

(19)



(11)

EP 2 708 810 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

19.03.2014 Bulletin 2014/12

(51) Int Cl.:

F21V 29/00 ^(2006.01)

F21Y 101/02 ^(2006.01)

(21) Application number: **13182216.5**

(22) Date of filing: **29.08.2013**

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

Designated Extension States:

BA ME

(30) Priority: **12.09.2012 IT TO20120786**

(71) Applicants:

- **OSRAM GmbH**
80807 München (DE)
- **OSRAM S.P.A. - SOCIETA' RIUNITE OSRAM**
EDISON CLERICI
20126 Milano (IT)

Designated Contracting States:

IT

(72) Inventors:

- **Martini, Michele**
30038 Spinea, VE (IT)
- **Cacchione, Fabrizio**
30031 Dolo (IT)

(54) **Method for assembling heat sinks and related tool**

(57) A tubular secondary heat sink (22) is fitted onto a primary heat sink (10), with thermal interface material (20) placed in between. The secondary heat sink (22) is radially expanded and the primary heat sink (10) is inserted into the radially expanded secondary heat sink (22) with the thermal interface material (102) interposed

between the primary heat sink (10) and the secondary heat sink (22). The subsequent radial contraction of the secondary heat sink (22) with the primary heat sink (10) inserted therein causes the thermal interface material (20) to be pressed between the primary heat sink (10) and the secondary heat sink (22).

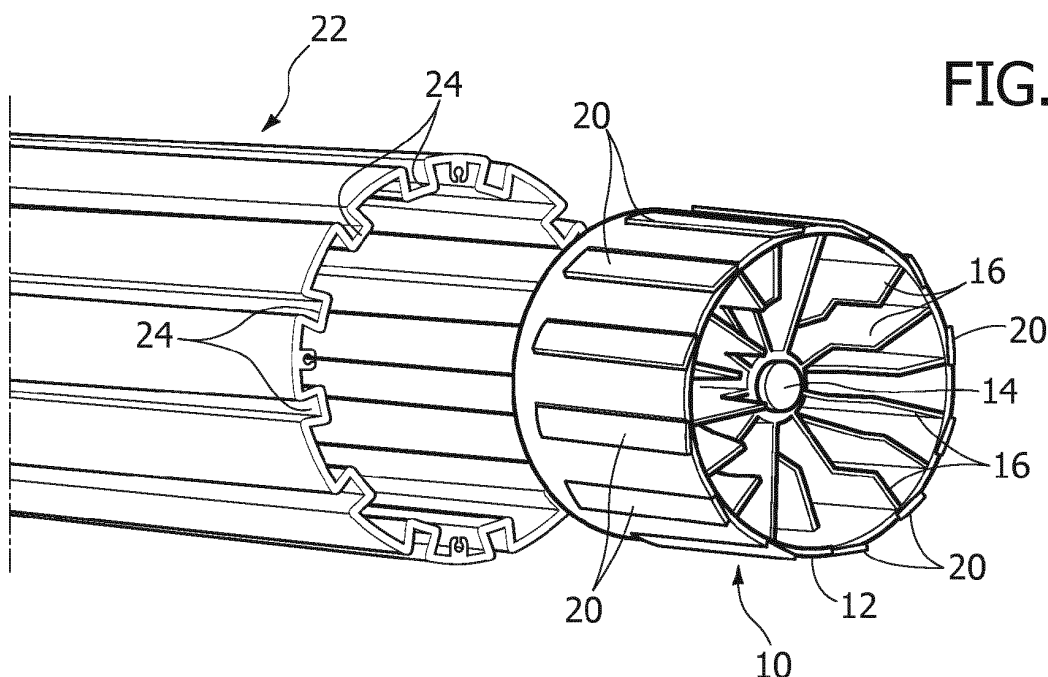


FIG. 1

EP 2 708 810 A2

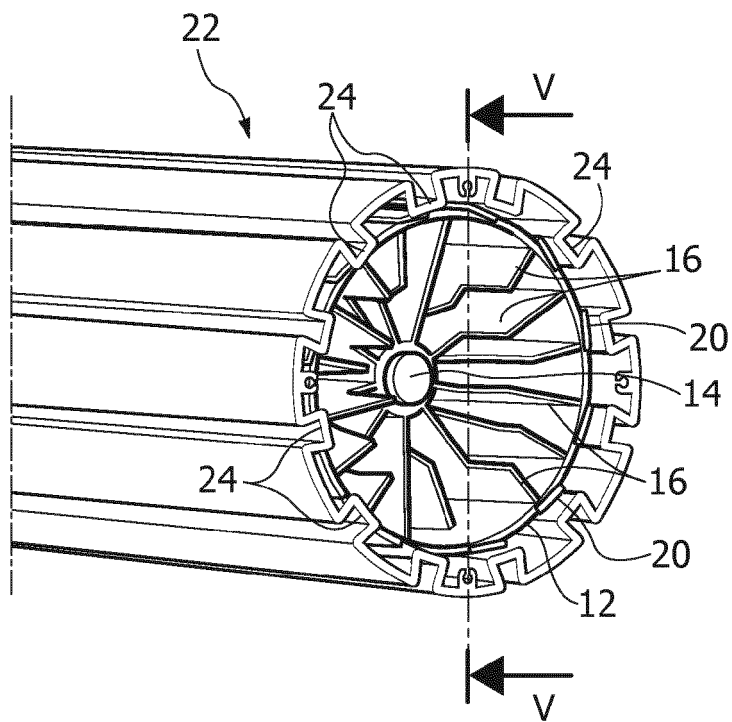


FIG. 2

Description

Technical field

[0001] The present description relates to the assembly of heat sinks.

[0002] Several embodiments may relate to the assembly of heat sinks for lighting sources, such as LED lighting sources.

Technological background

[0003] In several embodiments in which heat needs to be transferred between several bodies, for example bodies designed to act as heat sinks, different types of thermal interface material (TIM) may be interposed and held in position using screws or springs such as to apply an appropriate level of force to said materials.

Scope and summary

[0004] In such applications, it is known that optimum thermal coupling between two mechanical parts, such as a primary heat sink and a secondary heat sink, must be ensured, to enable heat to pass from one body to the other using thermal interface materials, while enabling the desired contact pressure to be achieved, addressing issues related to mechanical tolerance (which are liable to cause uncertainty when determining heat coupling) without the need to use additional attachment elements.

[0005] Several embodiments address this requirement. According to several embodiments, this objective is achieved using a method having the features set out in the claims below. Several embodiments also involve a corresponding tool. The claims are an integral part of the technical teaching provided in relation to the invention.

[0006] Some approaches may also be applied to the assembly of a secondary tubular heat sink fitted about a primary heat sink with a thermal interface material interposed between the primary heat sink and the secondary heat sink. Several embodiments may involve, for example, coupling two heat sinks of the type described in application T02011A000987, which belongs to the same applicant.

Short description of the figures

[0007] Several embodiments are described below by way of nonlimiting example with reference to the attached figures, in which:

- figures 1 and 2 show two heat sinks that can be joined together in certain embodiments,
- figure 3 is a schematic view, similar to a longitudinal diametral section with some parts removed, of a tool that can be used in certain embodiments, and
- figures 4 and 5a-5b, in which figures 5a-5b could be

considered to be ideal cross-sections along the line V-V of figure 2, show different phases of a method according to certain embodiments.

Detailed description

[0008] The description below illustrates various specific details to provide a more comprehensive understanding of the different embodiments. The embodiments may be realized without one or more of the specific details, or with other methods, components, materials, etc. In other cases, known structures, materials or operations are not shown or described in detail so as not to obscure the different aspects of the embodiments.

[0009] Reference to "an embodiment" in this description indicates that a particular configuration, structure or feature described in relation to the embodiment is included in at least one embodiment. Therefore, phrases such as "in one embodiment", which may appear in various places in this description, do not necessarily refer to the same embodiment. Furthermore, specific formations, structures or features may be appropriately combined in one or more embodiments.

[0010] The references used herein are used solely for convenience and therefore do not define the extent of protection or scope of the embodiments.

[0011] In the figures (as in the aforementioned application T02011A000987) reference sign 10 refers to a heat sink as a whole, comprising for example a heat conducting material such as metal (for example aluminum), plastic, heat-conducting plastic, and heat-conducting ceramic.

[0012] In several embodiments, the heat sink 10 may include a single part of pressed material.

[0013] In several embodiments, the heat sink 10 may include:

- a casing wall 12 having an overall tubular shape,
- a hub 14 arranged axially inside the tubular casing wall 12, and
- a row of fins 16 extending like spokes from the hub 14, joining the hub 14 to the casing wall 12.

[0014] In several embodiments, at one extremity of the hub 14 there may be a flat surface, for example a circular flat surface, that can be used as a support/assembly surface for a lighting device ("light engine" - not explicitly shown in the drawings).

[0015] In several embodiments, such a device may include, for example, one or more LED sources of luminous radiation and any related electrical control circuits.

[0016] The heat sink 10 is used to dissipate the heat generated by the aforementioned lighting device.

[0017] In several embodiments, the tubular casing wall 12 is cylindrical with the hub 14 extending in a central position in relation to the casing wall 12.

[0018] Thus, as better shown in figure 2, at least some of the fins 16 can be longer (measured axially in relation

to the casing wall 12) where they are close to the casing surface 12, compared to the standard length close to the hub 14. Thus, as shown in figures 1 and 2, one extremity of the heat sink 10 may have a cavity that can act as a seat for additional components, with the ability to make use of the heat dissipation performed by the fins 16.

[0019] In several embodiments, a coating of a thermal interface material (TIM) such as graphite, silicone-based pastes with heat conductive ceramic powder, or thermally conductive materials in general, may be applied to the outside of the casing wall 12.

[0020] In several embodiments, the aforementioned material may be provided in the form of strips 20 extending axially in relation to the casing wall 12, therefore, in the present embodiment, in the direction of the generators of the cylindrical surface on which the casing wall 12 extends.

[0021] In several embodiments, the strips 20 may be distributed about the heat sink 10 with a uniform angular distribution.

[0022] Figures 1 and 2 show the option of coupling a "primary" heat sink 10 as described above to an auxiliary or "secondary" heat sink 22 comprising for example a heat-dissipating material that may be the same as or different to the material used in the heat sink 10, for example metal (for example, aluminum) plastics, heat-conducting plastics and heat-conducting ceramics.

[0023] In several embodiments, the secondary heat sink 22 is a shaped tube that can be fitted onto the primary heat sink 10.

[0024] For this purpose, in several embodiments, the secondary heat sink 22 may be a profile with internal axial ribs 24 that can come into contact with the casing wall 12 of the primary heat sink 10, notably with the strips 20 of thermal interface material on the casing surface of the primary heat sink 10.

[0025] In several embodiments, as shown schematically in the sequence of figures 1 and 2, the primary heat sink 10 and the secondary heat sink 22 may be joined to one another by inserting the primary heat sink 10 into the axial cavity of the tubular body of the secondary heat sink 22 such as to create a composite heat-sink unit providing better heat-dissipation performance than the primary heat sink 10 on its own.

[0026] Figure 3 is a schematic representation, indicated as a whole with reference sign 100, of a tool that can be used to radially dilate the secondary heat sink 22 to enable the coupling between the two heat sinks 10 and 20 with the strips of thermal interface material 20 pressed (uniformly) against the casing surface 12 of the primary heat sink 10 with a uniform force generated by the radial elastic contraction of the secondary heat sink 22.

[0027] In the present embodiment, the dilation tool 100 may have a main shaft 102 extending along an axis X102 and having an enlarged head 104 at one extremity.

[0028] In several embodiments, the enlarged head 104 may have a flat end face and a peripheral casing surface, indicated with reference sign 104a, diverging towards the

flat end face and forming in several embodiments a (frusto) conical shape.

[0029] In the example in figure 3, reference sign 106 indicates an annular body formed substantially identically to the enlarged head 104, but having a different orientation. In several embodiments, the annular body 106 may have a side casing surface 106a, which is also divergent, for example forming a (frusto) conical shape.

[0030] Having an annular structure, the annular body 106 can be fitted onto the shaft 102 in the opposite direction to the enlarged head 104, i.e. with the two divergent surfaces 104a and 106a widening/diverging in mutually opposing directions.

[0031] In the present embodiment, the orientation is such that the radial dimensions of the surfaces 104a and 106a are lowest at the extremities that face one another and highest at the opposing extremities.

[0032] In several embodiments, a spring 108 may be placed between the enlarged head 104 and the annular body 106, pushing the annular body 106 away from the enlarged head 104, while the annular body 106 can be moved towards the enlarged head 104 by acting on an actuating nut or cylinder 110 screwed onto a threaded extremity 102a of the shaft 102.

[0033] In several embodiments, the arrangement shown is therefore such that the annular body 106 can be moved towards or away from the enlarged head 104 by tightening or loosening the nut or cylinder 110.

[0034] About all of the parts described above, there are a plurality of thrust sectors 112, for example in the form of cylindrical sectors, each having a tile-shaped external surface 112a.

[0035] The schematic view in figure 3 relates to the presence of sectors 112, each of which has an angular extension of approximately 60°. Consequently, the tool 100 shown in figure 3 has six of these sectors 112 arranged about the shaft 102, of which only three are shown with full lines to simplify the illustration. The sectors not explicitly shown in the figure, along with the others that are visible in the figure, jointly define an ideal cylindrical surface 114 having an approximate diameter matching (according to the criteria better described below) the internal diameter of the secondary heat sink 22 or, more specifically, the diameter defined by the radially internal extremities of the ribs 24 thereof.

[0036] In several embodiments, the sides of the sectors 112 facing the shaft 102 (or the axis X102) may have an overall V-shaped surface with two sections 112b and 112c inclined at an angle complementary to the conical surfaces 104a and 106a of the enlarged head 104 and of the annular body 106. In several embodiments, the sections 112b and 112c may have a rounded concave shape complementing the rounded convex shape of the conical surfaces 104a and 106a. Moreover, in several embodiments, there may be a straight section 112d corresponding to the spring 108 between the two sections 112b and 112c.

[0037] As can be determined intuitively by observing

figure 3, operation of the dilating tool 100 can be schematically summarized in the following terms:

- tightening the nut or cylinder 110 on the threaded extremity 102a of the shaft 102 causes the annular body 106 to move towards the enlarged head 104; consequently, the conical surfaces 104a and 106a move towards one another and act as ramps on the sections 112b and 112c of the sectors 112 causing the radial expansion of the sectors 112 and the consequent radial expansion of the surface 114 defined by the external surfaces 112a of the sectors 112;
- loosening the nut or cylinder 110 causes the annular body 106 to move away, for example by being pushed by the spring 108, from the enlarged head 104, on account of which the conical surfaces 104a and 106a move away from one another and the ramp coupling between the sections 112b and 112c of the sectors 112 cause these latter to return towards the axis X102 with a consequent radial contraction of the surface 114 defined by the external surfaces 112a of the sectors 112.

[0038] In several embodiments, the sectors 112 can be held in position on the shaft 102 and returned to the radially contracted position when the nut 110 is loosened using known means, for example with one or more elastic annular bands (for example similar to O-rings) 116 arranged in one or more annular grooves 118 formed in the casing surface 112a of the sectors 112.

[0039] As shown schematically in figure 4, in several embodiments, the axial extension of the tool 110 (or of the sectors 112) may be selected such that the tool 100 is "shorter" than the secondary heat sink 22. Consequently, when the tool 100 is inserted into the heat sink 22 from one extremity thereof, as shown in figure 4, an axial section long enough to enable the insertion of the primary heat sink 10 remains free at the opposite extremity of the heat sink 22, as shown schematically on the left-hand side of figure 4.

[0040] In several embodiments, this insertion, as shown schematically in figure 4, may be facilitated by the fact that the external radial dimensions of the primary heat sink 10 (defined in practice by the strips 20) and the internal radial dimensions of the secondary heat sink 22 (defined in practice by the internal extremities of the axial ribs 24, which protrude into the tubular body of the secondary heat sink 22) may be chosen to be practically identical to one another. The primary heat sink 10 may therefore be inserted into the secondary heat sink 22 with no appreciable interference when the secondary heat sink 22 has been radially expanded using the tool 100 according to the method described above, for example by acting on the nut 110 to radially dilate the sectors 112 such as to apply a radial expansion force to the heat sink 22.

[0041] In several embodiments, this force may cause

a limited elastic dilation of the heat sink 22, in particular of the radially internal extremities of the ribs 24.

[0042] Under such conditions (i.e. with the secondary heat sink 22 radially expanded, as shown schematically by the arrows in figure 5a) the primary heat sink 10 may be inserted into the secondary heat sink 22.

[0043] In several embodiments, this may be achieved, as shown schematically in figure 5a, either by sliding the primary heat sink 10 axially into the secondary heat sink 22 with the strips 20 kept in line with the spaces between the ribs 24 (distributed in an angularly uniform manner on the internal surface of the secondary heat sink 22), or with the strips 20 of thermal interface material angularly offset in relation to the ribs 24 of the secondary heat sink 22.

[0044] In several embodiments, the strips 20 may be assembled on the casing wall 12 of the primary heat sink 10 (for example placing the strips 20 in axial channels formed in the casing wall 12) in a cog arrangement (more specifically a ratchet wheel arrangement), i.e. ensuring that one side of each strip 20 is closer to the hub 14 than the opposite side of the same strip.

[0045] In the angular position in which the strips 20 are angularly offset in relation to the ribs 24 in the secondary heat sink 22, regardless of the assembly arrangement adopted for the strips 20, the primary heat sink 10 and the secondary heat sink 22 are able to move axially in relation to one another. This makes it possible, for example, to adjust and/or change the axial assembly condition of the heat sink 10 inside the secondary heat sink 22, for example as a function of the dimensions of the lighting device assembled on the primary heat sink 10.

[0046] As shown in the sequence of figures 5a and 5b, the primary heat sink 10 and the secondary heat sink 22 may be rotated in relation to one another (in the present embodiment, it is assumed that said relative movement occurs such that the heat sink 10 rotates clockwise inside the secondary heat sink 22) and the strips 20 are matched to the distal extremities of the ribs 24.

[0047] In several embodiments, if the "ratchet" assembly arrangement described above is used for the strips 20, this rotation may result in the wedging of the strips 20 beneath the ribs 24, in which the strips 20 of thermal interface material are wedged against the axial ribs 24 of the secondary heat sink 22.

[0048] In any case, i.e. regardless of whether the "ratchet" assembly arrangement is used for the strips 20 and/or whether the wedging described above is achieved, once the desired angular orientation is achieved (strips of thermal interface material 20 aligned with the internal ribs 24 of the secondary heat sink 22) the tool 100 can again be actuated, for example to loosen the nut or cylinder 110 such as to reduce the radial expansion force previously applied by the tool 100 to the secondary heat sink.

[0049] Under such conditions, the secondary heat sink 22 returns elastically to a radially contracted condition in which the strips of thermal interface material 20 are

pressed (with a force distributed uniformly throughout the facing surfaces of the heat sinks 10 and 22) between the external surface of the primary heat sink 10 and the internal surface of the secondary heat sink 20 (more specifically, the radially internal extremities of the ribs of this latter).

[0050] Naturally, notwithstanding the principle of the invention, the implementation details and embodiments may vary, even significantly, from those given here purely by way of nonlimiting example, without thereby moving outside the scope of protection of the invention, which is defined by the attached claims.

Claims

1. A method for fitting a tubular secondary heat sink (22) about a primary heat sink (10), with thermal interface material (20) being interposed between the primary heat sink (10) and the secondary heat sink (22), the method including radially expanding the secondary heat sink (22) and inserting the primary heat sink (10) into the radially expanded secondary heat sink (22) with the thermal interface material (20) interposed between the primary heat sink (10) and the secondary heat sink (22) whereby the subsequent radial contraction of the secondary heat sink (22) with the primary heat sink inserted therein (10) causes the thermal interface material (20) to be pressed between the primary heat sink (10) and the secondary heat sink (22).

2. The method as claimed in claim 1, including:

- inserting a dilation tool (100) into the secondary heat sink (22),
- activating the dilation tool (100) to produce a radial expansion force to radially expand the secondary heat sink (22),
- inserting the primary heat sink (10) into the radially expanded secondary heat sink (22) with the thermal interface material (20) interposed between the primary heat sink (10) and the secondary heat sink (22),
- deactivating the dilation tool (100) to discontinue the radial expansion force, with subsequent radial contraction of the secondary heat sink (22).

3. The method as claimed in claim 2, including using a dilation tool (100) that is axially shorter than the secondary heat sink (22), whereby the dilation tool (100) inserted at one extremity of the secondary heat sink (22) leaves a space at the opposite extremity of the secondary heat sink (22) for inserting the primary heat sink (10) into the secondary heat sink (22).

4. The method as claimed in any of the previous claims,

including placing the thermal interface material (20) on the primary heat sink (10) prior to inserting the primary heat sink (10) into the radially expanded secondary heat sink (22).

5. The method as claimed in any of the previous claims, including providing the thermal interface material in the form of strips (20) extending axially with respect to the secondary heat sink (22).

6. The method as claimed in any of the previous claims, including:

- providing the thermal interface material in the form of strips (20) arranged on a casing surface (12) of the primary heat sink (10),
- providing the secondary heat sink (22) with internal axial ribs (24) to be aligned with the strips (20) of thermal interface material,
- aligning the strips of thermal interface material (20) with the internal axial ribs (24) of the secondary heat sink (22) prior to radial contraction of the secondary heat sink (22).

7. The method as claimed in claim 6, including:

- inserting the primary heat sink (10) into the secondary heat sink (22) with the strips of thermal interface material (20) angularly offset with respect to the internal axial ribs (24) of the secondary heat sink (22), and
- imparting to the primary heat sink (10) and the secondary heat sink (22) a relative rotational movement to align the strips of thermal interface material (20) with the internal axial ribs (24) of the secondary heat sink (22).

8. The method as claimed in claim 7, including arranging said strips (20) of thermal interface material in a ratchet-wheel arrangement, whereby said relative rotational movement causes said strips (20) of thermal interface material to be wedged between the primary heat sink (10) and the internal axial ribs (24) of the secondary heat sink (22).

9. A dilation tool for radially expanding the tubular secondary heat sink (22) in the method as claimed in any one of claims 1 to 8, the tool including:

- a shaft (102) extending along an axis (X102),
- a plurality of thrust sectors (112) arranged about said shaft (102) and having external surfaces (112a) opposing said axis (X102) jointly defining a radially expandable external surface (114), and
- at least one wedge member (104a, 106a) moveable along said axis (X102) in said plurality of sectors (112) to spread them apart and radi-

ally expand said external surface (114).

10. The tool as claimed in claim 9, including a pair of wedge members (104a, 106a) movable in opposite directions along said axis (X102).

5

10

15

20

25

30

35

40

45

50

55

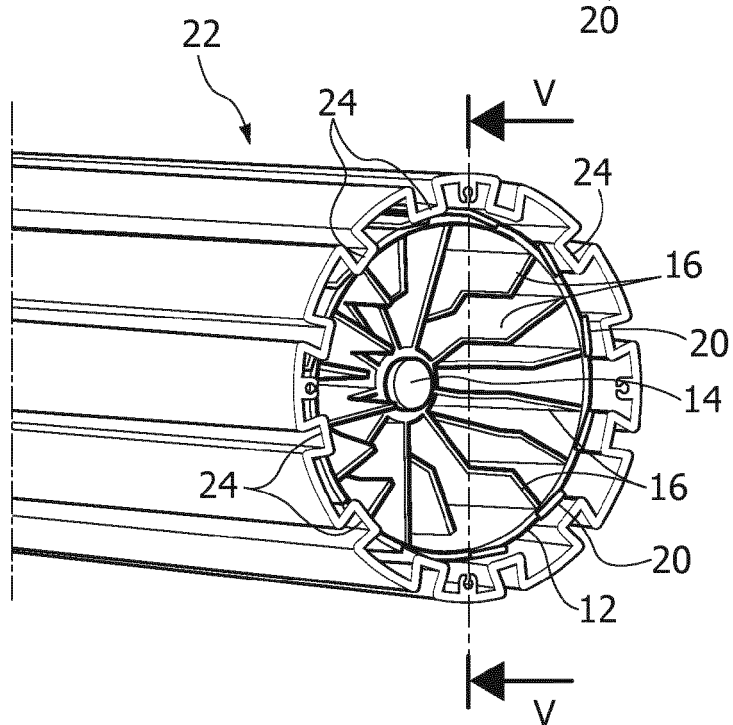
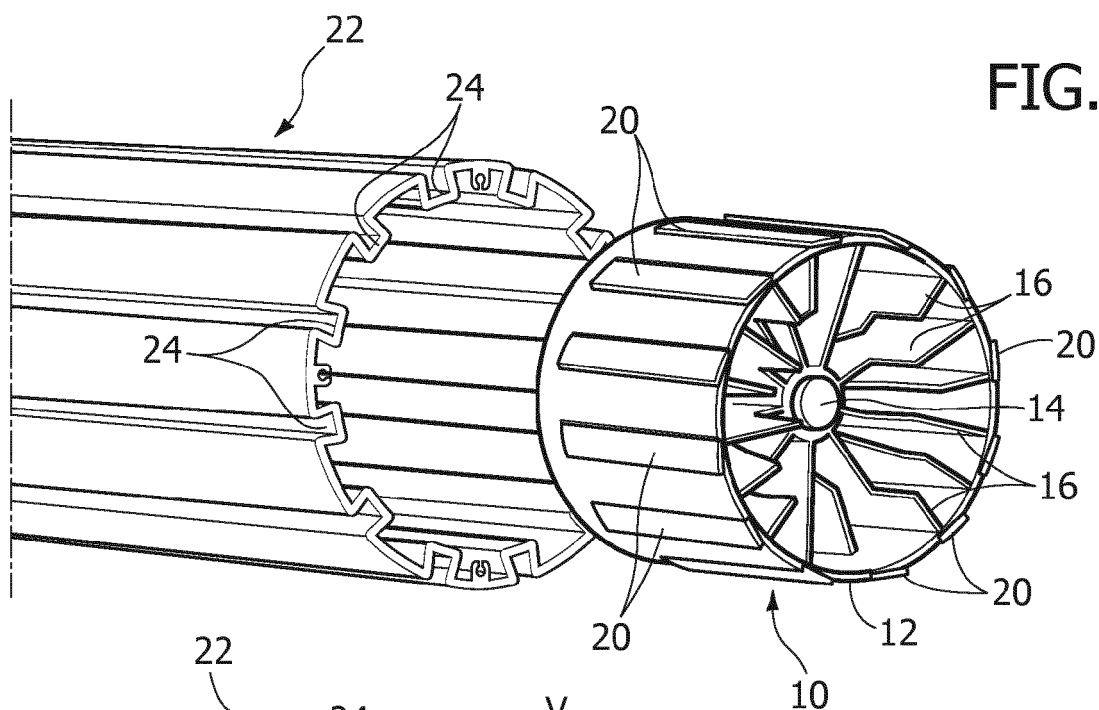


FIG. 3

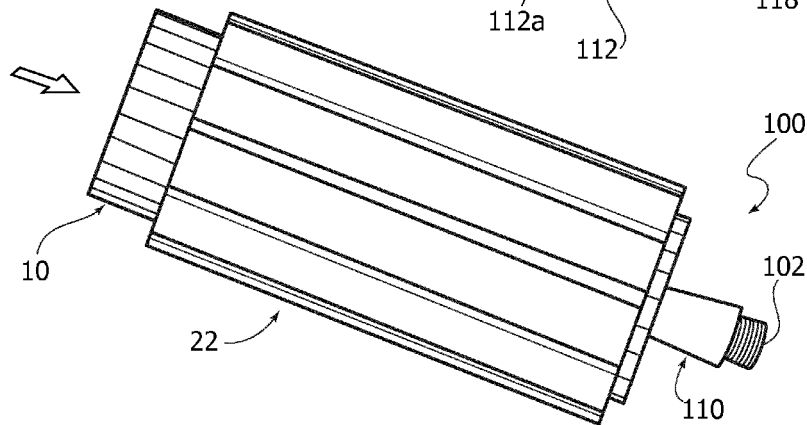
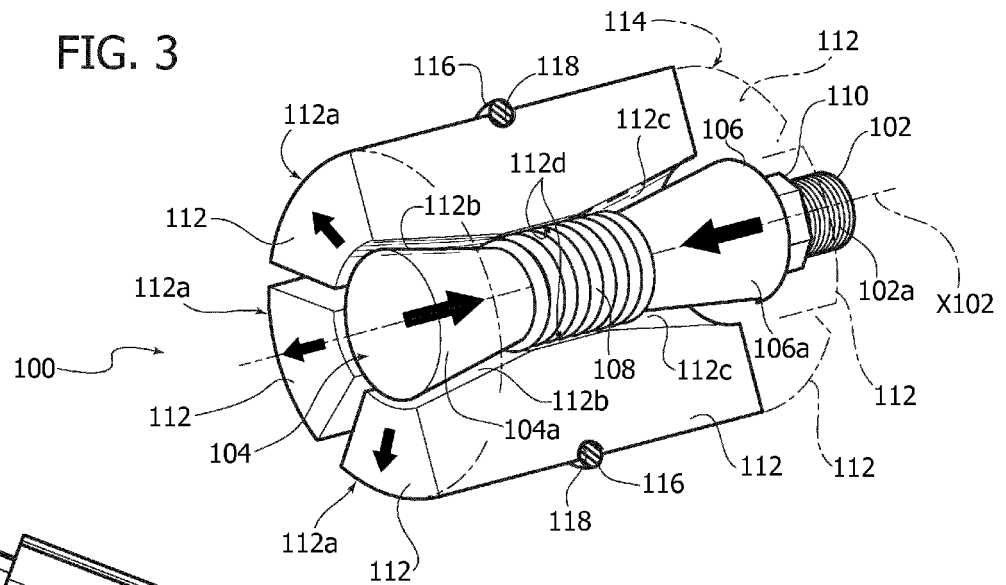


FIG. 4

FIG. 5a

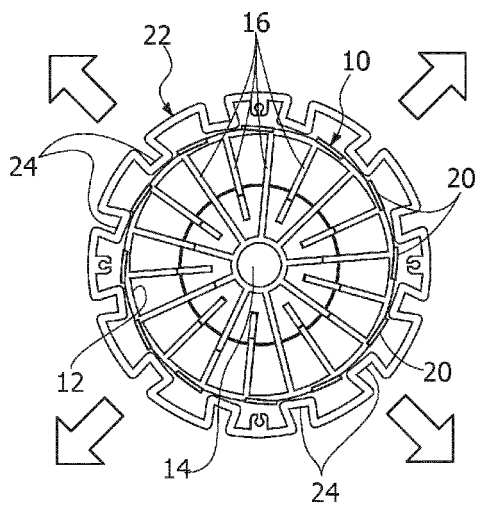


FIG. 5b

