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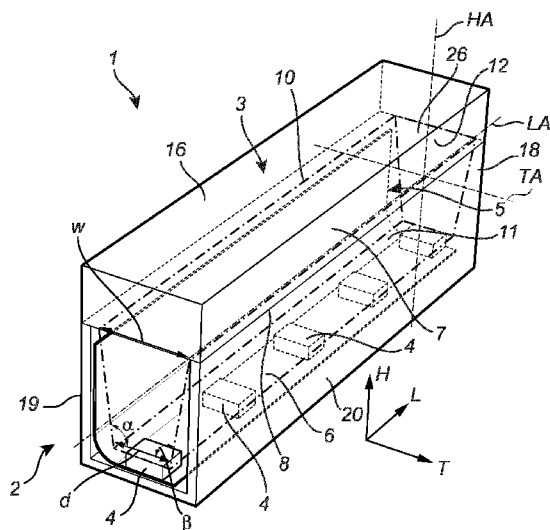


Fig. 1

(57) Abstract: A light emitting device (1) comprising a flexible reflective housing (2) extending in parallel with a longitudinal axis (LA) and comprising an upper end (8) and a bottom wall (20) spaced apart in a height direction (H), a flexible translucent element (3) provided at the upper end (8) of the flexible reflective housing (2) and extending in parallel with the longitudinal axis (LA), a plurality of LEDs (4) adapted for, in operation, emitting LED light (9) in a main direction of emission (M), a flexible substrate (5) comprising a first leg (6) and a second leg (7), the plurality of LEDs (4) being arranged on the first leg (6), the flexible substrate (5) being arranged in the flexible reflective housing (2) in such a way that it extends in parallel with the longitudinal axis (LA), and that the main direction of emission (M) of the plurality of LEDs (4) extend in the height direction (H), and a flexible light guiding element (10) extending in parallel with the longitudinal axis (LA) and comprising a light entry surface (11), a light exit surface (12), a first wall (13), and a second wall (14), the first wall (13) and the second wall (14) extending between the light entry surface (11) and the light exit surface (12), the flexible light guiding element (10) being arranged between the plurality of LEDs (4) and the flexible translucent element (3) and configured to guide the LED light (9) from the LEDs directly towards the flexible translucent element (3), the first leg (6) of the flexible substrate (5) comprising a plurality of leg sections (61-64), and neighboring leg sections of the plurality of leg sections (61-64) being movable with respect to one another.

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A light emitting device

FIELD OF THE INVENTION

The invention relates to light emitting device of the type comprising a longitudinal direction, L, a longitudinal axis, LA, extending in the longitudinal direction, a transversal direction, T, a transversal axis, TA, extending in the transversal direction, a height direction, H, being perpendicular to both the longitudinal direction and the transversal direction and a height axis, HA extending in the height direction, a flexible reflective housing extending in parallel with the longitudinal axis and comprising an upper end and a bottom wall spaced apart in the height direction, a flexible translucent element provided at or connected to the upper end of the flexible reflective housing and extending in parallel with the longitudinal axis, and a plurality of LEDs adapted for, in operation, emitting LED light in a main direction of emission, M.

BACKGROUND OF THE INVENTION

Generally, LED strips are basically composed of a flexible printed circuit board (PCB) containing cool white (CW), warm white (WW) and red-green-blue (RGB) LEDs. In addition to the LEDs, electronic components (such as integrated circuits and resistors) are also connected to the PCB. The LED strips are able to generate a color gradient in the length direction of the strip. The PCB is housed in a flexible silicone tube with a reflective part and a translucent (light scattering) part. The silicone tube is in general produced by extrusion. Extrusion technology allows to combine multiple different materials into a single extrusion run. In the case of flexible LED strips, the extrusion material is often silicone containing light scattering inorganic particles (TiO_2 , SiO_2) to fine-tune the required optical properties.

US 10,775,005 B2 discloses a light emitting device comprising a longitudinal direction, a longitudinal axis extending in the longitudinal direction, a transversal direction, a transversal axis extending in the transversal direction, a height direction being perpendicular to both the longitudinal direction and the transversal direction and a height axis extending in the height direction, a sleeve extending in parallel with the longitudinal axis and comprising a first part made of a transparent or translucent material, a second part made of a diffuse

material, and a channel extending in parallel with the longitudinal axis and being provided in the first part of the sleeve, a reflector comprising a cavity extending in parallel with the longitudinal axis, a substrate, and a plurality of LEDs adapted for, in operation, emitting light, and being arranged on the substrate in such a way as to extend in a direction parallel with the longitudinal axis of the light emitting device, the substrate with the plurality of LEDs mounted thereon being arranged in the channel of the sleeve. The cavity is adapted for receiving any one of the first part and the second part of the sleeve, and the sleeve being adapted for being mounted in the reflector by inserting any one of the first part and the second part into the cavity such as to obtain either a spotty lighting effect or a diffuse lighting effect.

In all light strip products for outdoor use, a high “in-plane” flexibility is required. Because waterproof light strips are frequently used in outdoor situations, it is required that these strips are able to meander through your garden (as an example). To achieve this flexibility, the PCB is always placed in a way as described in, for instance, the above-mentioned US 10,775,005 B2. That is, the optical axis of the LEDs is perpendicular to the optical axis of the LED strip. The result is that the optical efficiency (lm/lm) is relatively low. The silicone tube acts a mixing box for the light emitted by the various LEDs. However, the walls of the mixing box have a rather low average reflectance. This is because a large part of the cavity is determined by the PCB material plus, where applicable the electronic components, which has a relatively low reflectance. Consequently, the optical efficiency of the whole construction is relatively low (typically 30-40%).

CN 103712108A discloses a high-transparency LED lamp tube based on refraction. The LED lamp tube comprises a core wire and an overall wrapping layer covering the core wire. Refraction air gaps are formed in the LED lamp tube in the top direction of the LED lamp. An L-shaped circuit board is adopted in the bendable lamp tube.

Improving the efficacy (lm/W) of LED strips is important for obtaining a desired energy label, such as the energy label established by EU Directive 92/75/EF, for the resulting lighting device. The efficacy of the product is directly related to the energy label. For instance, label A states that the efficacy of the lighting product is ≥ 210 lm/W. A high optical efficiency contributes to a higher product efficacy and a better energy label of the product.

It is therefore desired to provide a light emitting device, and especially LED strip, which is bendable in two directions in the same plane, and which has an improved optical efficiency.

SUMMARY OF THE INVENTION

It is an object of the present invention to overcome this problem, and to provide a light emitting device, and especially LED strip, which is bendable in two directions in the same plane, and which has an improved optical efficiency.

According to a first aspect of the invention, this and other objects are achieved by means of a light emitting device comprising a longitudinal direction, L, a longitudinal axis, LA, extending in the longitudinal direction, a transversal direction, T, a transversal axis, TA, extending in the transversal direction, a height direction, H, being perpendicular to both the longitudinal direction and the transversal direction and a height axis, HA extending in the height direction, a flexible reflective housing extending in parallel with the longitudinal axis, LA, and comprising an upper end and a bottom wall spaced apart in the height direction, H, a flexible translucent element provided at or connected to the upper end of the flexible reflective housing and extending in parallel with the longitudinal axis, LA, a plurality of LEDs adapted for, in operation, emitting LED light in a main direction of emission, M, a flexible substrate comprising a first leg and a second leg, the plurality of LEDs being arranged on the first leg of the substrate, the flexible substrate being arranged in the flexible reflective housing in such a way that the flexible substrate extends in parallel with the longitudinal axis, LA, and that the main direction of emission, M, of the plurality of LEDs extend in the height direction, H, and a flexible light guiding element extending in parallel with the longitudinal axis, LA, and comprising a light entry surface, a light exit surface, a first wall, and a second wall, the first wall and the second wall extending between the light entry surface and the light exit surface, the flexible light guiding element being arranged between the plurality of LEDs and the flexible translucent element and configured to guide the LED light from the LEDs directly towards the flexible translucent element, where the first leg of the flexible substrate comprises a plurality of leg sections, and where neighboring leg sections of the plurality of leg sections are, or are configured to be, movable with respect to one another.

Thereby, and particularly by providing that the first leg of the flexible substrate comprises a plurality of leg sections, and that neighboring leg sections of the plurality of leg sections are movable with respect to one another, a light emitting device is provided which is bendable in two directions in the same plane, particularly the plane in which the first leg of the flexible substrate extends.

Furthermore, and particularly due to the position of the LEDs on the first leg of the flexible substrate in such a way that the main direction of emission, M , of the plurality of LEDs extend in the height direction, H , such a light emitting device has an improved optical efficiency. Also, providing a flexible light guiding element as described above and configured to guide the LED light from the LEDs directly towards the flexible translucent element, provides for an efficient way to guide the light directly from the LED source to the exit surface without the light interacting with the PCB, LED packages or other electronic components, which may otherwise result in optical loss. Therefore, such a light emitting device not only has an improved efficiency, but is also capable of producing a uniform color output and/or a color gradient in the length direction of the light emitting device.

In fact, tests have shown that the optical efficiency of a light emitting device according to the present invention is 70-80 %, while prior art light emitting devices typically have an optical efficiency of 30-40 %.

The light entry surface comprises a first width, d , the light exit surface comprises a second width, w , and the second width, w , may be equal to or larger than the first width, d . The flexible light guiding element has a cross section in the transversal direction, the cross section having a tapered shape, preferably a trapezium shape.

Thereby the optical efficiency of the light emitting device is improved even further by lowering light losses through the walls of the flexible light guiding element.

The second width, w , may be at least 50 % larger than the first width, d . The second width w may at least 66 % larger than the first width, d . The second width w may be at least 75 % larger than the first width, d . The second width w may be at least 100 % larger than the first width, d .

The light emitting device may comprise a space, the space being delimited by the flexible reflective housing and the first wall.

Thereby, a space is provided between the flexible light guiding element and the flexible reflective housing, the flexible substrate being arranged in the space. Such a space may save material but may more importantly increase the flexibility of the lighting device and increase the movability of neighboring leg sections of the plurality of leg sections. The space, preferably the space provided between the flexible light guiding element and the second leg of the flexible substrate, may further be used for mounting or arranging further components, such as control electronics or the like.

The first wall may extend in a first angle, α , with respect to the light entry surface, the second wall may extend in a second angle, β , with respect to the light entry

surface, and both the first angle, α , and the second angle, β , may be equal to or larger than 90 degrees.

Thereby the optical efficiency of the light emitting device is improved even further by lowering light losses through the walls of the flexible light guiding element.

5 The first leg of the flexible substrate may extend along the light entry surface, and the second leg of the flexible substrate may extend along one of the first wall and the second wall.

10 The first leg and the second leg of the flexible substrate extend in a third angle, γ , with respect to one another, and the third angle, γ , may be between 85 and 90 degrees, or the third angle, γ , may be 90 degrees.

Thereby, it is ensured that neither the flexible substrate, nor any components mounted on the second leg thereof, interfere with the optical path through the light guiding element, which would otherwise lower the optical efficiency by resulting in optical loss.

15 Neighboring leg sections of the plurality of leg sections of the first leg may be physically disconnected from one another.

Thereby it is ensured that neighboring leg sections of the plurality of leg sections are movable with respect to one another in a particularly simple manner.

Neighboring leg sections of the plurality of leg sections of the first leg may be spaced apart by a gap.

20 Thereby, an improved flexibility is obtained.

The gap may comprise a distance of at least 1 mm.

Thereby, a particularly improved flexibility is obtained.

Each leg section of the plurality of leg sections of the first leg may comprise at least one LED of the plurality of LEDs.

25 Such a position of the LEDs on the first leg of the flexible substrate ensures that the light emitting device has a particularly improved optical efficiency, and also a uniform light output along the longitudinal axis of the light emitting device.

The first wall and the second wall may be straight.

One or both of the first wall and the second wall may be curved.

30 Curved walls have the advantage of providing more available space to install the flexible substrate in the housing.

The flexible translucent element may comprise a cavity, the cavity extending in parallel with the longitudinal axis.

Such a cavity enhances the flexibility of the light emitting device without or with only minimal influence on the optical efficiency.

The flexible translucent element comprises a light exit surface, and the light exit surface may be flat, or the light exit surface may be rounded.

5 Especially when combined with a sleeker flexible light guiding element, a rounded light exit surface of the flexible translucent element has the advantage of providing more space for mounting additional components.

The flexible translucent element comprises a light exit surface, and the light exit surface may be symmetric, or the light exit surface may be asymmetric.

10 A symmetric light exit surface has the advantage of providing a light output with a symmetric intensity profile. An asymmetric light exit surface has the advantage of providing a light output with an asymmetric intensity profile.

The light emitting device may further comprise at least one electronic component, and the at least one electronic component may be attached to the second leg of
15 the substrate.

The at least one electronic component may for instance be a controller for controlling parameters related to the LED light emitted by the plurality of LEDs, an integrated circuit, or a resistor.

20 Thereby, both the functionality and the optical efficiency of the light emitting device is improved. By particularly mounting the at least one electronic component on the second leg of the substrate, it is ensured that the electronic component does not interfere with the optical path from the LEDs to the flexible light guiding element or the optical path through the flexible light guiding element, which would otherwise lower the optical efficiency by resulting in optical loss.

25 The flexible reflective housing may be made of a silicone. The silicone may comprise at least one light scattering element.

The flexible translucent element may be made of a silicone. The silicone may comprise at least one light scattering element.

The flexible light guiding element may made of a transparent silicone.

30 The light scattering element may be light scattering particles or light scattering pigment or a combination thereof. Suitable light scattering particles include inorganic particles such as TiO_2 or SiO_2 .

The invention further relates to a method of manufacturing the light emitting device, comprising extruding the flexible reflective housing, the flexible translucent element, and the flexible light guiding element in a single extrusion process step.

5 The flexible reflective housing, the flexible translucent element, and the flexible light guiding element may be made in a single extrusion process step creating an integrally formed monolithic body.

Thereby, the light emitting device may be manufactured in a particularly simple, efficient and time saving manner, reducing the number of assembly steps and the number of parts. Furthermore the method yields a body with excellent mechanical properties,
10 such as ingress protection and high mechanical reliability.

The light emitting device according to the present invention may be used for outdoor and indoor applications.

The invention further relates to a LED light strip comprising a light emitting device according to the present invention.

15 The invention further relates to a luminaire or a lamp comprising a light emitting device according to the present invention.

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

20 BRIEF DESCRIPTION OF THE DRAWINGS

This and other aspects of the present invention will now be described in more detail, with reference to the appended drawings showing embodiment(s) of the invention.

Fig. 1 shows a perspective schematical view of a light emitting device according to the invention.

25 Fig. 2 shows a cross-sectional side view of a light emitting device according to Fig. 1.

Fig. 3 shows a cross-sectional side view of an exemplary substrate with LEDs of a light emitting device according to the invention.

30 Fig. 4 shows a top view of the substrate with LEDs according to Fig. 3 in a straight condition.

Fig. 5 shows a top view of the substrate with LEDs according to Fig. 3 in a flexed or bent or meandering condition.

Fig. 6 shows a cross-sectional side view of another light emitting device according to the invention.

Fig. 7 shows a cross-sectional side view of another light emitting device according to the invention.

Fig. 8 shows a cross-sectional side view of another light emitting device according to the invention.

5 As illustrated in the figures, the sizes of layers and regions are exaggerated for illustrative purposes and, thus, are provided to illustrate the general structures of embodiments of the present invention. Like reference numerals refer to like elements throughout.

10 DETAILED DESCRIPTION

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which currently preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these
15 embodiments are provided for thoroughness and completeness, and fully convey the scope of the invention to the skilled person.

Fig. 1 shows a perspective schematical view of a light emitting device 1 according to the invention, while Fig. 2 shows a cross-sectional side view of the light emitting device 1. Generally, and irrespective of the embodiment, the light emitting device 1
20 according to the invention comprises a longitudinal direction L a longitudinal axis LA extending in the longitudinal direction L a transversal direction T a transversal axis TA extending in the transversal direction T, a height direction H being perpendicular to both the longitudinal direction L and the transversal direction T, and a height axis HA extending in the height direction H.

25 Generally, and irrespective of the embodiment, the light emitting device 1 according to the invention further comprises a flexible reflective housing 2, a flexible translucent element 3, a plurality of LEDs 4 arranged on a flexible substrate 5, and a flexible light guiding element 10.

The flexible reflective housing 2, the flexible translucent element 3, and the
30 flexible light guiding element 10 all extend in parallel with the longitudinal axis LA.

The flexible reflective housing 2 comprises an upper end 8 and a bottom wall 20. The upper end 8 and the bottom wall 20 are spaced apart in the height direction H. The flexible reflective housing 2 is a flexible element. The flexible reflective housing 2 further comprises side walls 18 and 19. The side walls 18 and 19 extend from the bottom wall in

parallel with the height axis HA to a position being flush with the flexible translucent element 3. The flexible reflective housing 2 is in the embodiment shown U-shaped in cross-section. The flexible reflective housing 2 may be made of a silicone. The flexible reflective housing 2 may further comprise a light scattering element 21, such as light scattering pigment, or light scattering particles, such as TiO_2 or SiO_2 , or a light scattering surface structure. The light scattering element 21 may be provided in one or more of the bottom wall 20 and the respective side walls 18 and 19.

The flexible translucent element 3 is provided at or connected to the upper end 8 of the flexible reflective housing 2. The flexible translucent element 3 comprises a light entry surface 26 and a light exit surface 16. The light exit surface 16 is in the embodiment shown flat. Also, the light exit surface 16 is symmetric around the height axis HA. The flexible translucent element 3 is a flexible element. The flexible translucent element 3 may be made of a silicone. The flexible translucent element 3 may further comprise a light scattering element 22, such as light scattering particles, e.g., TiO_2 or SiO_2 , or light scattering pigment or a light scattering surface structure.

The plurality of LEDs 4 are adapted for, in operation, emitting LED light 9 in a main direction of emission M. The plurality of LEDs 4 are arranged such that the main direction of emission M of the plurality of LEDs 4 extend in the height direction H. The plurality of LEDs 4 may comprise one or more of cool white (CW) LEDs, warm white (WW) LEDs, and red-green-blue (RGB) LEDs.

The flexible substrate 5 comprises a first leg 6 and a second leg 7. The plurality of LEDs 4 are arranged on the first leg 6 of the substrate 5. The flexible substrate 5 is arranged in the flexible reflective housing 2 in such a way that the flexible substrate 5 extends in parallel with the longitudinal axis LA. The flexible substrate 5 is arranged in the flexible reflective housing 2 in such a way that the main direction of emission M of the plurality of LEDs 4 extend in the height direction H. The flexible substrate 5 may be a flexible printed circuit board (PCB). The flexible substrate 5 may comprise electrical circuitry for supplying electrical energy to the plurality of LEDs 4. The flexible substrate 5 is arranged in the flexible reflective housing 2 in such a way that the first leg 6 of the flexible substrate 5 generally extends along the light entry surface 11. The flexible substrate 5 is arranged in the flexible reflective housing 2 in such a way that the second leg 7 of the flexible substrate 5 extends along the second wall 14. Alternatively, the flexible substrate 5 may be arranged in the flexible reflective housing 2 in such a way that the second leg 7 of the flexible substrate 5 may extend along the first wall 13.

Reference is now also made to Figs. 3-5 showing an exemplary substrate with LEDs of a light emitting device according to the invention in a cross-sectional view, a top view of a straight condition of the substrate, and a top view of a flexed or bent or meandering condition of the substrate, respectively. As is shown specifically on Figs. 1 and 3, the first leg 6 and the second leg 7 of the flexible substrate 5 extend in a third angle, γ , with respect to one another. The third angle, γ , may be between 85 and 90 degrees. Particularly, the third angle, γ , may be 90 degrees.

As is shown in Figs. 4 and 5, the first leg 6 of the flexible substrate 5 further comprises a plurality of leg sections 61-64. Each leg section 61-64 of the plurality of leg sections 61-64 may comprise at least one LED 4 of the plurality of LEDs 4. Neighboring leg sections, for instance leg sections 61 and 62, of the plurality of leg sections 61-64 are movable, or are configured to be movable, with respect to one another. This may be achieved in a number of different ways. For instance, neighboring leg sections of the plurality of leg sections 61-64 may be physically disconnected from one another, for instance by means of a slit, an incision, a cut or a slot. Alternatively, and as illustrated in Figs. 4 and 5, neighboring leg sections 61-64 may be spaced apart by a gap 611-641. The gap 611-641 may comprise a distance D (cf. Fig. 4) measured as the shortest distance between two neighboring leg sections 61-64 at the transition to the second leg 7. The distance D may for instance be at least 1 mm or at least 0.5 mm. The distance D may be in the range of 1 mm to 10 mm, preferably in the range of 0.5 mm to 5 mm. In principle, it is also feasible that neighboring leg sections 61-64 may be connected to one another by means of a flexible material, particularly a material being more flexible than that of the leg sections 61-64, such as to form a continuous first leg section 6.

Referring particularly to Fig. 5, it is noted that when the light emitting device 1 according to the invention is bent or curved or meandering, the flexible substrate 5 is bent in such a way, that only the second leg 7 follows the bent or curved or meandering shape, while the first leg sections 61-64 of the first leg 6 remain straight but are moved with respect to each other, in the embodiment shown by a modification of the size or distance of the respective gaps 611-641 caused by the formation of the chosen bent or curved or meandering shape, to enable the second leg 7 to follow the curvature.

In the embodiment shown in Figs. 4 and 5, the first leg sections 61-64 of the first leg 6 are trapezium shaped. The trapezium shape may be the preferred shape for the leg sections 61-64 since it enables freedom to bend in large angles. Alternatively, the leg sections may also have a rectangular shape, optionally in combination with comprising a distance

which is larger than the width of the leg section or larger than 5 mm or larger than 10 mm. Other feasible shapes of the leg sections 61-64 include for example a rounded shape, a U-shape, a triangular shape, or any combination of any of the shapes mentioned.

Referring again to Figs. 1 and 2, the flexible light guiding element 10 comprises a light entry surface 11, a light exit surface 12, a first wall 13, and a second wall 14. The first wall 13 and the second wall 14 extend between the light entry surface 11 and the light exit surface 12. The flexible light guiding element 10 is arranged between the plurality of LEDs 4 and the flexible translucent element 3. The flexible light guiding element 10 is configured to guide the LED light 9 from the LEDs 4 directly towards the flexible translucent element 3.

The light entry surface 11 comprises a first width d . The light exit surface 12 comprises a second width w . The second width w is equal to or larger than the first width d . In the embodiment shown in Figs. 1 and 2, the second width w is in the order of 1.5 times larger than the first width d . Other percentages are likewise feasible. For instance, the second width w may be at least 1.66 times larger than the first width d . Alternatively, the second width w may be at least two or at least three times larger than the first width d . Alternatively, the second width w may be at least 1.75 times larger than the first width d . The first wall 13 further extends in a first angle, α , with respect to the light entry surface 11. The second wall 14 further extends in a second angle, β , with respect to the light entry surface 11. Both the first angle, α , and the second angle, β , may be equal to or larger than 90 degrees. The flexible light guiding element 10 has a cross section in the transversal direction, the cross section having a tapered shape, preferably a trapezium shape. Such a flexible light guiding element 10 having a tapered or trapezium shaped cross section may create a space 28 being delimited by the flexible reflective housing 2, the light entry surface 11, and at least one of the first wall 13 and the second wall 14.

At least one of the first wall 13 and the second wall 14 may be straight as in the embodiment illustrated. Alternatively, at least one of the first wall 13 and the second wall 14 may be curved. The flexible light guiding element 10 may be made of a transparent silicone.

The flexible reflective housing 2, the flexible translucent element 3, and the flexible light guiding element 10 may all be made of the same material, such as a suitable silicone. The flexible reflective housing 2, the flexible translucent element 3, and the flexible light guiding element 10 may alternatively be made of two or three different materials, such as different suitable silicones. The flexible reflective housing 2, the flexible translucent

element 3, and the flexible light guiding element 10 may further be made in a single extrusion process step, or in more than one extrusion steps.

Referring now specifically to Fig. 2, the plurality of LEDs 4 emit, in operation, LED light 9 in a main direction of emission M. The LED light 9 is entering the flexible light guiding element 10 at the light entry surface 11. The light entry surface 11 may preferably be arranged as close as possible to the plurality of LEDs 4, but direct contact may have a negative impact on optical performance and/or flexibility. Hence, there may be a separation 27 (i.e. a distance or gap) in between the light entry surface 11 and the plurality of LEDs 4 (i.e. the top surface of the LED). The separation 27 may be in the range of 0.1 mm to 10 mm, preferably in the range of 0.1 mm to 5 mm, such as in the range of 0.1 mm to 1 mm. The flexible reflective housing ensures that any LED light 9, which at first does not enter the flexible light guiding element 10, or which escapes from the flexible light guiding element 10 through one of the walls 13 and 14, is reflected back into the flexible light guiding element 10. As indicated by rays 23, the LED light then travels through the flexible light guiding element 10, leaves the flexible light guiding element 10 at the light exit surface 12 and enters the flexible translucent element 3 at the light entry surface 26. Finally, the light is emitted from light emitting device 1 as light emitting device light 24 or as scattered light emitting device light 25, as the case may be, at the light exit surface 16.

Turning now to Fig. 6, a cross-sectional side view of another light emitting device 100 according to the invention is shown. The light emitting device 100 differs from the light emitting device 1 described above in relation to Figs. 1 and 2 in virtue of the following features.

The flexible translucent element 3 of the light emitting device 100 comprises a cavity 15. The cavity 15 extends in parallel with the longitudinal axis LA. In the embodiment shown, the cavity 15 comprises a rectangular cross-section. The cavity 15 may also comprise another cross-sectional shape.

Turning now to Fig. 7, a cross-sectional side view of another light emitting device 101 according to the invention is shown. The light emitting device 101 differs from the light emitting devices 1 and 100 described above in relation to Figs. 1, 2 and 6 in virtue of the following features.

The light exit surface 16 of the flexible translucent element 3 of the light emitting device 101 is rounded. The light exit surface 16 of the flexible translucent element 3 more particularly comprises a semi-circular shape. Other rounded shapes of the light exit surface 16 of the flexible translucent element 3 are also feasible.

Furthermore, the light emitting device 101 comprises an electronic component 17. One or more electronic components 17 may be provided. The one or more electronic components 17 are attached to or arranged on the second leg 7 of the flexible substrate 5. The one or more electronic components 17 may be arranged in the space 28 created by the tapered shape of the flexible light guiding element 10 and the flexible reflective housing 2. Suitable electronic components 17 include, but are not necessarily limited to, integrated circuits, controllers, and resistors. The controller may be a controller for controlling parameters related to the LED light 9 emitted by the plurality of LEDs 4.

Finally, in the embodiment shown in Figs. 7 and 8, the second width w is in the order of three times larger than the first width d .

Turning now to Fig. 8, a cross-sectional side view of yet another light emitting device 102 according to the invention is shown. The light emitting device 102 differs from the light emitting devices 1, 100 and 101 described above in relation to Figs. 1, 2, 6 and 7 in virtue of the following features.

The light exit surface 16 of the flexible translucent element 3 of the light emitting device 101 is asymmetric. The light exit surface 16 of the flexible translucent element 3 more particularly comprises the shape of a quarter of a circle. Other asymmetric shapes of the light exit surface 16 of the flexible translucent element 3 are also feasible.

Furthermore, the side walls 18 and 19 of the flexible housing 2 are also asymmetric. More particularly, the side walls 18 and 19 of the flexible housing 2 are asymmetric in such a way that both side walls 18 and 19 extend to a position being flush with a respective end of the opposite ends 161 and 162 of the light exit surface 16 of the flexible translucent element 3.

Light emitting devices 1, 100, 101 and 102 according to the invention may be used in luminaires, such as LED light strips, for outdoor and indoor applications. Such LED strips are capable of producing a uniform color output and/or a color gradient in the length direction of the LED strip.

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.

Additionally, variations to the disclosed embodiments can be understood and effected by the skilled person in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a

plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

CLAIMS:

1. A light emitting device comprising:

a longitudinal direction (L), a longitudinal axis (LA) extending in the longitudinal direction, a transversal direction (T), a transversal axis (TA) extending in the transversal direction, a height direction (H) being perpendicular to both the longitudinal direction and the transversal direction and a height axis (HA) extending in the height direction,

a flexible reflective housing (2) extending in parallel with the longitudinal axis and comprising an upper end (8) and a bottom wall (20) spaced apart in the height direction,

a flexible translucent element (3) provided at or connected to the upper end (8) of the flexible reflective housing and extending in parallel with the longitudinal axis,

a plurality of LEDs (4) adapted for, in operation, emitting LED light (9) in a main direction of emission (M),

a flexible substrate (5) comprising a first leg (6) and a second leg (7), the plurality of LEDs being arranged on the first leg of the substrate, the flexible substrate (5) being arranged in the flexible reflective housing (2) in such a way that the flexible substrate (5) extends in parallel with the longitudinal axis, and that the main direction of emission (M) of the plurality of LEDs extend in the height direction (H), and

a flexible light guiding element (10) extending in parallel with the longitudinal axis (LA) and comprising a light entry surface (11), a light exit surface (12), a first wall (13), and a second wall (14), the first wall and the second wall extending between the light entry surface and the light exit surface, the flexible light guiding element (10) being arranged between the plurality of LEDs and the flexible translucent element and configured to guide the LED light (9) from the LEDs directly towards the flexible translucent element (3),

wherein the flexible light guiding element (10) has a cross section in the transversal direction, the cross section having a tapered shape,

wherein the light entry surface (11) comprises a first width d , wherein the light exit surface (12) comprises a second width w , and wherein w is larger than d ,

wherein the first wall (13) extends in a first angle, α , with respect to the light entry surface (11), wherein the second wall (14) extends in a second angle, β , with respect to

the light entry surface (11), the first angle, α , being larger than 90 degrees, the second angle, β , being equal to or larger than 90 degrees, and

wherein the first leg (6) of the flexible substrate comprises a plurality of leg sections (61-64), and wherein neighboring leg sections of the plurality of leg sections (61-64) are movable with respect to one another.

2. A light emitting device according to any one of the above claims, wherein the light entry surface (11) and the plurality of LEDs (4) are spaced apart by a separation (27) in a range of 0.1 to 10 mm.

3. A light emitting device according to any one of the above claims, wherein w is at least 50 % larger than d .

4. A light emitting device according to any one of the above claims, wherein the light emitting device comprises a space (28), the space (28) being delimited by the flexible reflective housing (2) and the first wall (13).

5. A light emitting device according to any one of the above claims, wherein one or more of the following applies:

the first leg (6) of the flexible substrate extends along the light entry surface (11), and the second leg (7) of the flexible substrate extends along one of the first wall (13) and the second wall (14),

the first leg (6) and the second leg (7) of the flexible substrate extends in a third angle, γ , with respect to one another, and wherein third angle, γ , is between 85 and 90 degrees, or wherein the third angle, γ , is 90 degrees.

6. A light emitting device according to any one of the above claims, wherein neighboring leg sections of the plurality of leg sections (61-64) of the first leg (6) are physically disconnected from one another or are spaced apart by a gap (611-641).

7. A light emitting device according to any one of the above claims, wherein neighboring leg sections of the plurality of leg sections (61-64) of the first leg (6) are spaced apart by a gap (611-641), and wherein the gap (611-641) comprises a distance of at least 1 mm.

8. A light emitting device according to any one of the above claims, wherein each leg section of the plurality of leg sections (61-64) of the first leg (6) comprises at least one LED of the plurality of LEDs (4).

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9. A light emitting device according to any one of the above claims, wherein the first wall (13) and the second wall (14) are straight, or wherein the first wall (13) and the second wall (14) are curved.

10. A light emitting device according to any one of the above claims, wherein the flexible translucent element (3) comprises a cavity (15), the cavity extending in parallel with the longitudinal axis.

11. A light emitting device according to any one of the above claims, wherein the flexible translucent element (3) comprises a light exit surface (16), and wherein the light exit surface is flat, or wherein the light exit surface is rounded.

12. A light emitting device according to any one of the above claims, wherein the flexible translucent element (3) comprises a light exit surface (16), and wherein the light exit surface is symmetric, or wherein the light exit surface is asymmetric.

13. A light emitting device according to any one of the above claims, and further comprising at least one electronic component (17), wherein the at least one electronic component is attached to the second leg (7) of the substrate.

14. A method of manufacturing the light emitting device according to any one of the above claims, wherein the method comprises extruding the flexible reflective housing (2), the flexible translucent element (3), and the flexible light guiding element (10) in a single extrusion process step.

15. A luminaire (25) comprising a light emitting device (1) according to any one of claims 1 to 13.

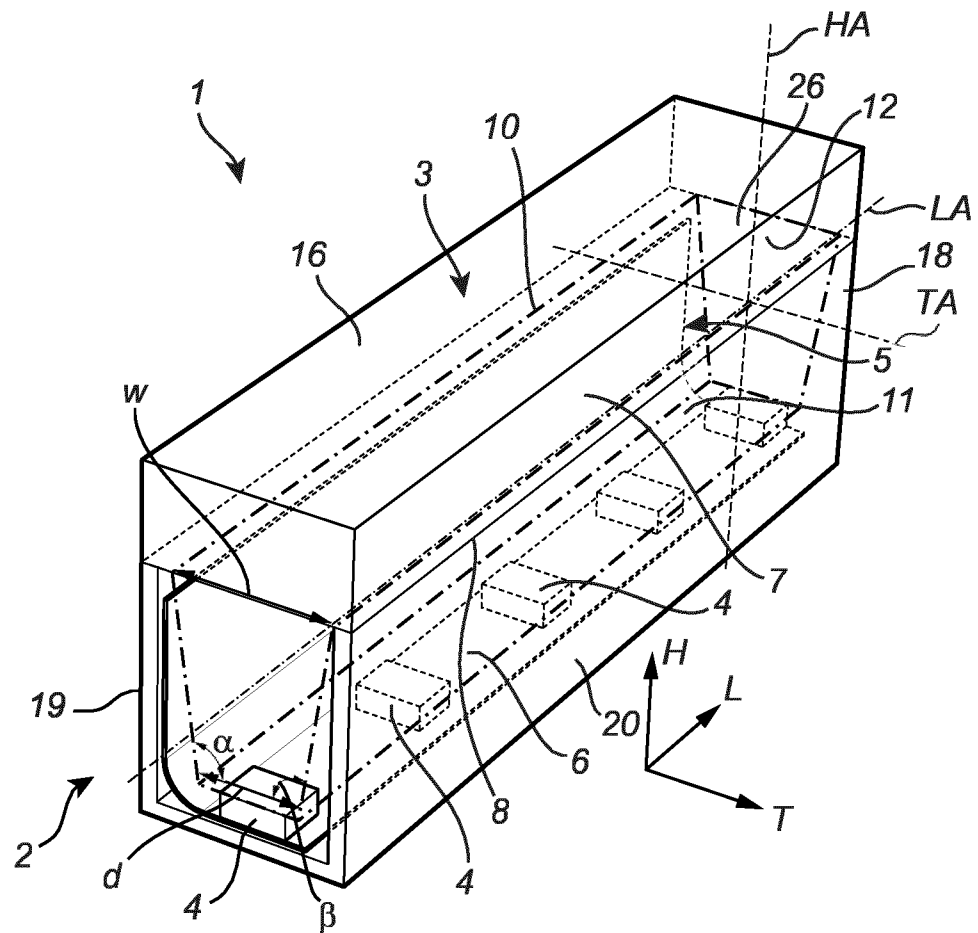


Fig. 1

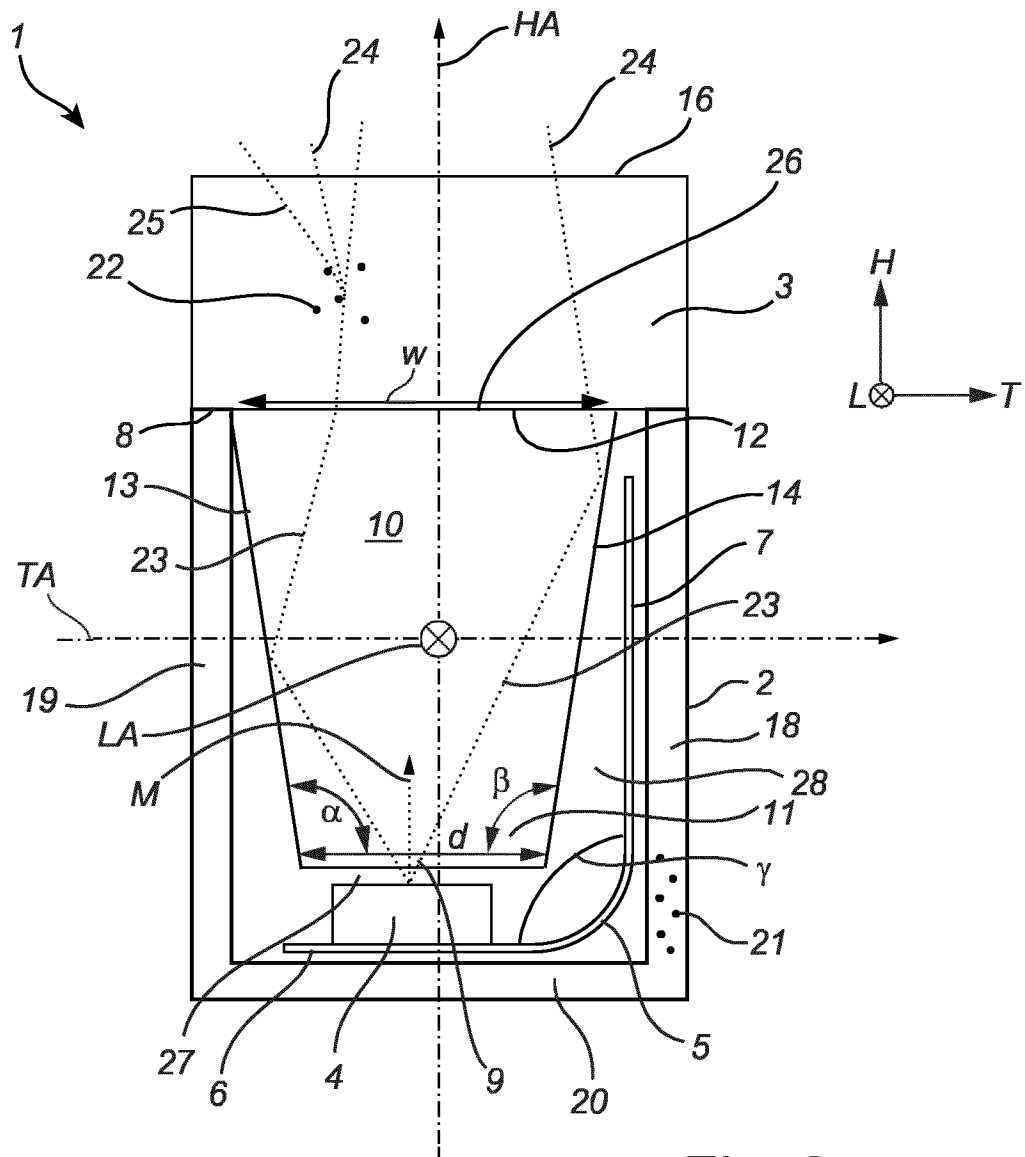


Fig. 2

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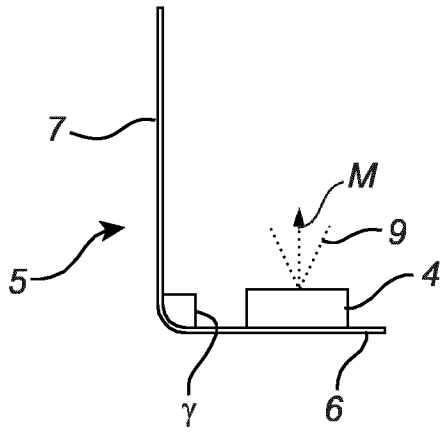


Fig. 3

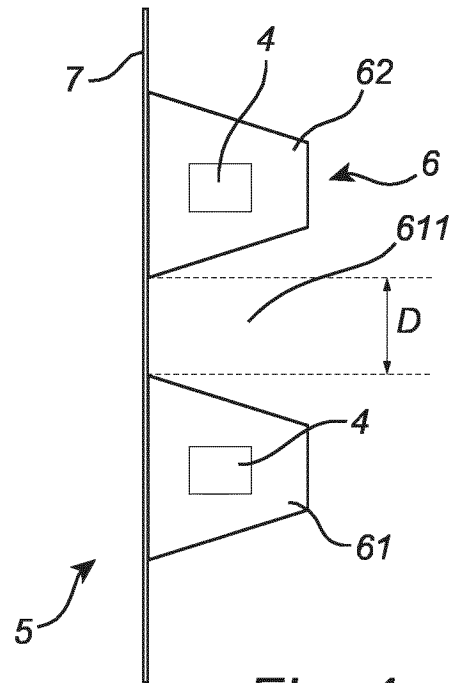


Fig. 4

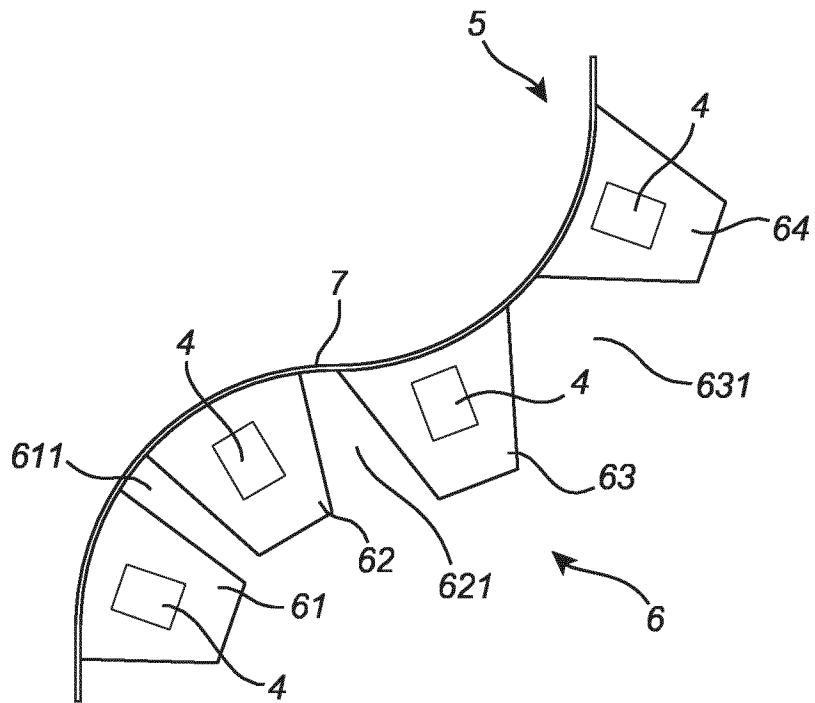


Fig. 5

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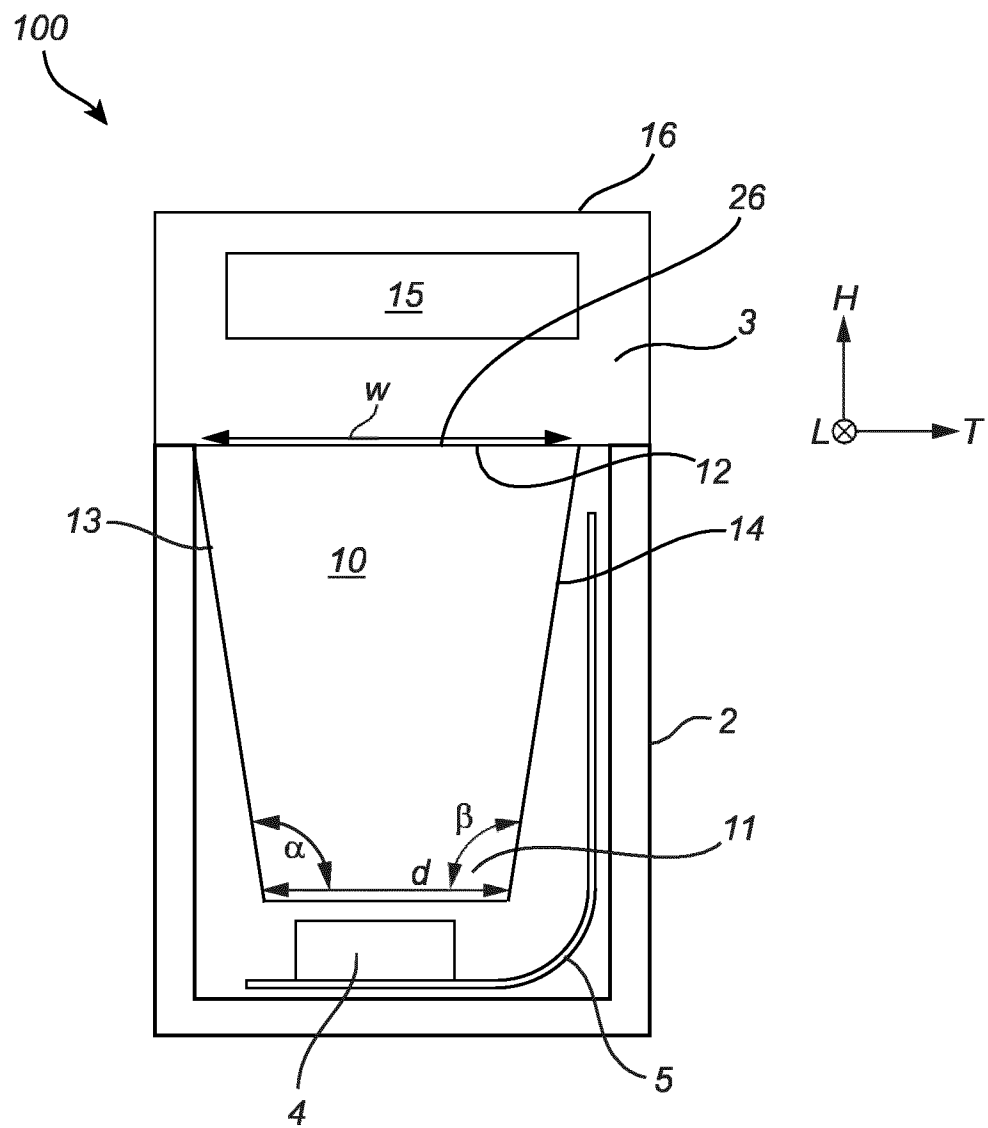
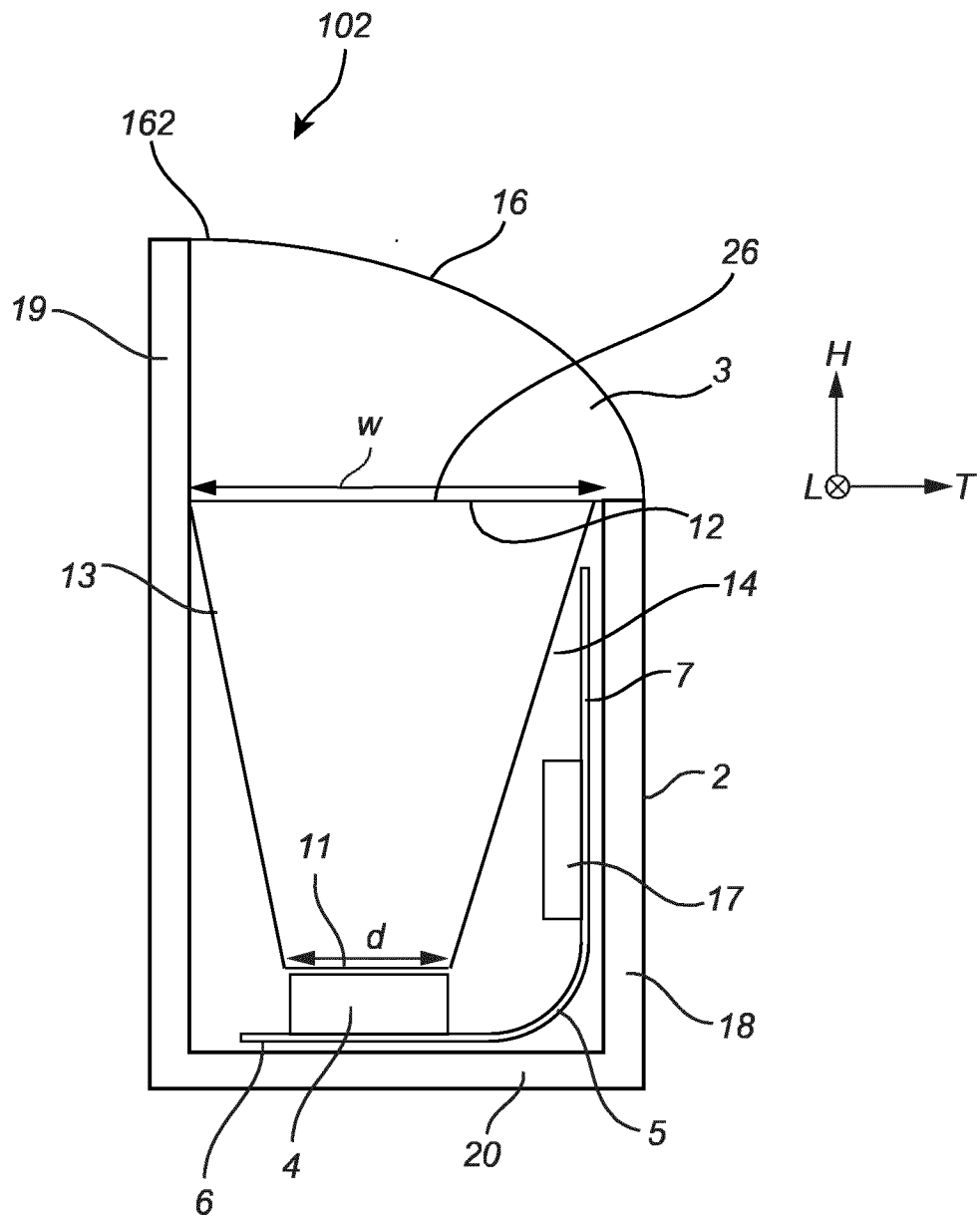


Fig. 6

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*Fig. 8*

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/067225

A. CLASSIFICATION OF SUBJECT MATTER

INV. F21S4/22
ADD. H01L25/075

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 F21V H05K F21Y H01L

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2022/128218 A1 (KLEIJNEN CHRISTIAN [NL] ET AL) 28 April 2022 (2022-04-28) paragraphs [0016], [0019], [0022], [0047]; figures 2,5,6 -----	1,3-15
Y	EP 3 537 038 A1 (BILTON INT GMBH [AT]) 11 September 2019 (2019-09-11) figures 1,6 -----	1,2,5-13
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A	CN 102 748 726 A (ZHONGSHAN KESHUN ANALYSIS & TEST TECHNOLOGY CO LTD) 24 October 2012 (2012-10-24) figures 3-6 -----	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

12 September 2024

Date of mailing of the international search report

01/10/2024

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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