin and chlorinated paraffin, characterized by comprising a binder to prevent the paraffin or chlorinated paraffin from separating.

14. A liquid motion lamp according to any of the preceding claims, characterized in that the contained phosphor material (15) comprises at least one phosphor

component selected from a group comprising organic phosphors, inorganic yellow-green phosphors, and reddish inorganic phosphors.

15. A liquid motion lamp according to claim 14, characterized in that the
5 inorganic yellow-green phosphors are selected from a group comprising YAG and Luag
SSONE, and the reddish inorganic phosphors are selected from a group comprising
ECAS101, ECAS102, and BSSNe.

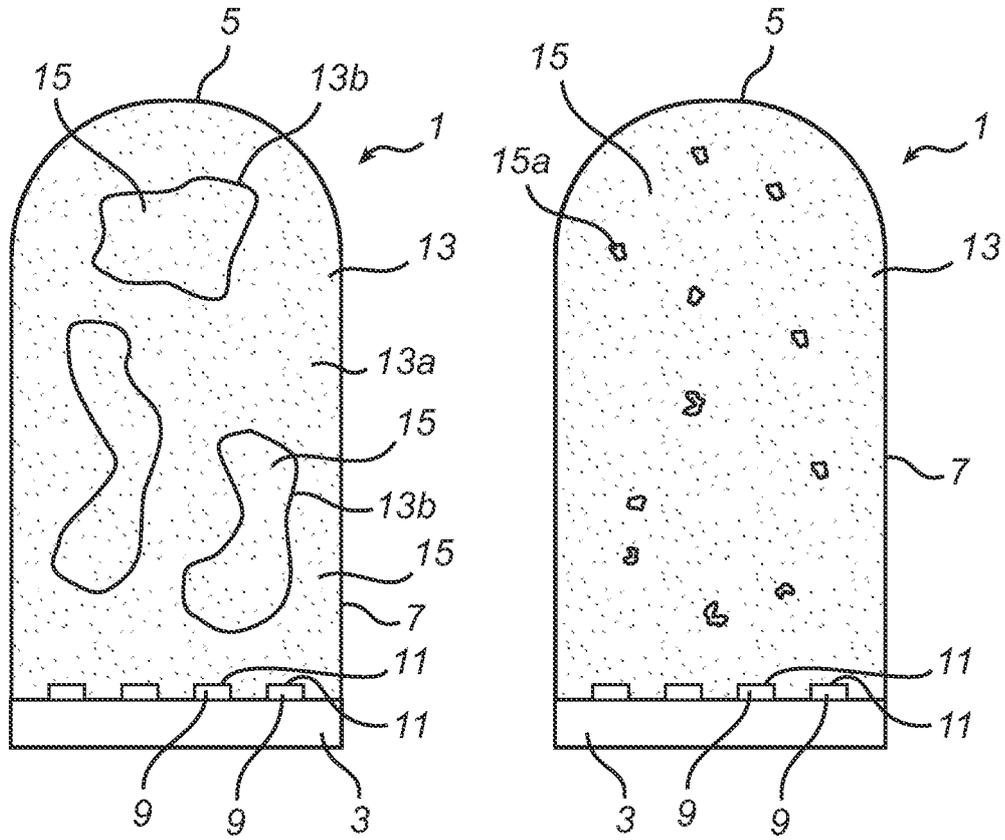


Fig. 1

Fig. 2

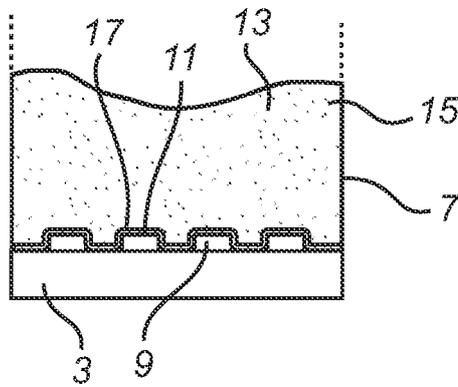


Fig. 3

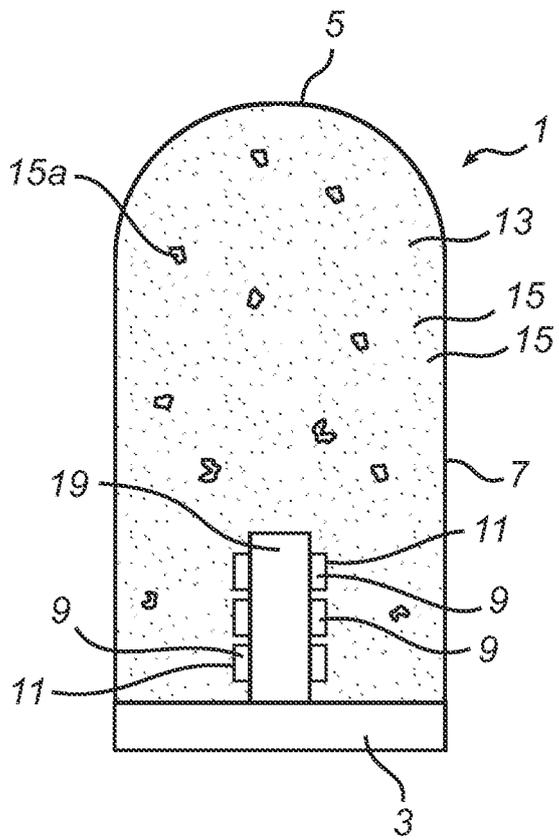


Fig. 4

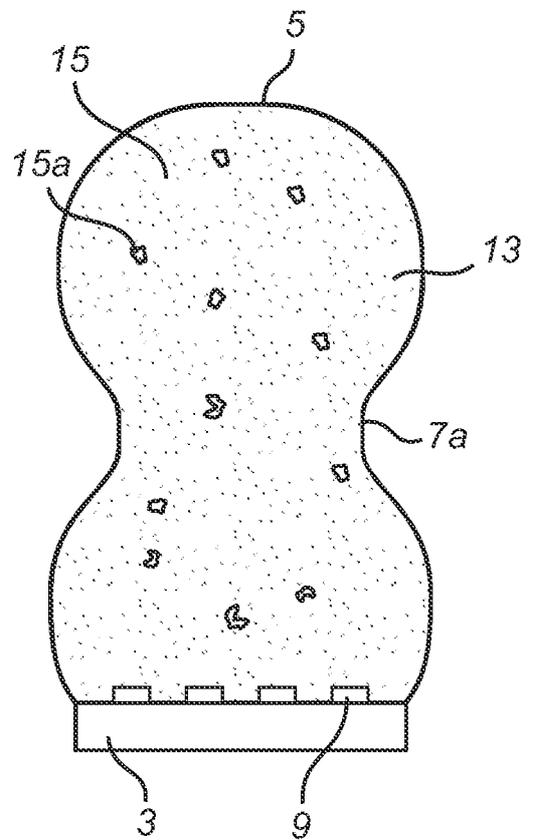


Fig. 5

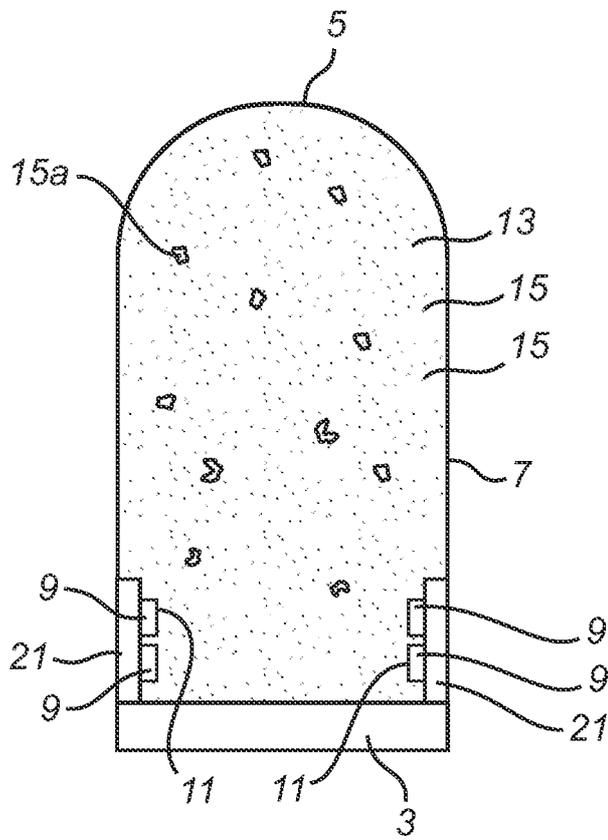


Fig. 6

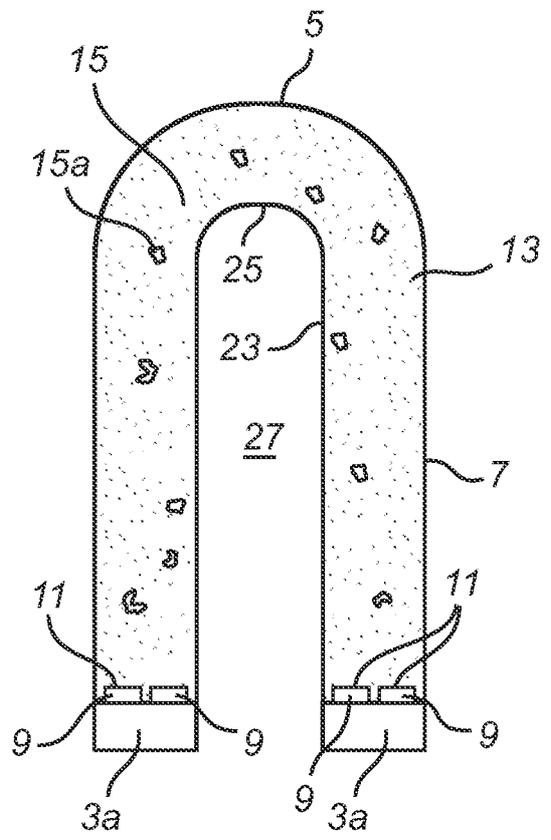


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/051820

A. CLASSIFICATION OF SUBJECT MATTER
INV. F21S10
ADD. F21Y101/02 F21V9/16

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)
F21V F21S F21Y

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)
EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	figures 4, 5 paragraphs [0024] , [0025] -----	4-6,9 , II- 13
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X	Wo 2010/056324 AI (NEOS INTERNATIONAL LLC [US]) 20 May 2010 (2010-05-20) figure 14 page 9, line 14 - line 19 page 21, line 13 - line 24 ----- -/- .	1,2, 10, 14, 15

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

* Special categories of cited documents :

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search 13 June 2013	Date of mailing of the international search report 20/06/2013
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Sacepe, Ni col as
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INTERNATIONAL SEARCH REPORT

 International application No
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INTERNATIONAL SEARCH REPORT

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