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(71) Applicants:

• **OSRAM GmbH**

80807 München (DE)

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• **Osram S.p.A. - Societa' Riunite Osram Edison Clerici**
20126 Milano (IT)

(72) Inventors:

• **CACCHIONE, Mr. Fabrizio**
I-30031 Dolo (Venezia) (IT)

• **RONCHESE, Mr. Riccardo**
I-31040 Chiarano (Treviso) (IT)

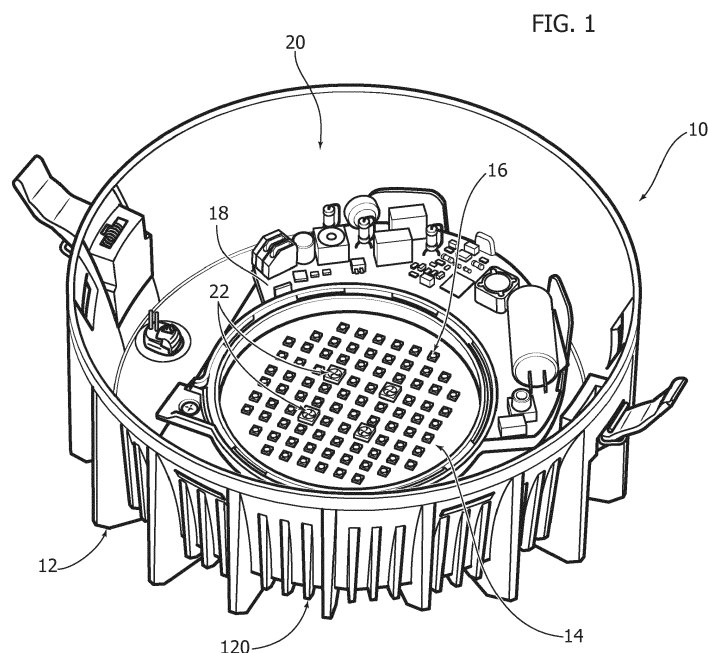
• **FAVRETTO, Mr. Antonio**
I-31013 Codognè (Treviso) (IT)

(74) Representative: **Bosotti, Luciano Buzzi, Notaro & Antonielli d'Oulx S.r.l.**
Via Maria Vittoria, 18
10123 Torino (IT)

(54) **A LIGHTING DEVICE AND CORRESPONDING METHOD**

(57) A lighting device (10) includes:
- a support board (14),
- one or more electrically-powered light radiation sources (16), e.g. LED sources, arranged on said support board

(14), and
- one or more aeriform pumping sources (22) active on said support board (14) in the vicinity of said light radiation source(s) (16).



Description

Technical Field

[0001] The present description relates to lighting devices.

[0002] One or more embodiments may refer to lighting devices employing electrically-powered solid-state lighting sources, e.g. LED sources.

[0003] One or more embodiments may find employment in LED-based high-power lighting systems, e.g. for street lighting applications.

Technological Background

[0004] In operation, lighting devices employing solid-state light radiation sources, e.g. comprising a support board "populated" with an array of LED sources, produce a certain amount of heat which may be considerable in high-power light radiation sources.

[0005] Therefore, measures must be adopted to facilitate heat dissipation, enabling i.a. the preservation of the lighting device performances in time.

[0006] In this respect, a widespread solution consists in coupling heat sinks to the light radiation sources mounted on the support boards.

[0007] This solution has been commonly used for more traditional light radiation sources, e.g. halogen lamps or high-intensity discharge (HID) lamps. These lighting sources, however, are adapted to withstand rather high operating temperatures.

[0008] In the case of LED light radiation sources, in order to dissipate the heat generated by LEDs while keeping them at the correct temperature, the support board carrying the LEDs may be coupled to a thermally conductive support adapted to dissipate heat (e.g. being configured as a finned heat sink) or, generally speaking, to remove heat, by transferring it towards a further component adapted to exchange energy with media having a lower temperature (e.g. radiators or the like).

[0009] These solutions may however be difficult to implement.

Object and Summary

[0010] One or more embodiments aim at providing a solution enabling the dissipation of the heat produced by light radiation sources such as LED sources, while overcoming the previously outlined drawbacks.

[0011] According to one or more embodiments, said object may be achieved thanks to a lighting device having the features specifically set forth in the claims that follow.

[0012] One or more embodiments may also concern a corresponding method.

[0013] The claims are an integral part of the technical teaching provided herein with reference to the embodiments.

[0014] One or more embodiments may envisage dis-

sipating the heat produced by a light radiation source such as a LED source by resorting to an active component (such as a fan or a blower) adapted to act as a ventilation aeriform (e.g. air) pumping source, and sized so as to be arranged in the vicinity of the light radiation source(s), e.g. on the support board (e.g. a Printed Circuit Board, PCB) accommodating the light radiation source (s).

[0015] In one or more embodiments, said active component may be small-sized and adapted to be mounted onto the support board in a similar way as the light radiation sources are mounted thereon (e.g. via SMD mounting technologies).

15 Brief Description of the Figures

[0016] One or more embodiments will now be described, by way of non-limiting example only, with reference to the annexed Figures, wherein:

- Figure 1 is a perspective view of a lighting device according to one or more embodiments, and
- Figure 2 is a partially cutaway perspective view of a lighting device according to embodiments.

[0017] It will be appreciated that, for clarity and simplicity of illustration, the Figures may not be all drawn to the same scale.

30 Detailed Description

[0018] In the following description, various specific details are given to provide a thorough understanding of various exemplary embodiments according to the present specification. The embodiments may be practiced without one or several specific details, or with other methods, components, materials, etc. In other instances, well-known structures, materials, and operations are not shown or described in detail to avoid obscuring various aspects of the embodiments.

[0019] Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, the possible appearances of the phrases such as "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, particular features, structures or characteristics may be combined in any suitable manner in one or more embodiments.

[0020] The headings provided herein are for convenience only, and therefore do not interpret the extent of protection or scope of the embodiments.

[0021] In the Figures, reference 10 denotes a lighting device comprising a casing 12, e.g. of a metal or moulded plastic material, optionally having good heat-dissipating features.

[0022] In one or more embodiments, casing 12 may have a general bowl-like shape, so as to be adapted to accommodate, e.g. centrally, a support board 14 e.g. substantially similar to a Printed Circuit Board (PCB).

[0023] In one or more embodiments, board 14 may have a circular shape, adapted to be mirrored by a substantially corresponding shape of casing 12. Of course, the choice of such shape does not limit the embodiments in any way.

[0024] In one or more embodiments, support board 14 may host at least one light radiation source, e.g. an array of electrically-powered light radiation sources 16.

[0025] In one or more embodiments, the light radiation source(s) 16 may comprise solid-state light radiation sources, e.g. LED sources.

[0026] In one or more embodiments, the light radiation source(s) may be high-power sources, so that they may be employed e.g. in street lighting applications: the reference to this applicability must not however be construed as limiting the embodiments.

[0027] Figure 1 also shows, mounted onto a further board 18 e.g. in the shape of a crescent, electronic components 20 adapted to perform supply and/or control functions on source(s) 16.

[0028] In one or more embodiments, casing 12 may be externally provided with fins 120, adapted to favour heat dissipation from casing 12 towards the external environment.

[0029] In one or more embodiments, as exemplified in Figure 2, casing 12 may be associated with a (e.g. finned) heat sink 140, which in one or more embodiments is adapted to be placed in (wide) surface contact with board 14, so as to favour heat dissipation from board 14 itself.

[0030] In one or more embodiments, device 10 may comprise one or more aeriform (e.g. air) pumping sources 22, adapted to act onto board 14 in the vicinity of light radiation source(s) 16, in order to create a ventilation flow as schematically represented by arrows F in Figure 2.

[0031] In one or more embodiments, pumping source(s) 22 may be mounted onto support board 14 together with radiation source(s) 16.

[0032] In one or more embodiments, pumping source(s) 22 may be interspersed, e.g. at regular positions, in the array of light radiation sources 16.

[0033] For example, Figure 1 shows a possible embodiment having an array comprising several tens of light radiation sources 16, arranged according to a general octagonal configuration.

[0034] Four pumping sources 22 may be provided and distributed around the central area of the array of light radiation sources 16, so that each pumping source 22 "covers" about one quarter of the arrayed light radiation sources 16.

[0035] In one or more embodiments, source(s) 22 are small-sized (both in the case of a fan and in the case of an e.g. centrifugal blower).

[0036] Said sources may be mounted onto board 14 for example via technologies (e.g. SMD technologies)

substantially similar to those used to mount sources 16 onto board 14.

[0037] As exemplified in Figure 2, in one or more embodiments casing 12 (wherein, thanks to the action of sources 22, an ventilation flow F is produced) may host a reflector, and/or may be closed at the distal end thereof by a closing screen 24, through which the light radiation of sources 16 is projected towards the outside: the inner volume of casing 12 may thus be a closed space, within which the ventilation flow F takes place.

[0038] As visible e.g. in Figure 2, the reflector may be received within casing 12 with a portion of casing 12 being external to the reflector. One or more embodiments may envisage, at the "proximal" light input end and/or at the "distal" light output end with reference to the reflector, the presence of ventilation openings or passageways, through which air may flow between the inner space and the outer space of the reflector, the latter being the portion of casing 12 outside the reflector.

[0039] One or more embodiments may therefore envisage a solution wherein the light radiation source(s) 16 and the aeriform pumping source(s) 22 are arranged on support board 14, such pumping sources 22 being adapted to act directly on light radiation source(s) 16 and not on a heat sink.

[0040] One or more embodiments may therefore operate according to a principle different from transferring heat from sources 16 towards board 14 and from the latter towards a heat sink such as 140.

[0041] It was observed that, in the implementation of said traditional, so to say "static" system, heat tends to form layers in the area surrounding source(s) 16, thus originating a mechanism which does not favour heat dissipation.

[0042] Thanks to the presence of pumping source(s) 22, one or more embodiments involve moving the air in the vicinity of source(s) 16, therefore transferring heat from the close neighbourhood of board 14 to the other regions of casing 12, e.g. towards screen 24.

[0043] The latter may optionally be a diffusive screen, or simply a screen adapted to protect device 10 against the penetration of external agents (e.g. having an IP protection degree).

[0044] Thus, in one or more embodiments, thermal energy may be transferred to the outside:

- via a heat sink, such as heatsink 140 optionally coupled to board 14,
- via the walls of casing 12 (which may be finned, as exemplified at 120 in Figure 1),
- via closing screen 24.

[0045] In one or more embodiments, the mechanism described herein - with an active role played by ventilation sources 22 - may therefore be used either alone or in hybrid solutions, wherein said mechanism may be added to traditional dissipating mechanisms (e.g. a finned heat sink associated with board 14, a finned casing, etc.) and

may cooperate therewith.

[0046] In one or more embodiments, ventilation sources 22 are adapted to be mounted onto board 14 in the same way as the other electrical components of device 10, in conditions which are practically invisible from the outside.

[0047] This solution for transferring heat towards the outside is particularly beneficial e.g. in ceiling installations, e.g. with devices 10 adapted to act as downlights, in conditions wherein the convective action of a heatsink such as heatsink 140 may be poor.

[0048] One or more embodiments may therefore be employed in environments which do not in themselves favour heat dissipation towards the outside, e.g. in the case of a device 10 mounted into a false ceiling.

[0049] In one or more embodiments, source(s) 22 may comprise (micro)fans or micro(blowers) available e.g. from SEPA Europe GmbH of Breisgau in Eschbach (Germany) or from Sunonweath Electric Machine Industry Co., Ltd. of Kaohsiung City, Taiwan.

[0050] Without prejudice to the basic principles, the implementation details and the embodiments may vary, even appreciably, with respect to what has been described herein by way of non-limiting example only, without departing from the extent of protection.

[0051] The extent of protection is defined by the annexed claims.

Claims

1. A lighting device (10), including:
 - a support board (14),
 - at least one electrically-powered light radiation source (16) arranged on said support board (14), and
 - at least one aeriform pumping source (22) active on said board (14) in the vicinity of said at least one radiation source (16).
2. The lighting device (10) of claim 1, wherein said at least one pumping source (22) is arranged on said support board (14).
3. The lighting device (10) of claim 1 or claim 2, including an array of electrically powered light radiation sources (16) with said at least one pumping source (22) interspersed in said array.
4. The lighting device (10) of claim 3, including a plurality of said pumping sources (22) interspersed in said array.
5. The lighting device (10) of any of the previous claims, wherein said at least one pumping source (22) includes a fan or a blower.
6. The lighting device (10) of any of the previous claims, wherein said at least one pumping source (22) is mounted on said board (14) by SMD mounting.
7. The lighting device (10) of any of the previous claims, including a heat sink (140) coupled with said support board (14) opposed said at least one light radiation source (16).
8. The lighting device (10) of any of the previous claims, including a casing (12), preferably of a finned (120) type, surrounding said at least one light radiation source (16), said at least one pumping source (22) activatable to promote air flow within said casing (12).
9. The lighting device (10) of claim 8, wherein said casing (12) includes a front screen (24) closing said casing (12), wherein said casing (12) and said front screen (24) provide a closed space around said at least one light radiation source (16).
10. The lighting device (10) of claim 8 or claim 9, wherein said casing (12) includes a reflector surrounding said at least one light radiation source (16).
11. The lighting device (10) of claim 10, wherein said at least one light radiation source (16) and said at least one pumping source (22) are arranged in said reflector.
12. The lighting device (10) of claim 9 in combination with claim 10 or claim 11, including said front screen (24) closing said reflector.
13. The lighting device (10) of any of claims 10 to 12, including a heat sink (140) coupled with said reflector opposed said at least one light radiation source (16).
14. The lighting device (10) of any of claims 10 to 13, including, at the input and/or output end of the reflector, ventilation passageways between the inner space and the outer space of the reflector.
15. A method of operating a lighting device (10), the device including:
 - a support board (14),
 - at least one electrically-powered light radiation source (16) arranged on said support board (14),
 the method including providing at least one aeriform pumping source (22) active on said board (14) in the vicinity of said at least one radiation source (16).

FIG. 1

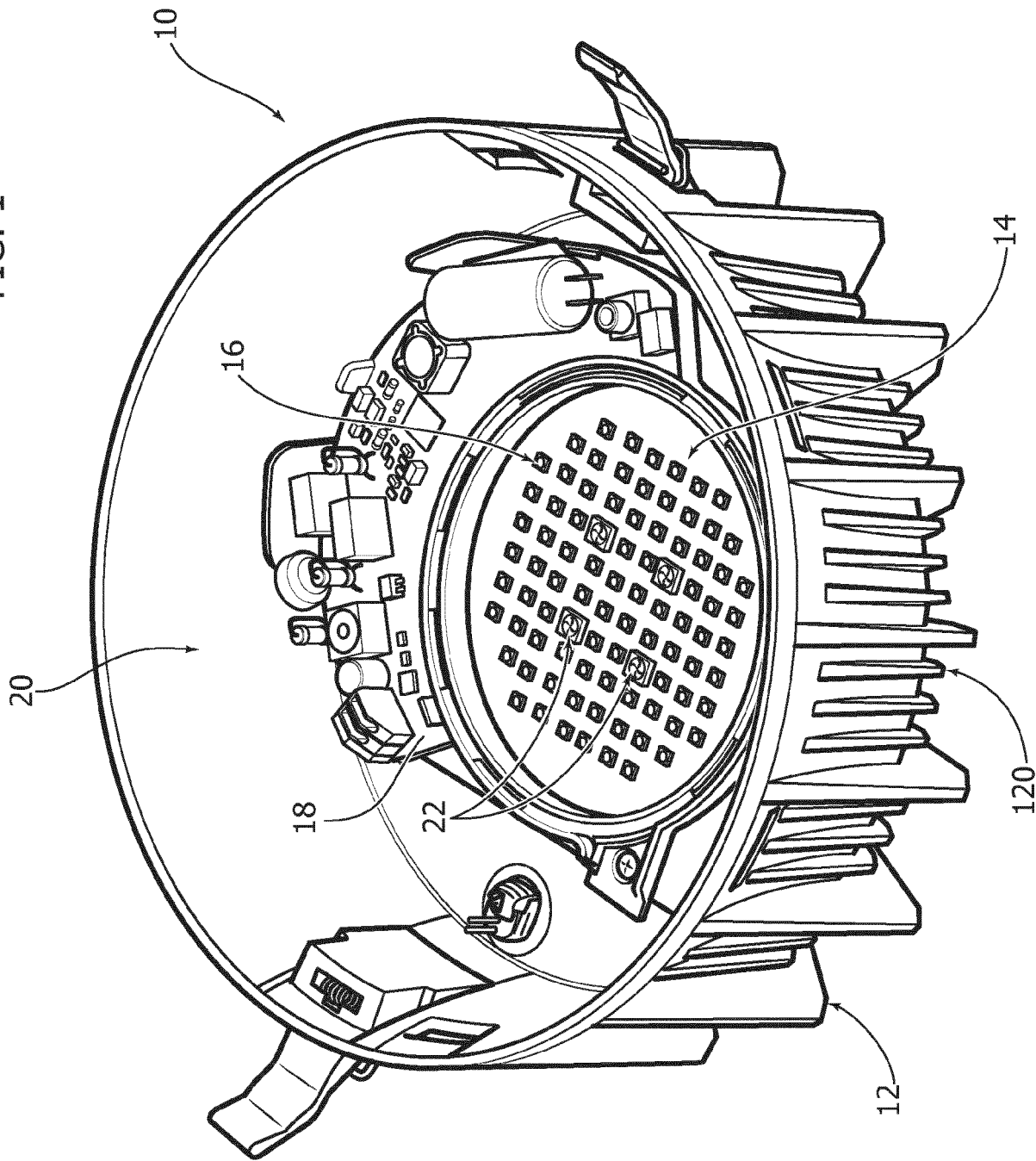
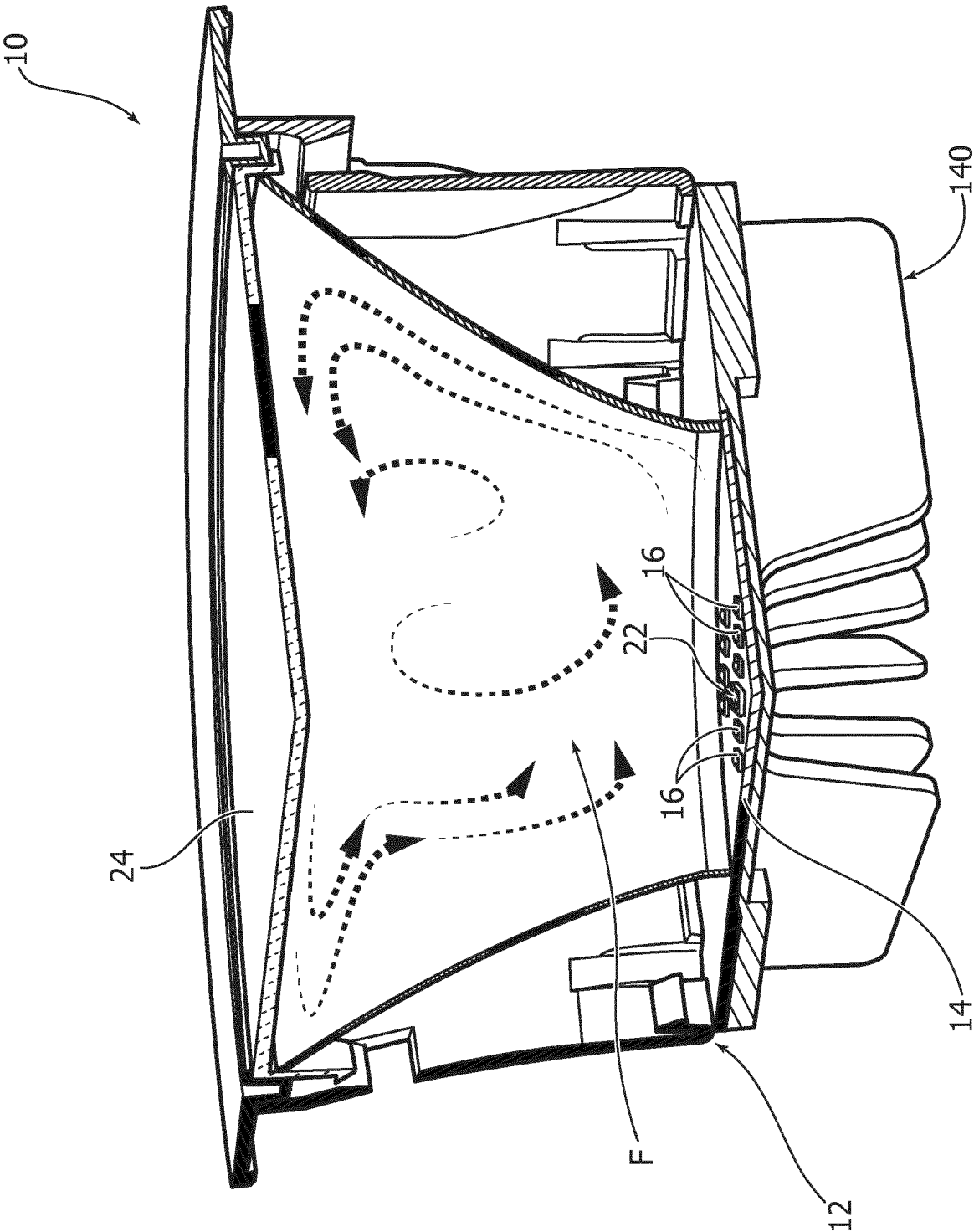


FIG. 2





EUROPEAN SEARCH REPORT

 Application Number
 EP 17 16 7711

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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			F21V F21K F21Y H05K F21W
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 18 September 2017	Examiner Menn, Patrick
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 17 16 7711

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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