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(54) **LIGHT SOURCE ASSEMBLY AND LIGHT FIXTURE COMPRISING SAID LIGHT SOURCE ASSEMBLY**

(57) A light source assembly (7) is provided with at least one solid state light source (10) configured to emit one or more light beams along an emitting direction (D); at least one reflector assembly (11) associated with the light source (10); at least one optical element (12) ar-

ranged downstream of the reflector assembly (11) along the emitting direction (D); and at least one acoustic barrier element (13) arranged between the optical element (12) and the reflector assembly (11).

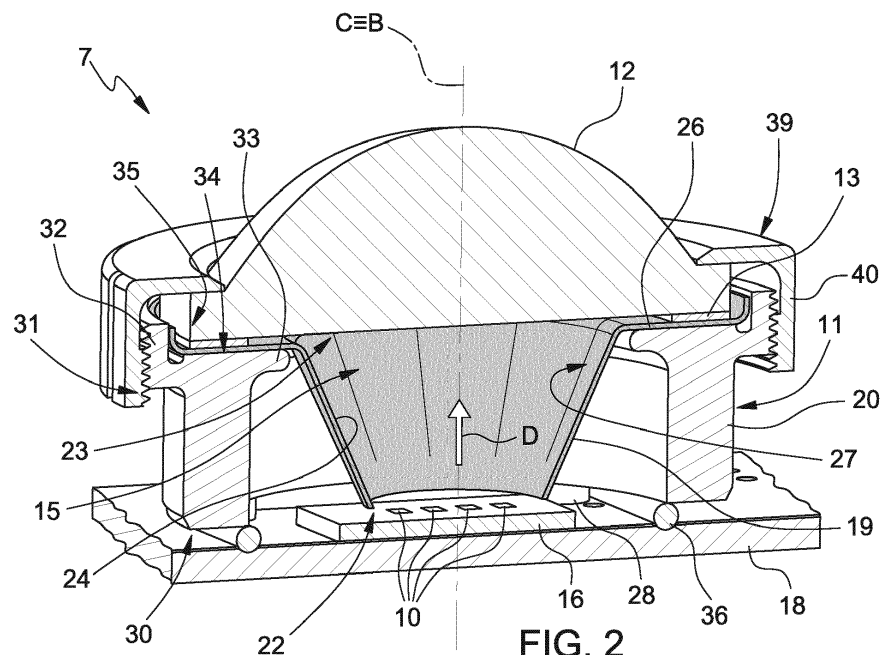


FIG. 2

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims priority from Italian patent application no. 102018000010257 filed on 12/11/2018.

TECHNICAL FIELD

[0002] The present invention relates to a light source assembly and to a light fixture comprising said light source assembly. Preferably, the light fixture is a stage light fixture.

BACKGROUND ART

[0003] In recent years, in the entertainment sector, there has been a significant increase in the use of light fixtures with solid state light sources (Solid State Lighting), such as LEDs.

[0004] Solid state light sources are associated with electronic components that can become a significant source of acoustic noise, especially when they are adjusted by pulse width modulation commands. The electromagnetic force induced on these components by the PWM modulation, in fact, determines a vibration of the components, which causes audible acoustic noise. The generated acoustic noise has a dominant component at the same frequency as the PWM modulation or its harmonics.

[0005] Currently, some solutions plan to increase the PWM modulation frequency above the audible frequency level. This means increasing the PWM modulation frequency above 16 KHz. The use of modulation at such high frequencies leads to a reduction in the resolution of the modulation with obvious negative consequences in terms of colour stability and brightness of the light beam.

DISCLOSURE OF INVENTION

[0006] It is therefore an object of the present invention to provide a light source assembly that is free from the drawbacks of the known art herein disclosed. In particular, an object of the invention is to provide a light source assembly in which the acoustic noise is significantly reduced and which, at the same time, emits a high quality light beam.

[0007] In accordance with these objects, the present invention relates to a light source assembly comprising:

- at least one solid state light source configured to emit one or more light beams along an emitting direction;
- at least one reflector assembly associated with the light source;
- at least one optical element arranged downstream of the reflector assembly along the emitting direction;
- at least one acoustic barrier element arranged be-

tween the optical element and the reflector assembly.

[0008] Advantageously, the light source assembly according to the present invention is noiseless with respect to the source assemblies of the known art.

[0009] The presence of the acoustic barrier element, in fact, significantly reduces the audible noise level outside the light source assembly.

[0010] According to a preferred embodiment, the acoustic barrier element and the optical element are made in a single piece. In this way, the assembling of the light source assembly is simplified and speeded up.

[0011] According to a variant, the acoustic barrier element and the optical element are distinct pieces.

[0012] According to a preferred embodiment, the acoustic barrier element is air-permeable. In this way, the air circulates inside the chamber housing the light source. This avoids the onset of pressure imbalances due to temperature changes caused by the presence of at least one light source. According to a preferred embodiment, the acoustic barrier element is made of a polymeric material.

[0013] According to a preferred embodiment, the acoustic barrier element is made of a material having a hardness below 100 on the Shore OO hardness scale. In this way, the acoustic barrier element has a level of compressibility that is sufficient to guarantee a correct acoustic noise reduction effect.

[0014] According to a preferred embodiment, the acoustic barrier element is made of a silicone material.

[0015] According to a preferred embodiment, the reflector assembly comprises a reflector element and at least one support body configured to support the reflector element.

[0016] According to a preferred embodiment, the light source assembly comprises at least one clamping device configured to clamp the acoustic barrier element against a support surface. This further optimizes the acoustic noise isolation level.

[0017] According to a preferred embodiment, the light source assembly comprises at least one support plate to support the light source, wherein the support body is fixed to the support plate. This guarantees the stability of the reflector assembly.

[0018] According to a preferred embodiment, the light source assembly comprises at least one further acoustic barrier element arranged between the support plate and the support body. This further optimizes the acoustic noise isolation level.

[0019] According to a preferred embodiment, the further acoustic barrier element is air-permeable. In this way, even the further acoustic barrier element ensures a correct air circulation to avoid the onset of any pressure unbalance.

[0020] A further object of the invention is to provide a light fixture in which the acoustic noise is significantly reduced and which is capable of projecting high quality

light beams.

[0021] In accordance with these objects, the present invention relates to a light fixture comprising a casing and at least one light source assembly of the type described above, which is housed inside the casing and is configured to generate a light beam along at least one optical axis. The light fixture is provided with at least one output optical assembly arranged inside the casing or closing the casing downstream of the light source assembly along the optical axis.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] Further characteristics and advantages of the present invention will appear clear from the following description of a non-limiting embodiment thereof, with reference to the figures of the annexed drawings, in which:

- Figure 1 is a schematic side view, with parts in section and parts removed for clarity's sake, of a light fixture according to the present invention;
- Figure 2 is a perspective side view, with parts in section and parts removed for clarity's sake, of a light source assembly according to a first embodiment of the present invention;
- Figure 3 is a perspective side view, with parts in section and parts removed for clarity's sake, of a light source assembly according to a second embodiment of the present invention;
- Figure 4 is a perspective side view, with parts in section and parts removed for clarity's sake, of a light source assembly according to a third embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0023] In Figure 1 the reference number 1 indicates a light fixture, preferably a stage light fixture.

[0024] The light fixture 1 comprises a casing 2 and support means (not shown in the attached figures) configured to support the casing 2. Preferably, the support means are configured to move the casing 2 and to allow the casing 2 to rotate about two orthogonal axes, commonly known as PAN and TILT. The operation of the support means is regulated by a movement control device (not visible in the attached figures). The movement control device can also be managed remotely, preferably via DMX protocol communications. According to a variant, the support means can be configured to support only the casing 2 without allowing it to be moved.

[0025] The casing 2 extends along a longitudinal axis A and is provided with a first closed end 4 and with a second end 5, opposite to the first closed end 4 along the axis A and provided with a projection mouth 6. In the non-limiting example herein described and shown, the projection mouth 6 has a substantially circular section. Preferably, the projection mouth 6 is centred on the axis A of the casing 2.

[0026] The light fixture 1 further comprises a frame (not visible in the attached figures) coupled to the casing 2, at least one light source assembly 7 supported by the frame and arranged near the first closed end 4, and at least one output optical assembly 9.

[0027] The light source assembly 7 is configured to generate a light beam along an optical axis B. In the non-limiting example herein described and shown, the optical axis B coincides with the longitudinal axis A.

[0028] A not shown variant provides that the light fixture 1 comprises a plurality of light source assemblies, preferably side by side on the same plane orthogonal to the axis A. Each light source assembly is configured to generate a respective light beam along a respective optical axis.

[0029] The output optical assembly 9 is arranged downstream of the light source assembly 7 along the respective optical axis B.

[0030] According to a not shown variant, the light fixture 1 can further comprise one or more optical assemblies and/or one or more colour assemblies and/or one or more beam processing groups, preferably arranged downstream of the respective light source assembly along the respective optical axis.

[0031] With reference to Figure 2, the light source assembly 7 comprises at least one solid state light source 10 configured to emit one or more light beams along an emitting direction D, at least one reflector assembly 11 associated with the light source 10, at least one optical element 12 arranged downstream of the reflector assembly 11 and at least one acoustic barrier element 13 arranged between the optical element 12 and the reflector assembly 11 so as to provide a chamber 15 to isolate the acoustic noise.

[0032] In the non-limiting example herein described and shown, the light source assembly 7 comprises a plurality of solid state light sources 10, preferably of the LED type.

[0033] The light sources 10 are integrated in a chip coupled to a printed circuit board 16. The chip is connected to contact pads on the printed circuit board 16 via wire bonding, not shown in the attached figures for simplicity's sake.

[0034] The printed circuit board 16 is supported by a support plate 18.

[0035] Preferably, the light sources 10 together define an emission surface of the light beams that can have a cross-section having a circular, square, elliptical, hexagonal, polygonal or any other shape.

[0036] The reflector assembly 11 comprises a reflector element 19 and a support body 20.

[0037] The reflector element 19 is configured to reflect the light beam emitted by each light source 10 and direct it towards an outlet opening 23 of the reflector element 19. Preferably, the outlet opening 23 has a circular shape. Preferably, the reflector element 19 is further provided with an inlet opening 22, opposite to the inlet opening 22 along the emitting direction D.

[0038] In particular, the reflector element 19 is arranged with respect to the light source 10 so that the light beam emitted by each light source 10 first crosses the inlet opening 22 and then the outlet opening 23.

[0039] In other words, the reflector element 19 is arranged so that the outlet opening 23 is downstream of the inlet opening 22 along the emitting direction D.

[0040] Preferably, the light sources 10 are arranged substantially at the inlet opening 22.

[0041] Preferably, the inlet opening 22 is shaped so as to collect as many light beams as possible.

[0042] In particular, the inlet opening 22 defines an inlet passage, which has an area at least equal to the area of the emission surface defined by the light sources 10. More specifically, the area of the inlet passage is greater than the area of the emission surface defined by the light sources 10.

[0043] Preferably, the inlet opening 22 is shaped so as to substantially surround the light sources 10.

[0044] Preferably, the shape of the section of the inlet passage of the inlet opening 22 is chosen according to the shape of the emission surface defined by the light sources 10, which for example can have a circular, square, elliptical, hexagonal, polygonal or any other shape.

[0045] Preferably, the outlet opening 23 has a greater passage section than the passage section of the inlet opening 22. In the non-limiting example herein described and shown, the reflector element 19 is substantially defined by a main body 24, preferably having the shape of a truncated cone. In the non-limiting example herein described and shown, the outlet opening 23 is provided with an annular edge 26, which extends from the main body 24.

[0046] The main body 24 is provided with an inner surface 27, which has at least one active portion.

[0047] The active portion is configured to reflect the inlet light beams and direct them towards the outlet opening 23. In the non-limiting example herein described and shown, the active portion extends over the entire inner surface 27.

[0048] The reflector element 19 can be made of a metallic material (e.g. aluminium or silver) or of a polymeric material (e.g. PET or PMMA).

[0049] The support body 20 is configured to support the reflector element 19.

[0050] In particular, the support body 20 is configured to support the reflector element 19 so that the reflector element 19 is arranged downstream of the light source 10 along the emitting direction D.

[0051] More preferably, the reflector element 19 is supported by the support body 20 so as to be spaced from the printed circuit board 16. In this way, any contact with conductive portions of the printed circuit board 16 and/or of the light sources 10 is avoided.

[0052] The support body 20 is fixed to the support plate 18, for example by means of screws 28 (partially visible in Figure 2).

[0053] The support body 20 is substantially cylindrical and extends along an axis C about the reflector element 19.

[0054] The support body 20 is provided with a first end 30 fixed to the support plate 18 and with a second end 31 to which the reflector element 19 is coupled.

[0055] In particular, at the second end 31, the support body 20 is provided with a preferably threaded outer edge 32 and with an inner edge 33, which defines an annular coupling surface 34. Preferably, the annular coupling surface 34 is orthogonal to the axis C of the support body 20. The outer edge 32 protrudes from the outer side surface of the support body 20 and preferably has an L-shaped section. The outer edge 32 and the inner edge 33 substantially define an inner annular seat 35, which, as shown in greater detail below, houses a portion of the reflector element 19, a portion of the acoustic barrier element 13 and at least a portion of the optical element 12.

[0056] In the non-limiting example herein described and shown, the annular edge 26 of the reflector element 19 is arranged to rest on the annular coupling surface 34.

[0057] A further acoustic barrier element 36 is preferably arranged between the support plate 18 and the support body 20.

[0058] As shown in more detail later, the further acoustic barrier element 36 is preferably made with a material having characteristics similar to those of the material constituting the acoustic barrier element 13.

[0059] Preferably, the reflector element 19 and the support body 20 are coaxially arranged. Preferably, also the light sources 10 are centred on the axis C. In the specific non-limiting example herein described and shown, the printed circuit board 16 is centred on the axis C of the support body 20.

[0060] The optical element 12 is arranged downstream of the reflector assembly 11 and is also preferably centred on the axis C.

[0061] The optical element 12 is configured to modify the direction of at least a portion of the light rays that make up the beam emitted by one or more light sources 10.

[0062] In the example of Figure 2, the optical element 12 is a condenser element and comprises one or more optical devices arranged and configured so that the inlet beam is concentrated in a desired manner. In the non-limiting example herein described and shown, the optical element comprises a lens configured to concentrate the beam at a given point (called focus point). In the non-limiting example herein described and shown the lens is a plano-convex lens. In this way, the light beam leaving the optical element 12 is a beam having an optical axis B.

[0063] The acoustic barrier element 13 is arranged between the optical element 12 and the reflector assembly 11 and is configured to attenuate the audible noise produced by the light sources 10 and by the electronic components associated with them.

[0064] Preferably, the acoustic barrier element 13 is arranged between the optical element 12 and the reflector

tor assembly 11 and is configured to attenuate the noise produced by the light sources 10 and by the associated electronic components of at least 5 dB, preferably of at least 10 dB.

[0065] In particular, the acoustic barrier element 13 is annular and is preferably arranged resting on the annular edge 26 of the reflector element 19.

[0066] A not shown variant provides that the acoustic barrier element 13 is arranged to rest on the annular coupling surface 34 without contact with the reflector element 19. This solution is particularly useful in applications where it is desired to avoid any contact between the reflector element 19 and the acoustic barrier element 13 to keep them at different temperatures.

[0067] The acoustic barrier element 13 is preferably air-permeable, e.g. made of an air-permeable material. The air circulation in the chamber 15, in fact, avoids the onset of pressure imbalances due to temperature changes during the activation, operation and deactivation of the light sources 10.

[0068] Preferably, the acoustic barrier element 13 is made of a compressible material.

[0069] In particular, the acoustic barrier element 13 is made of a material having a hardness below 100 on the Shore OO hardness scale, preferably in the range 80-90.

[0070] Preferably, the acoustic barrier element 13 is made of a polymeric material that does not release hydrocarbons when subjected to thermal cycles caused by the activation/operation/deactivation of the light sources 10.

[0071] In the non-limiting example herein described and shown, the acoustic barrier element is made of a silicone material.

[0072] A not shown variant provides that the acoustic barrier element is configured so that the noise is dissipated inside it, e.g. by means of one or more bodies, provided with at least one surface with a high acoustic transparency facing the chamber 15 and defined by a filler with porosities arranged in a different direction from the one of the flow so as to have a high resistance to the flow. In this way, the sound wave penetrates easily and is therefore dissipated inside.

[0073] A further not shown variant provides that the acoustic barrier element comprises one or more bodies provided with calibrated resonant cavities communicating with the chamber 15 by means of respective calibrated necks/holes.

[0074] The light source assembly 7 further comprises at least one clamping device 39 configured to clamp the acoustic barrier element 13 against a support surface.

[0075] In the non-limiting example of Figure 2, the clamping device 39 clamps the acoustic barrier element 13 against the annular edge 26 of the reflector element 19. According to a not shown variant, the clamping device 39 clamps the acoustic barrier element 13 against the annular coupling surface 34 of the support body 20.

[0076] In the non-limiting example herein described and shown, the clamping device 39 is an annular ring nut

40, which is internally threaded to cooperate with the outer edge 32 of the support body 20 of the reflector assembly 11. The annular ring nut 40 is arranged on the perimeter edge of the optical element 12.

[0077] According to a not shown variant, the annular ring nut 40 is made of a material that is optically transparent to the radiations in the visible range.

[0078] In use, the annular ring 40 is screwed onto the outer edge 32 of the support body 20. The screwing of the annular ring 40 causes the clamping of the acoustic barrier element 13 against the annular edge 26. In the non-limiting example herein described and shown, the acoustic barrier element 13 is clamped between the optical element 12 and the annular edge 26 of the reflector assembly 11. It is clear that the clamping device can be made in an alternative way, for example by means of clamping devices of various types.

[0079] The clamping device 39 is configured to clamp the acoustic barrier element 13 so as to minimize the space between the acoustic barrier element 13 and the surfaces in contact therewith. Preferably, the space between the acoustic barrier element 13 and the surfaces in contact with it is less than 1 mm.

[0080] The light source assembly 7 thus obtained defines, as already anticipated, a chamber 15 for isolating the acoustic noise. The light sources 10, the reflector assembly 11, the optical element 12 and the acoustic barrier element 13, in fact, define the chamber 15.

[0081] In particular, the audible noise associated with the light sources 10 does not escape from the chamber 15. This is mainly due to the particular arrangement of the elements that make up the light source assembly 7 and to the presence of the acoustic barrier element 13 arranged between the optical element 12 and the reflector assembly 11.

[0082] Moreover, the clamping device 39 further improves the soundproofing properties thanks to the clamping of the acoustic barrier element against the adjacent elements. Finally, the further acoustic barrier element 36 further optimizes the soundproofing properties, thus contributing to the closure of the chamber 15.

[0083] The further acoustic barrier element 36 is preferably air-permeable, for example made of an air-permeable material. Preferably, the further acoustic barrier element 36 is made of a compressible material.

[0084] In particular, the further acoustic barrier element 36 is made of a material having a hardness below 100 in the Shore OO hardness scale, preferably in the range 80-90. Preferably, the further acoustic barrier element 36 is made of a polymeric material, which does not release hydrocarbons when subjected to the thermal cycles caused by the activation/operation/deactivation of the light sources 10.

[0085] In the non-limiting example herein described and shown, the further acoustic barrier element 36 is made of a silicone material.

[0086] Figure 3 shows a light source assembly 7 according to a variant of the present invention in which the

acoustic barrier element 13 and the optical element 12 are made in a single piece 50.

[0087] Preferably, the acoustic barrier element 13 is optically transparent to the radiations in the visible range. Preferably, the acoustic barrier element 13 and the optical element 12 are made in a single piece 50 made of a polymeric material. The single piece 50 can be made of a material comprising a single mixture of polymeric material or it can comprise at least a first central area made of a material having a first mixture of polymeric material and at least a second peripheral area made of a material comprising a second mixture of polymeric material different from the first mixture of polymeric material. Preferably, the first central area will be made of a material having the required optical properties (e.g. silicone enriched with ceramic powder), while the second peripheral area will be made of a material which is air-permeable and, for example, also compressible.

[0088] Figure 4 shows a light source assembly 7 in accordance with a further variant of the present invention, in which the optical element 12 comprises a diffuser element 51 and a condenser element 52, which are mutually spaced apart by an annular spacer element 53. The condenser element 52 and the acoustic barrier element 13 are made in a single piece 50. Also in this case the acoustic barrier element 13 is preferably optically transparent to the radiations in the visible range.

[0089] In this case, the clamping device 39 clamps the acoustic barrier element 13 against a support surface 54 of the annular spacer 53.

[0090] The diffuser element 51 is preferably a monolithic element. A not shown variant provides that the mixer comprises a plurality of mixing devices arranged next to each other and substantially aligned with the respective light sources 10. The condenser element 52 is arranged downstream of the diffuser element 51 along the emitting direction D and comprises one or more optical devices arranged and configured so that the inlet beam is concentrated in a desired manner. In the non-limiting example herein described and shown, the condenser element 52 comprises a lens configured to concentrate the beam at a given point (called the focus point). In the non-limiting example herein described and shown the lens is a plano-convex lens. A not shown variant provides that the condenser element 52 is defined by a group of coupled lenses.

[0091] Substantially, the light beam leaving the optical element 12 is mixed, homogeneous and condensed. In this way, the light beam leaving the optical element 12 is a beam having an optical axis B.

[0092] According to a variant not shown in the present invention, the acoustic barrier element is provided with an annular groove, which is engaged by an annular portion of the reflector assembly or of the spacer element.

[0093] Finally, it is clear that modifications and variations may be made to the light source assembly and to the light fixture described herein without departing from the scope of the appended claims.

Claims

1. Light source assembly (7) comprising:

5 at least one solid state light source (10) configured to emit one or more light beams along an emitting direction (D) ;
at least one reflector assembly (11) associated to the light source (10);
10 at least one optical element (12) arranged downstream of the reflector assembly (11) along the emitting direction (D) ;
at least one acoustic barrier element (13) arranged between the optical element (12) and the reflector assembly (11) .

2. Light source assembly according to claim 1, wherein the acoustic barrier element (13) and the optical element (12) are made in a single piece (50).

3. Light source assembly according to claim 1, wherein the acoustic barrier element (13) and the optical element (12) are made in separate pieces.

25 4. Light source assembly according to any one of the preceding claims, wherein the acoustic barrier element (13) is air-permeable.

30 5. Light source assembly according to any one of the preceding claims, wherein the acoustic barrier element (13) is made of a polymeric material.

35 6. Light source assembly according to any one of the preceding claims, wherein the acoustic barrier element (13) is made of a material having a Shore lower than 100 in the Shore 00 scale.

40 7. Light source assembly according to any one of the preceding claims, wherein the acoustic barrier element (13) is optically transparent at least to radiations in the visible range.

45 8. Light source assembly according to any one of the preceding claims, wherein the acoustic barrier element (13) is made of a silicone material.

50 9. Light source assembly according to any one of the preceding claims, wherein the reflector assembly (11) comprises a reflector element (19) and at least one support body (20) configured to support the reflector element (19).

55 10. Light source assembly according to claim 9, comprising at least one clamping device (39) configured to clamp the acoustic barrier element (13) against a support surface (26; 34; 53).

11. Assembly according to claim 9 or 10, comprising at

least one printed circuit board (16), the light source (10) being integrated into a chip coupled to the printed circuit board (16).

12. Assembly according to any one of the claims from 9 to 11, comprising at least one support plate (18) to support the light source (10); the support body (20) being fixed to the support plate (18). 5
13. Assembly according to claim 12, comprising at least one further acoustic barrier element (36) arranged between the support plate (18) and the support body (20). 10
14. Assembly according to claim 13, wherein the further acoustic barrier element (36) is air-permeable. 15
15. Light fixture comprising a casing (2) and at least one light source assembly (7) according to any one of the preceding claims, which is housed inside the casing (2) and is configured to emit a light beam along at least an optical axis (B), the light fixture being provided with at least one output optical assembly (9) arranged inside the casing (2) or arranged so as to close the casing (2) downstream of the light source assembly (7) along the optical axis (B). 20 25

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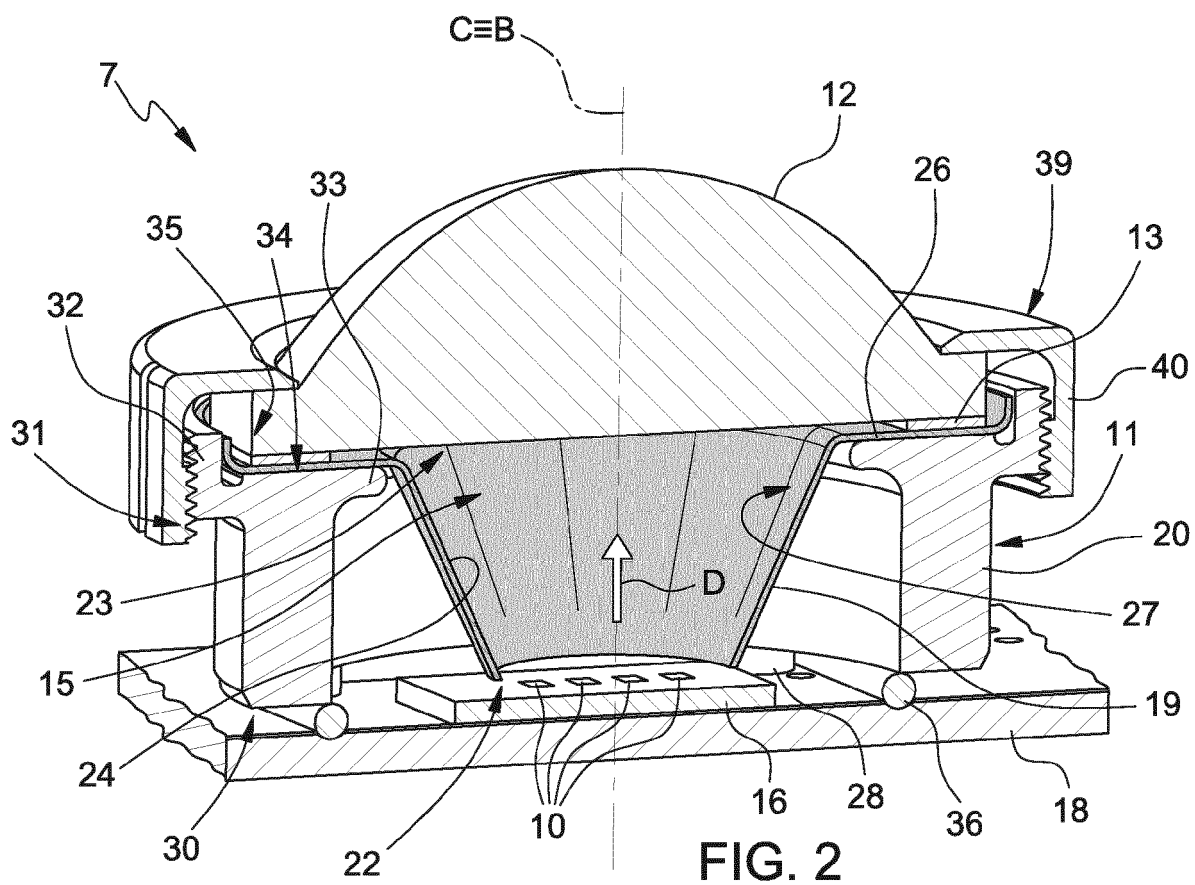
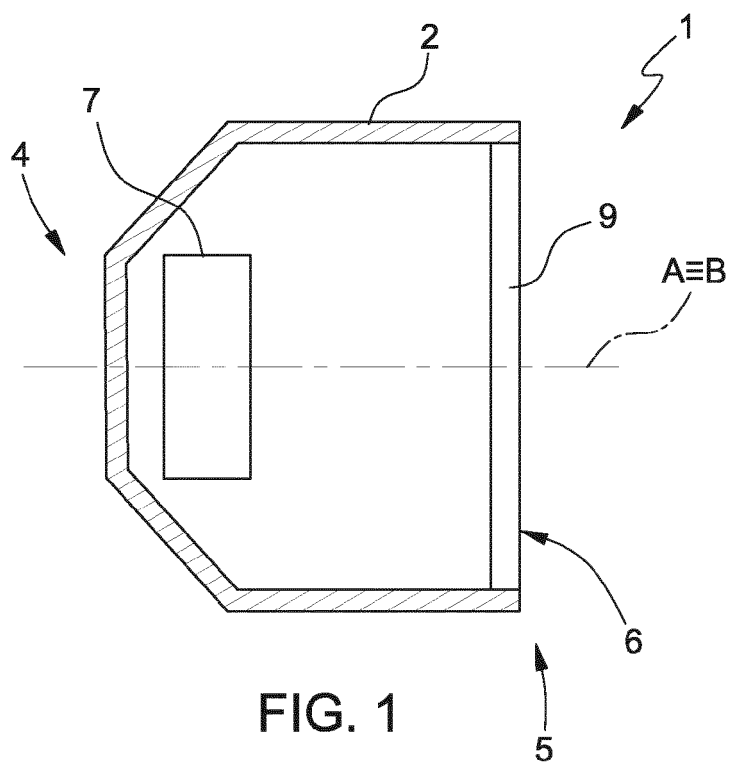
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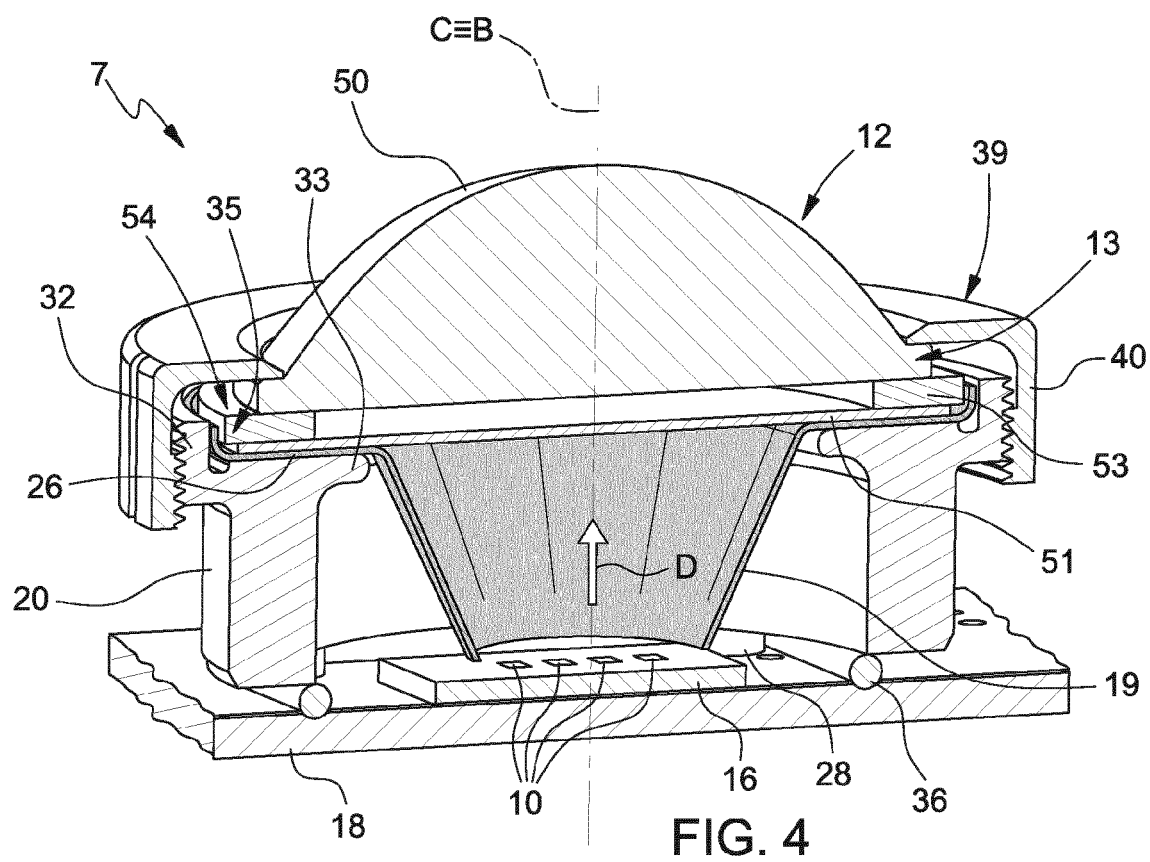
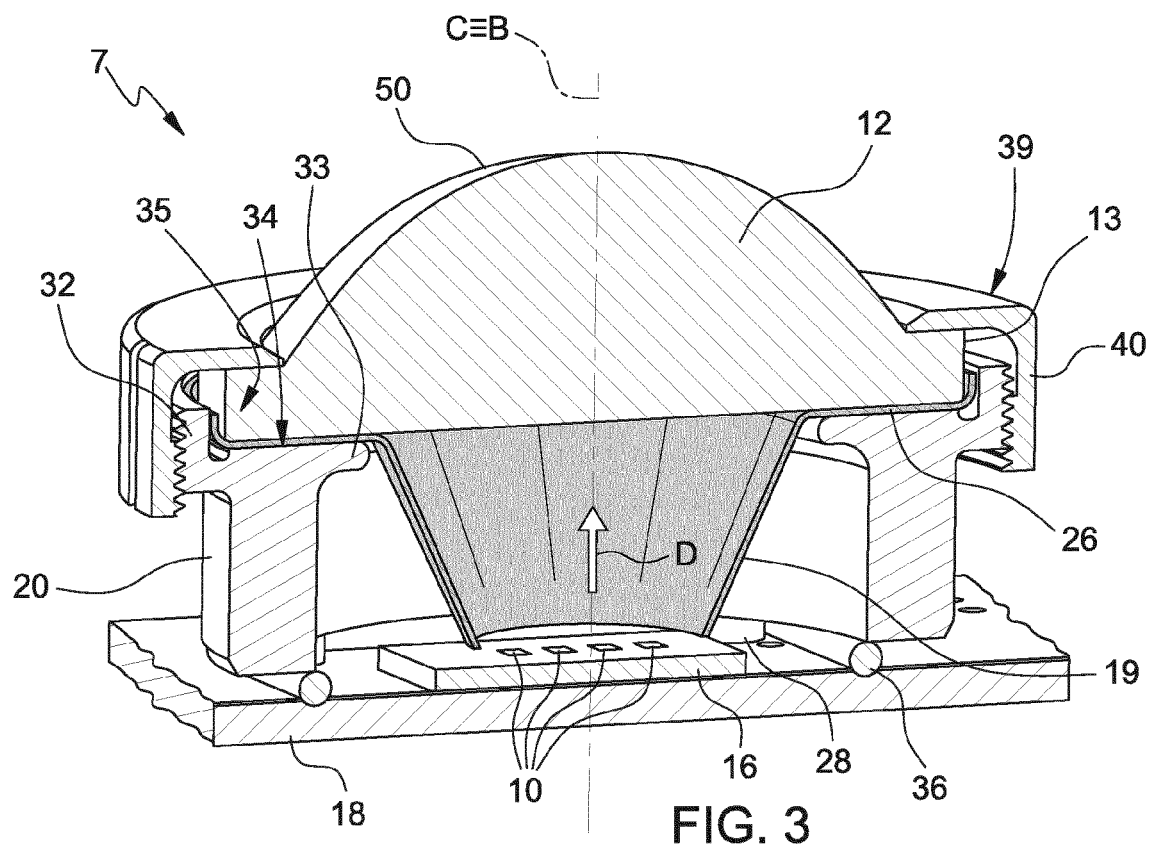
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EUROPEAN SEARCH REPORT

Application Number
EP 19 20 8723

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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