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(54) FAN AIR GUIDE AND FAN AIR GUIDE MANUFACTURING METHOD

(57) A fan air guide (6) and a method for manufacturing such a fan air guide are provided. The fan air guide comprises a frame (8) and a plurality of vanes (12, 54). Each of the vanes extends from a hub (10) inside the frame to the frame and engages with the frame. Each of the vanes comprises a first end part (14), a second end part (16) and an intermediate part (18) extending between the first and second end parts. The fan air guide is characterized in that a first portion (20) of the first end part of at least a first vane (12') of the vanes is twisted around its longitudinal axis (A) in relation to the intermediate part of the first vane. This is for adaption of a length (L1) of the first vane to a distance (d) between the frame and the hub.

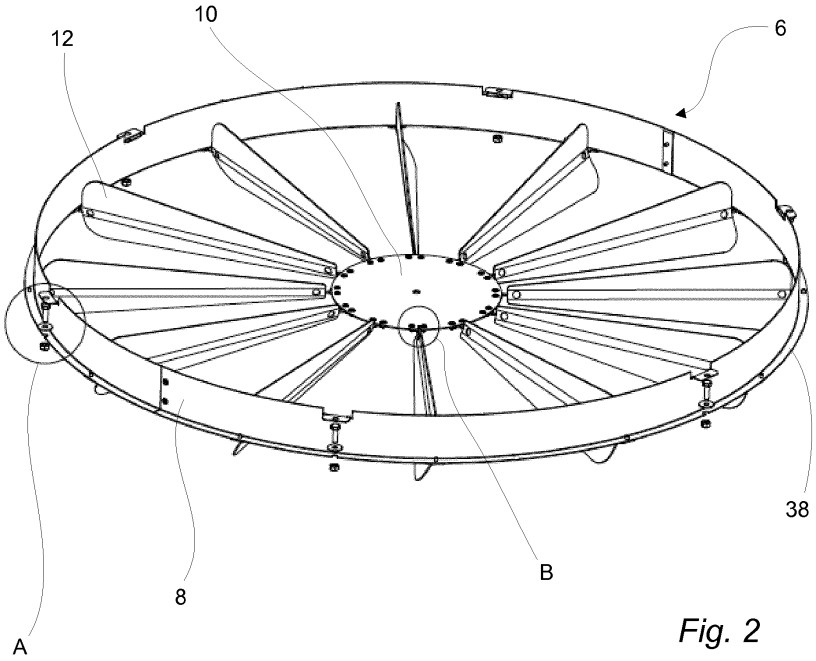

Fig. 2

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Description

Technical Field

[0001] The invention relates to a fan air guide comprising a frame and a plurality of vanes and to a method for manufacturing such a fan air guide.

Background Art

[0002] Fans are used in a vast number of different applications such as within the area of air heat exchangers. An air heat exchanger typically comprises a casing enclosing a great number of fins arranged in an aligned manner, one after the other, in a fin stock. The fins are each provided with a matrix of holes through which a plurality of tubes extend. The tubes extend back and forth through the fin stock, essentially perpendicularly to an extension plane of the fins. At one end the tubes are connected to a fluid inlet, and at the other end the tubes are connected to a fluid outlet, for feeding a fluid through the air heat exchanger. The air heat exchanger further comprises one or more fans arranged to draw air through the fin stock, i.e. through the parallel flow channels between the fins, to transfer heat between the fluid in the pipes and the air. The air enters the air heat exchanger through and air inlet with a temperature T_1 and leaves the air heat exchanger through an air outlet with a temperature T_2 which may be higher or lower than T_1 depending on whether the air heat exchanger is used for cooling or heating the fluid in the pipes.

[0003] To optimize the performance of the air heat exchanger, recirculation of air through the air heat exchanger should be avoided. To prevent, or at least reduce, such air recirculation, the air heat exchanger may be provided with an air guide for each fan. The air guide typically looks like a static propeller mounted in a rim and it is arranged after the fan as seen in an air flow direction. The air guide comprises blades or vanes extending from the rim to a hub inside the rim. These vanes increase the air throwing distance of the fan which in turn decreases air recirculation through the air heat exchanger.

[0004] The separate components of the air guide must be precisely manufactured, i.e. with small tolerances, to enable subsequent assembly of the air guide. Also, different types of fans require different types of air guides. As an example, to enable provision of air guides of different sizes, a specific set-up of components for each size is required. The previous factors contribute to a higher air guide cost.

Summary

[0005] An object of the present invention is to provide a rigid fan air guide which is less expensive than known fan air guides. The basic concept of the invention is to construct the fan air guide with vanes having a length that can be adjusted to the dimensions of the other components of the fan air guide such that the requirements as regards tolerances of the components of the fan air guide can be decreased, and such that the same vanes can be used for fan air guides of, at least slightly, differing sizes. Another object of the present invention is to provide a method for manufacturing such a fan air guide.

[0006] The fan air guide and the fan air guide manufacturing method for achieving the objects above are defined in the appended claims and discussed below.

[0007] A fan air guide according to the present invention comprises a frame and a plurality of vanes. Each of the vanes extends from a hub inside the frame, to the frame, and engages with the frame. Each of the vanes comprises a first end part, a second end part and an intermediate part that extends between the first and second end parts. The fan air guide is characterized in that a first portion of the first end part of at least a first vane of the vanes is twisted around a longitudinal axis of the first portion in relation to the intermediate part of the first vane. This is for adaption of a length of the first vane to a distance between the frame and the hub.

[0008] The fan air guide could be used in many different applications, for example be provided in an air heat exchanger.

[0009] The first end part of the first vane could be arranged at the frame and the second end part of the first vane at the hub, or it could be the other way around.

[0010] In that the first portion of the first end part of the first vane is deformed, more particularly twisted around a longitudinal direction thereof, the length of the first vane is decreased as compared to the the length of the first vane prior to deformation, i.e. twisting. By a suitable degree of twisting, the first vane may be spanned or tightened between the frame and the hub which may contribute to the rigidity of the fan air guide.

[0011] As said above, twisting of the first vane enables adjustment of the length of the first vane. Also, twisting of the first vane enables adjustment of the orientation of the first vane which makes the inventive fan air guide even more adjustable to different applications.

[0012] Also the intermediate part of the first vane may be twisted, but typically only slightly, e.g. for optimization of the function of the fan air guide, e.g. for increasing the air throwing capability of the fan air guide. However, such a twist would be different from the twist of the first portion of the first end part, whereby the the first portion of the first endpart can be said to be twisted *in relation to* the intermediate part.

[0013] During use, the air flow through the fan air guide may be high whereby the fan air guide must be rigid not to break. Such rigidity may be achieved by building the fan air guide of robust and strong elements, e.g. of vanes having a large material thickness. However, according to the present invention, the first vane may be at least partly made of sheet metal. Since the first vane, by being suitably twisted, may be spanned between the frame and the hub, it may be rigid even if it, at least partly, is made of sheet metal. A sheet metal vane is typically less ma-

terial demanding, and thus less expensive, than a vane having a large material thickness.

[0014] The intermediate part of the first vane may be provided with a hole at the transition to the first end part of the first vane. This hole is arranged to guide vane material towards the first end part during twisting of the first portion thereof to make sure that enough vane material for deforming, i.e. twisting, is available so as to make sure that the first vane is not broken as a result of the twisting.

[0015] A smallest width of the intermediate part of the first vane may be larger than a smallest width of the first end part of the first vane. Typically, it is easier to twist a narrow portion of a vane than a wide portion of the vane. Thus, this design makes it easier to have the twist of the first vane localized within the first end part, as is desired, than within the intermediate part.

[0016] Further, a smallest width of the first portion of the first end part of the first vane may be smaller than a smallest width of a second portion of the first end part of the first vane. The first portion of the first vane is arranged between the second portion and the intermediate part of the first vane. This design makes it easier to have the twist of the first vane localized within the first portion of the first end part, as is desired, than within the second portion of the first end part. As an example, the second portion of the first end part of the first vane may be a very end of the first vane and/or arranged for engagement with the rest of the fan air guide. A wider second portion may improve the strength of this engagement.

[0017] A first portion of the second end part of the first vane may be twisted around its longitudinal axis in relation to the intermediate part of the first vane. This is for further adaption of the length of the first vane to the distance between the frame and the hub and means that the first vane is twisted on both sides of its intermediate part.

[0018] The first portion of the first end part of the first vane, and the first portion of the second end part of the first vane, may be twisted in opposite directions as seen from the intermediate part of the first vane. As an example, this configuration will be obtained if the first vane is twisted, by simply rotating the intermediate part of it, after it has been firmly mounted in the fan air guide.

[0019] The intermediate part of the first vane may be provided with a hole also at the transition to the second end part of the first vane. The advantages of such a hole is apparant from the above discussion.

[0020] A smallest width of the intermediate part of the first vane may be larger than a smallest width of the second end part of the first vane. Further, a smallest width of the first portion of the second end part of the first vane may be smaller than a smallest width of a second portion of the second end part of the first vane. The first portion of the first vane is arranged between the second portion and the intermediate part of the first vane. The advantages with these embodiments are apparent from the above discussion.

[0021] A length of the intermediate part of the first vane may be larger than a respective length of the first and second end parts of the first vane. The intermediate part of the first vane contributes the most to the desired function of the fan air guide. Making the intermediate part occupy as much as possible of the distance between the frame and the hub of the fan air guide enables optimization of the function of the fan air guide.

[0022] The fan air guide could be such that pairwise coupled vanes extend between opposite points on an inside of the frame wherein the hub could be the crossing of those pairwise coupled vanes. However, according to on embodiment of the present invention the hub instead comprises an element with which each of the vanes engages. Thereby, a mechanically straight-forward construction of the fan air guide is enabled.

[0023] A subset, or all, of the vanes of the fan air guide could be constructed like the first vane.

[0024] A method for manufacturing a fan air guide according to the invention comprises providing a frame and attaching a plurality of vanes to the frame such that each of the vanes extends from the frame to a hub inside the frame. Each of the vanes comprises a first end part, a second end part and an intermediate part that extends between the first and second end parts. The method is characterized in further comprising twisting a first portion of the first end part of at least a first vane of the vanes around a longitudinal axis of the first portion in relation to the intermediate part of the first vane. This is to adjust a length of the first vane to a distance between the frame and the hub.

[0025] The method may further comprise twisting a first portion of the second end part of the first vane around its longitudinal axis in relation to the intermediate part of the first vane so as to adjust the length of the first vane to the distance between the frame and the hub.

[0026] Further, the method may comprise providing an element comprised in the hub inside the frame and attaching each of the vanes to the element.

[0027] The advantages of the different embodiments of the inventive fan air guide discussed above, are transferable to the corresponding embodiments of the inventive method for manufacturing the fan air guide.

[0028] It should be stressed that the steps of the inventive method need not be performed in the order mentioned above, in the detailed description or in the claims. Further, some steps of the inventive method may be performed simultaneously.

[0029] Still other objectives, features, aspects and advantages of the invention will appear from the following detailed description as well as from the drawings.

Brief Description of the Drawings

[0030] The invention will now be described in more detail with reference to the appended schematic drawings, in which

Fig. 1 is a schematic side view of an air heat exchanger provided with a fan air guide,
Fig. 2 is a perspective view of the fan air guide of Fig. 1 illustrating an upperside of the fan air guide,
Fig. 3 is an enlargement of a portion A of Fig. 2,
Fig. 4 is an enlargement of a portion B of Fig. 2,
Fig. 5 is a plan view of the fan air guide of Fig. 1 illustrating an underside of the fan air guide,
Fig. 6 is a side view of the fan air guide of Fig. 1,
Fig. 7 is an enlargement of a portion C of Fig. 6,
Fig. 8 is a plan view of a vane of the fan air guide of Fig. 1,
Fig. 9 is a plan view of the fan air guide of Fig. 1 in a non-finished state, illustrating the upperside of the fan air guide,
Fig 10 is an enlarged perspective view of an outer portion D (see Fig. 5) of the fan air guide of Fig. 1 in a finished state, illustrating the underside of the fan air guide, and,
Fig. 11 is a perspective view of a center portion of a fan air guide according to an alternative embodiment of the invention, in a non-finished state, illustrating an upperside of the fan air guide.

Detailed description

[0031] With reference to Fig. 1 an air heat exchanger 2 is illustrated. The air heat exchanger 2 comprises a fan (not visible), a fan guard 4 and a fan air guide 6. The fan guard 4 is connected to the fan air guide 6 at connection tabs 3 thereof (visible especially in Fig. 3). Further, the fan air guide 6 is at connection recesses 5 connected to a body 7 of air heat exchanger 2 by means of screws, nuts and washers (see Figs. 1 & 3). The connection between the fan air guide and the other components of the air heat exchanger will not be further discussed herein.

[0032] The fan is arranged to draw outside air through the air heat exchanger 2, as is illustrated by the arrows in Fig. 1. A brief description of an air heat exchanger was given by way of introduction, and since the present invention is not focused on the air heat exchanger 2 itself, it will not be described in further detail herein.

[0033] The fan air guide 6 is further illustrated in Figs. 2-7. It comprises a circular stainless steel frame 8 and a hub in the form of a circular stainless steel plate 10 arranged inside the frame 8 and concentrically therewith. The fan air guide 6 further comprises a plurality of similar vanes 12 extending radially from the frame 8 to the plate 10. A first one of these vanes 12, denoted 12', is illustrated in further detail in Fig. 8 and further described below. However, the description of the first vane 12' is valid for all the vanes 12.

[0034] The first vane 12' is elongated and it extends along a longitudinal axis A. The first vane 12' is made of sheet stainless steel and it comprises a first end part 14, a second end part 16 and a tapered intermediate part 18 extending between the first and second end parts 14 and 16. The transitions between these parts are illustrated by the dashed lines B1 and B2. In turn, the first end part 14 comprises a first portion 20 and a second portion 22 and the second end part 16 comprises a first portion 24 and a second portion 26. The transition between these portions are illustrated by the point-dashed lines B3 and B4. The second portion 22 of the first end part 14 is provided with a mounting hole 28 arranged centrered with respect to the longitudinal axis A. The second portion 26 of the second end part 16 is provided with two mounting holes 30 and 32 symmetrically arranged at opposite sides of the longitudinal axis A. Further, the intermediate part 18 of the first vane 12' is provided with a deformation hole 34 arranged close to the transition to the first end part 14 and centrered with respect to the longitudinal axis A. Similarly, the intermediate part 18 is provided with a deformation hole 36 arranged close to the transition to the second end part 16 and centrered with respect to the longitudinal axis A. The mounting and deformation holes will be further discussed below.

[0035] With reference to the figures, the frame 8 is at an underside thereof provided with an outwards extending brim 38, which in turn is provided with a mounting hole 40 (Fig. 3) for each of the vanes 12. Further, an edge portion of the plate 10 is provided with a corresponding pair of mounting holes 42 and 44 (Fig. 4) for each of the vanes 12. The first vane 12' (Fig. 8) is mounted inside the frame 8 such that the second portion 22 of the first end part 14 engages with an underside of the brim 38 by means of a rivet 46 (Figs. 3, 5 & 10) extending through the mounting hole 28 of the first vane 12' and one of the mounting holes 40 of the brim 38. Further, the second portion 26 of the second end part 16 engages with an underside of the plate 10 by means of two rivets 48 and 50 (Figs. 5 & 9) extending through the mounting holes 30 and 32, respectively, of the first vane 12' (Fig. 8) and the corresponding ones of the mounting holes 42 and 44 (Fig. 4), respectively, of the plate 10. Fig. 8 illustrates what the first vane 12' looks like in an undeformed state. The first vane' 12 is mounted inside the frame 8 in this undeformed state.

[0036] Thus, when the fan air guide 6 is to be manufactured, the frame 8 is first provided, Step A, and then the plate 10 is provided inside the frame 8, Step B. Each of the vanes 12 is then attached to the frame 8 (Step C) and the plate 10 (Step D) in the above described manner. Fig. 9 illustrate what the fan air guide 6 looks like after Steps A-D have been performed. Thereafter, each of the vanes 12 is rotated, as seen from the upperside of the plate 10, clock-wise around its longitudinal axis A. This rotation results in deformation of the vanes 12, more particularly twisting of their respective first portions 20 of the first end parts 14 (Step E), and simultaneous twisting of their respective first portions 24 of the second end parts 16 (Step F). After this rotation of the vanes 12, they will each comprise two first portions 20 and 24 which are twisted, in relation to the intermediate part 18 between the first portions 20 and 24, around the respective longitudinal axis A of the vanes. In other words, after the ro-

tation, the first portions 20 and 24 of the vanes will each be, at least partly, essentially helix shaped, the first portions 20 and the first portions 24 having opposite twisting directions as seen from the intermediate parts 18. Figs. 2, 5 and 10 illustrate the finished fan air guide 6, i.e. what the fan air guide looks like after Steps A-F have been performed.

[0037] With reference to Fig. 8, the above mentioned deformation holes 34 and 36 in the intermediate part 18 of the vanes 12 are provided to guide vane material towards the deformation zones, i.e. the first portions 20 and 24 of the vanes 12, in connection with vane rotation, such that the vane material required for "proper" (see below for explanation) deformation is available. Thereby, breakage of the vanes in connection with vane rotation may be avoided. The deformation holes 34 and 36 may also be of use in connection with rotation of the vanes. As an example, a screwdriver may be inserted in any of the deformation holes and rotated for vane rotation.

[0038] With reference to Fig. 8, the undeformed first vane 12' has a total length L, the first end part 14 has a length L1, the second end part 16 has a length L2 and the intermediate part 18 has a length L3. Clearly, L3 >> L1, L2 so as to optimize the capacity of the fan air guide since the intermediate part, much more than the first and second end part, is behind the desired function of the fan air guide, which is to increase the air throwing distance of the fan. When the first portions 20 and 24 of the first vane 12' are twisted, they get shorter which means that L1 and L2 vary with vane rotation. The intermediate part 18 of the first vane 12' is not twisted and its length L3 does not vary with vane rotation but is constant. In this specific example, before deformation of the first vane 12', L = 52,3 cm, L3 = 46,7 cm, L2 = 3,0 cm and L1 = 2,6 cm. These values can, however, be varied in an endless number of ways.

[0039] Thus, when the vanes 12 are "properly" deformed in the above described way, their length is reduced and adjustment of the vane length to a distance d (Fig. 5) between the frame 8 and the plate 10 is enabled. In this specific example, d = 48,65 cm, a diameter of the plate 10 is 28 cm, a maximum outer diameter (at the brim 38) of the frame 8 is 128,7 cm and an inner diameter of the frame is 125,3 cm. Thess values can, however, be varied in an endless number of ways. By rotatation of the vanes, the vanes may be firmly spanned between the frame and the plate which makes the resulting fan air guide rigid and strong, despite of the fact that the vanes are made of sheet metal, here sheet stainless steel. Typically, the more the vanes are twisted, the shorter, and thus more tensioned, they get. Naturally, this is true for "proper" deformation, i.e. up to a certain point beyond which further vane rotation causes the vane to "collapse". Then, further rotation will not result in increased vane tension but perhaps instead decreased vane tension and/or even vane breakage.

[0040] From the above follows that the degree of twisting of the vanes of the finished fan air guide is dependent upon the measures of the different components of the fan air guide and the desired final rigidity of the fan air guide. Thus, for example, the first and/or second portions of the vanes may be twisted between a tenth of a revolution and a quarter of a revolution, or less or more than that.

[0041] By a suitable rotation of the vanes, a desired vane orientation adapted to the specific application of the fan air guide may also be obtained, which is another advantage of the present invention.

[0042] With reference again to Fig. 8, different sections of the first vane 12' have different widths, the widths being measured transverse to the longitudinal axis A of the first vane. More particularly, the first portion 20 of the first end part 14 of the first vane 12' has a smallest width W1 that is smaller than a smallest width W2 of the second portion 22 of the first end part of the first vane, i.e. W1 < W2. Similarly, the first portion 24 of the second end part 16 of the first vane 12' has a smallest width W3 that is smaller than a smallest width W4 of the second portion 26 of the second end part of the first vane, i.e. W3 < W4. Thus, the first vane 12' is locally wider where it is arranged be attached to the frame 8 and the plate 10 which provides for a more safe engagement between the first vane and the frame and the plate, respectively. Further, the intermediate part 18 of the first vane 12' has a smallest width W5 (which in this specific non-limiting example happens to be approximately equal to W4) that is larger than the smallest widths of the first and second end parts, respectively, of the first vane, i.e. W5 > W1, W3. A more narrow vane section is more prone to twisting than a wider section. Thus, the twisting of the first vane 12' in connection with vane rotation will occur within the first portions 14 and 16 of the vane, as is desired. In this specific example, before deformation of the first vane 12', W1 & W3 = 1,4 cm and W2 & W4 & W5 = 2,8 cm. These values can, however, be varied in an endless number of ways.

[0043] The above described embodiment of the present invention should only be seen as an example. A person skilled in the art realizes that the embodiment discussed can be varied in a number of ways without deviating from the inventive conception.

[0044] As an example, the frame and/or plate need not be circular but may have other forms, for example an oval or polygonal form. Further, the hub need not be centred within the frame. In connection with such alternative embodiments, fan air guide design adjustments may be required. As an example, vanes of different lengths and/or shapes may be required.

[0045] In the fan air guide above, the hub consists of an element in the form of a plate. Differently designed hubs are naturally possible. As an example, Fig. 11 illustrates an alternative fan air guide 52 according to the present invention. Largely, the construction of the fan air guide 52 is similar to the construction of the fan air guide 6. However, the fan air guide 52 does not comprise a hub in the form of a plate 10. Further, the fan air guide 52 comprises vanes 54 meeting in a center of the frame.

The vanes 54 are connected by a bolt, nut and washer, jointly denoted 56. Naturally, other means for connecting the vanes are possible. Also, embodiments according to which the vanes themselves provides for their mutual connection, i.e. according to which no separate means for connecting vanes is necessary, are conceivable.

[0046] The vanes of the fan air guide above all have deformed, i.e. helix shaped, first end parts and second end parts. According to an alternative embodiment, all or some of the vanes could have deformed first end parts only, or deformed second end parts only.

[0047] The vanes of the fan air guide above are rotated clock-wise, as seen from the upperside of the plate 10, to cause deformation of the first and second end parts of the vanes. Naturally, the vanes could instead be rotated counterclockwise to cause the deformation.

[0048] In the above described embodiment, the first and second end parts of the vanes are firmly attached to the frame and the plate, respectively, before the vanes are rotated. Alternatively, one of the vane end parts could be firmly attached before, and the other one of the vane end parts could be firmly attached after, rotation of the vanes. Also, the vanes could be "properly" deformed prior to mounting of vanes between the frame and the plate. Consequently, the first portions 20 and the first portions 24 of the vanes need not have opposite twisting directions, as seen from the intermediate parts 18, like above, but may instead have the same twisting direction. The first portions 20 and/or the first portions 24 of the vanes may be twisted along their complete, or just a part of their, extension.

[0049] The vanes need not be made of sheet stainless steel but may be made of other sheet metals or even non-metals. Further, the vanes need not have the shape illustrated in Fig. 8. Rather, the shape of the vanes may be varied in numerous ways. Not all vanes need to be similar.

[0050] The vanes need not engage with the underside of a brim of the frame and the underside of the plate, like above. For example, the vanes could instead engage with an inside of the frame and periphery of the plate. As another example, the vanes could extend through apertures in the frame so as to engage with an outside of the frame. Thus, the vanes need not be provided with mounting holes for engagement with the frame and the plate but could be provided with other engagement means.

[0051] Other components than rivets could be used to secure the engagement between the vanes and the frame, and the vanes and the plate, e.g. screws and nuts, pins, hooks, etc.

[0052] For the above described vanes, the longitudinal axes for the first and second portions of the first and second end parts and the intermediate part coincide and equals the longitudinal axis A. Naturally, the longitudinal axes of the different parts and portions of the vanes need not coincide.

[0053] The above described fan air guide comprises an even number of vanes and the vanes are arranged in pairs. The vanes of each pair extend in parallel in opposite directions from the plate, i.e. diametrically across the frame. The fan air guide need not be constructed like this. For example, it may comprise an uneven number of vanes.

[0054] It should be stressed that the attributes first, second, etc. is used herein just to distinguish between species of the same kind and not to express any kind of mutual order between the species.

[0055] It should be stressed that a description of details not relevant to the present invention has been omitted and that the figures are not drawn according to scale. It should also be said that some of the figures have been more simplified than others. Therefore, some components may be illustrated in one figure but left out on another figure.

Claims

1. A fan air guide (6, 52) comprising a frame (8) and a plurality of vanes (12, 54), each of the vanes extending from a hub (10) inside the frame to the frame and engaging with the frame, and each of the vanes comprising a first end part (14), a second end part (16) and an intermediate part (18) extending between the first and second end parts, **characterized in that** a first portion (20) of the first end part of at least a first vane (12') of the vanes is twisted around its longitudinal axis (A) in relation to the intermediate part of the first vane for adaption of a length (L) of the first vane to a distance (d) between the frame and the hub.

2. A fan air guide (6, 52) according to claim 1, wherein the first vane (12') at least partly is made of sheet metal.

3. A fan air guide (6, 52) according to any of the preceding claims,
wherein the intermediate part (18) of the first vane (12') is provided with a hole (34) at the transition to the first end part (14) of the first vane.

4. A fan air guide (6, 52) according to any of the preceding claims,
wherein a smallest width (W5) of the intermediate part (18) of the first vane (12') is larger than a smallest width (W1) of the first end part (14) of the first vane.

5. A fan air guide (6, 52) according to any of the preceding claims,
wherein a smallest width (W1) of the first portion (20) of the first end part (14) of the first vane (12') is smaller than a smallest width (W2) of a second portion (22) of the first end part (14) of the first vane, the first portion (20) of the first vane being arranged between the second portion (22) and the intermediate part

(18) of the first vane.

6. A fan air guide (6, 52) according to any of the preceding claims,
wherein a first portion (24) of the second end part (16) of the first vane (12') is twisted around its longitudinal axis (A) in relation to the intermediate part (18) of the first vane for adaption of the length (L) of the first vane to the distance (d) between the frame (8) and the hub (10).

7. A fan air guide (6, 52) according to claim 6, wherein the first portion (20) of the first end part (14) of the first vane (12') and the first portion (24) of the second end part (16) of the first vane are twisted in opposite directions as seen from the intermediate part (18) of the first vane.

8. A fan air guide (6, 52) according to any of the preceding claims,
wherein the intermediate part (18) of the first vane (12') is provided with a hole (36) at the transition to the second end part (16) of the first vane.

9. A fan air guide (6, 52) according to any of the preceding claims,
wherein a smallest width (W5) of the intermediate part (18) of the first vane (12') is larger than a smallest width (W3) of the second end part (16) of the first vane.

10. A fan air guide (6, 52) according to any of the preceding claims,
wherein a smallest width (W3) of the first portion (24) of the second end part (16) of the first vane (12') is smaller than a smallest width (W4) of a second portion (26) of the second end part (16) of the first vane, the first portion (24) of the first vane being arranged between the second portion (26) and the intermediate part (18) of the first vane.

11. A fan air guide (6, 52) according to any of the preceding claims,
wherein a length (L3) of the intermediate part (18) of the first vane (12') is larger than a respective length (L1, L2) of the first and second end parts (14, 16) of the first vane.

12. A fan air guide (6, 52) according to any of the preceding claims,
wherein the hub (10) comprises an element (10, 56) with which each of the vanes (12, 54) engages.

13. A method for manufacturing a fan air guide (6, 52) comprising providing (Step A) a frame (8),
attaching (Step C) a plurality of vanes (12, 54) to the frame such that each of the vanes extends from a hub (10) inside the frame to the frame, each of the vanes comprising a first end part (14), a second end part (16) and an intermediate part (18) extending between the first and second end parts, **characterized in** further comprising
twisting (Step E) a first portion (20) of the first end part (14) of at least a first vane (12') of the vanes around its longitudinal axis (A) in relation to the intermediate part (18) of the first vane so as to adjust a length (L) of the first vane to a distance (d) between the frame and the hub.

14. A method according to claim 13, further comprising twisting (Step F) a first portion (24) of the second end part (16) of the first vane (12') around its longitudinal axis (A) in relation to the intermediate part (18) of the first vane so as to adjust the length (L) of the first vane to the distance (d) between the frame (8) and the hub (10).

15. A method according to any of claims 13-14, further comprising providing (Step B) an element (10, 56) comprised in the hub (10) inside the frame (8), and attaching (Step D) each of the vanes (12, 54) to the element.

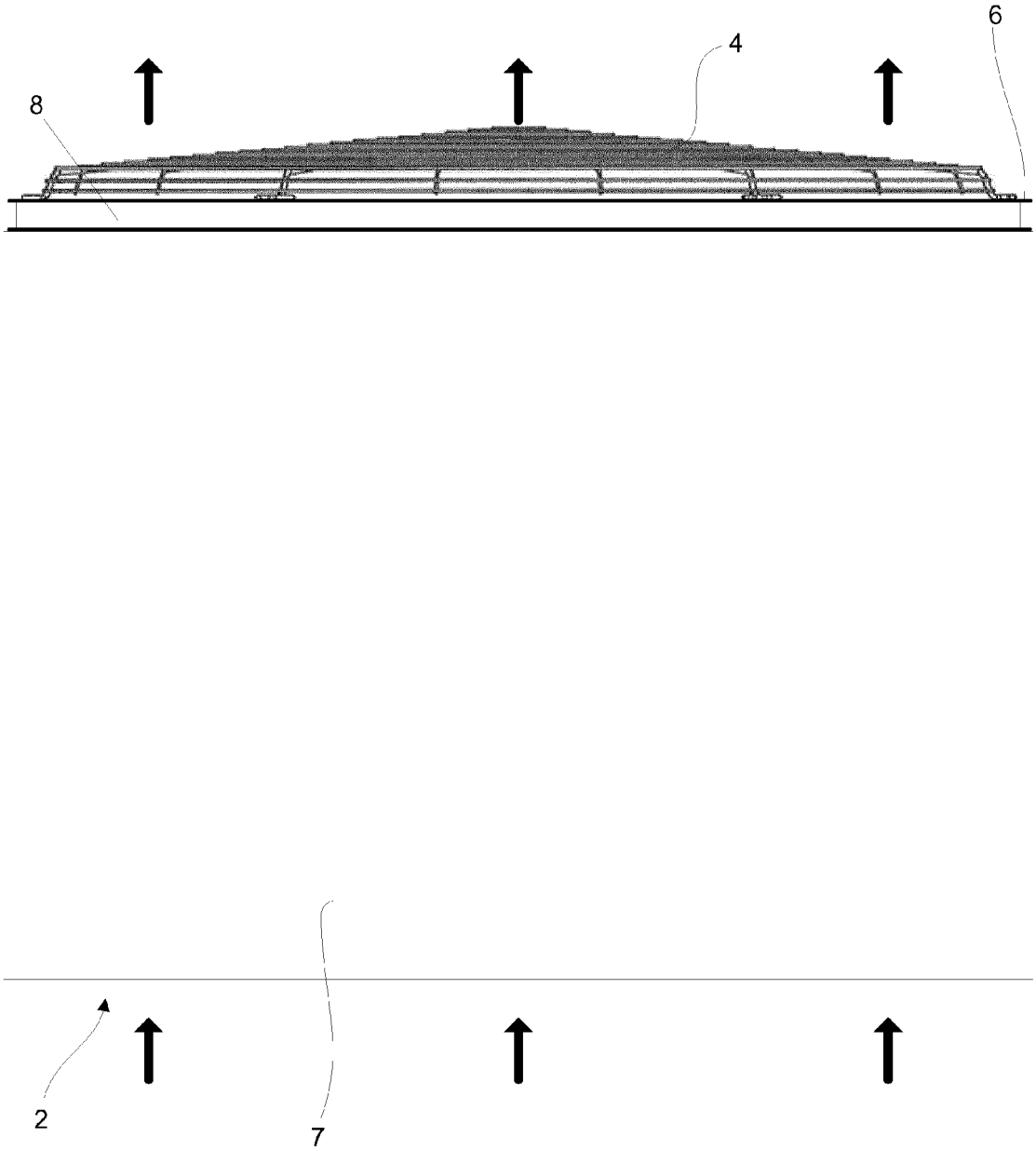

Fig. 1

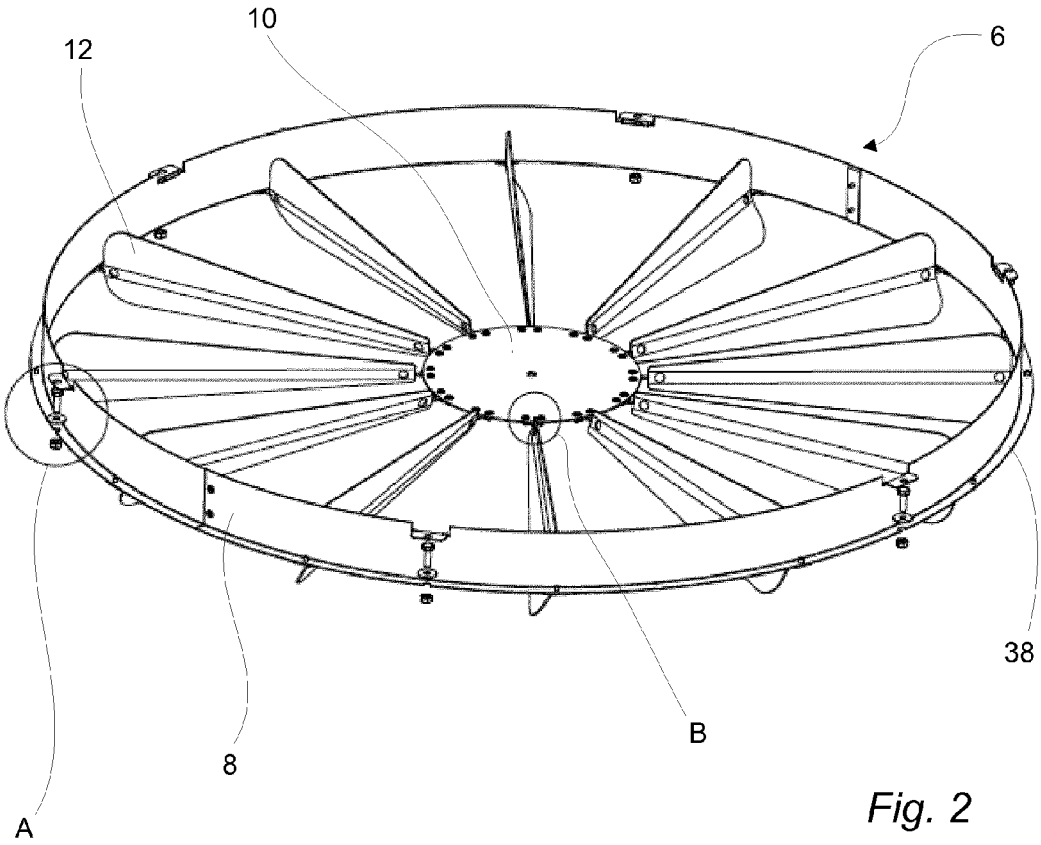

Fig. 2

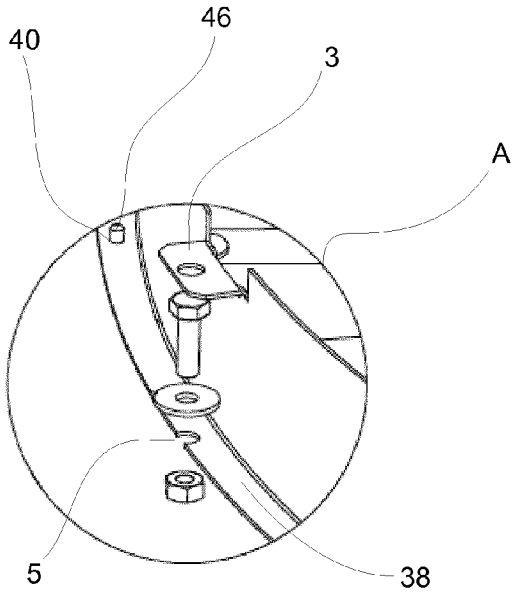

Fig. 3

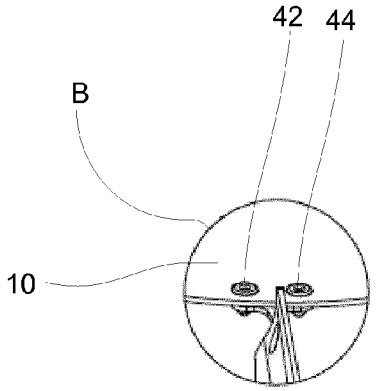

Fig. 4

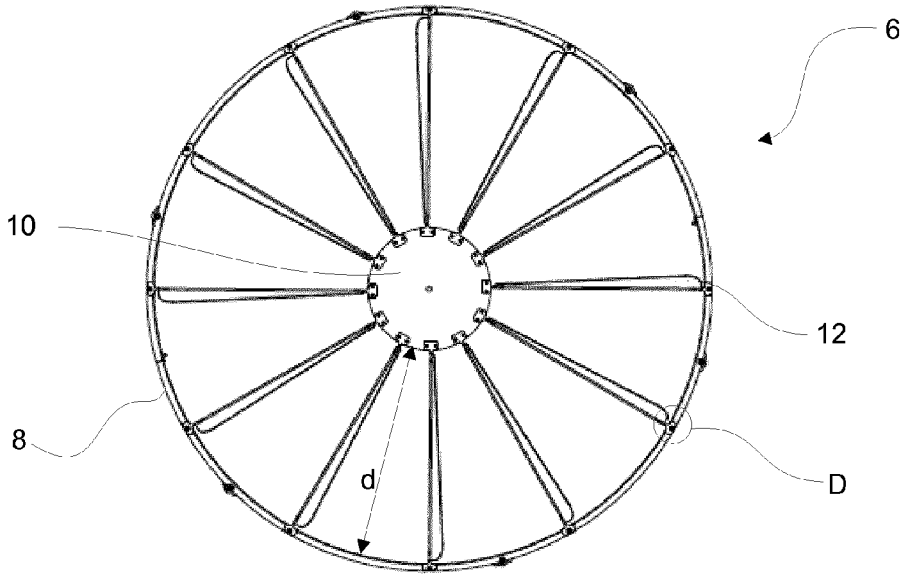

Fig. 5

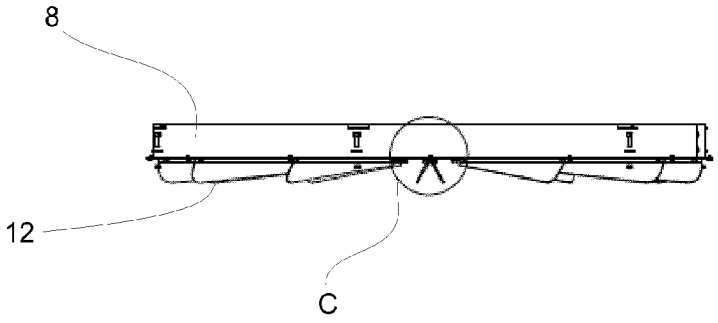

Fig. 6

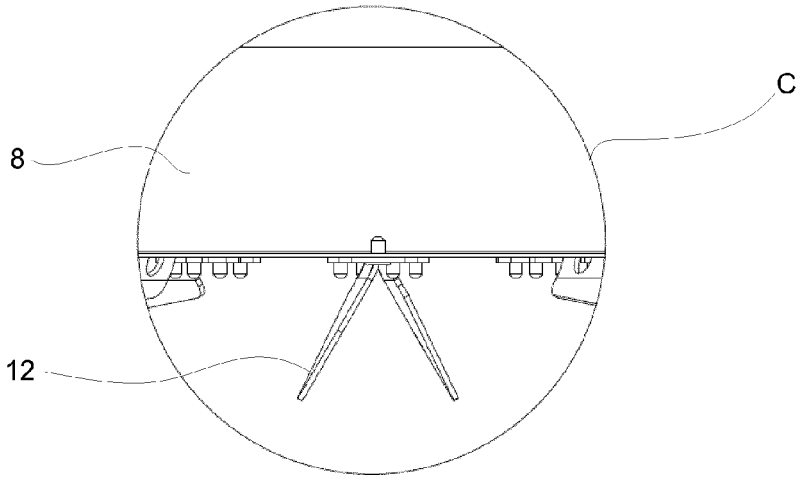

Fig. 7

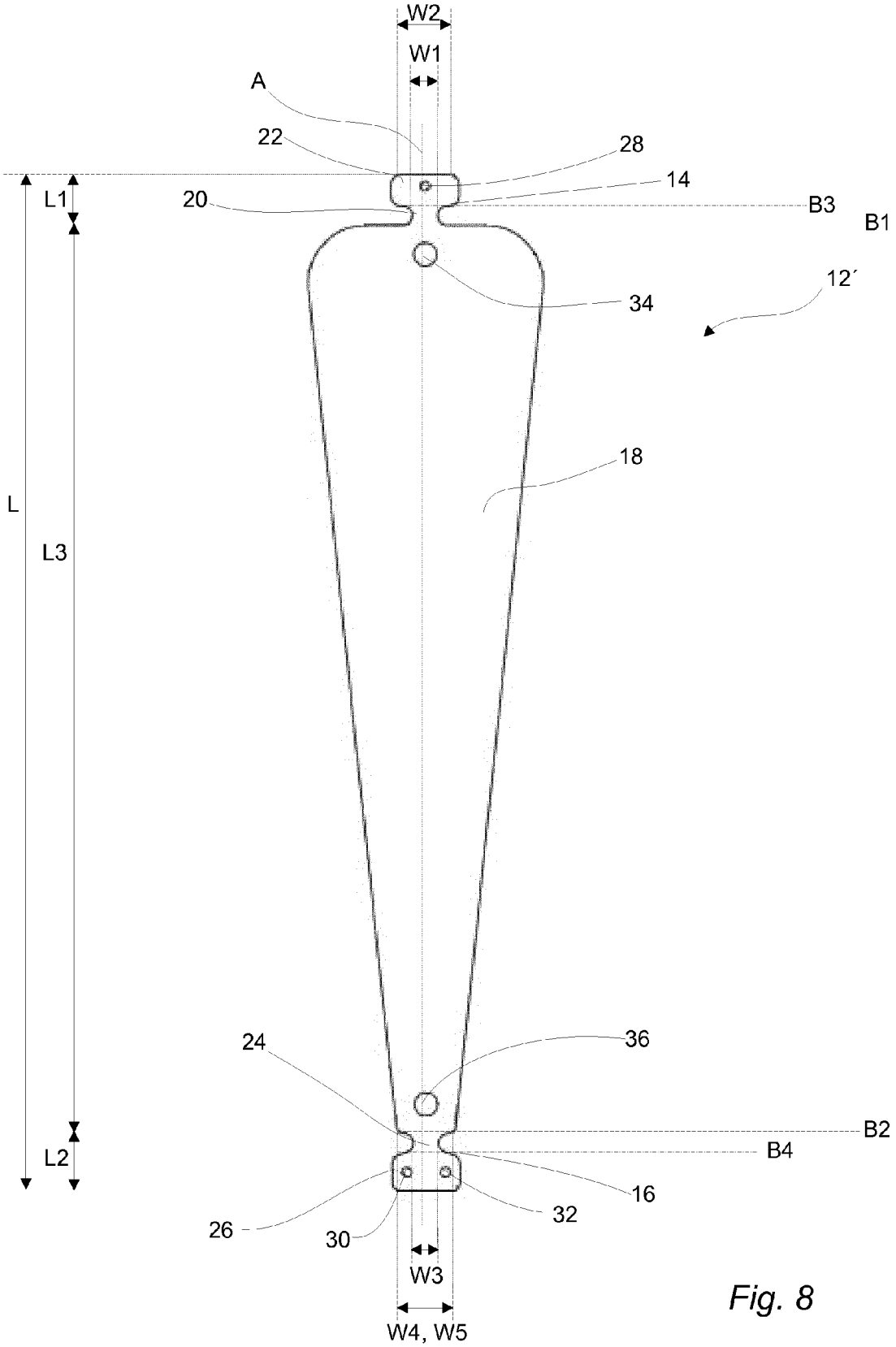
W2
W1
A
22
28
14
20
B3
B1
L1
12´
34
18
L
L3
24
36
B2
B4
L2
16
32
26
30
W3
W4, W5

Fig. 8

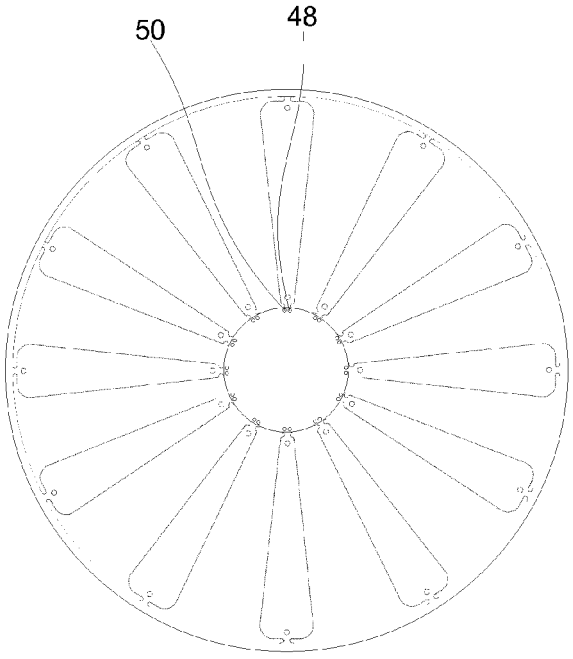

Fig. 9

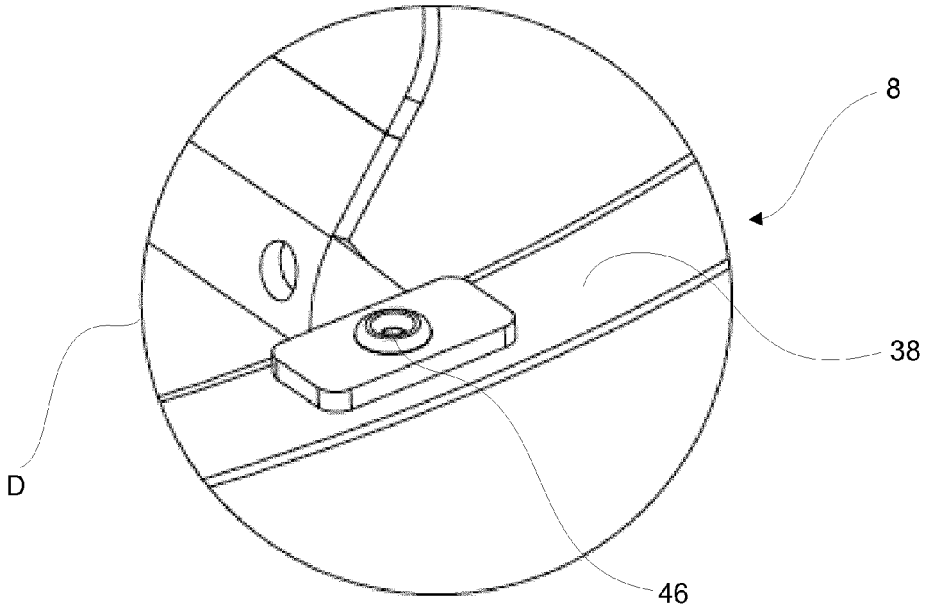

Fig. 10

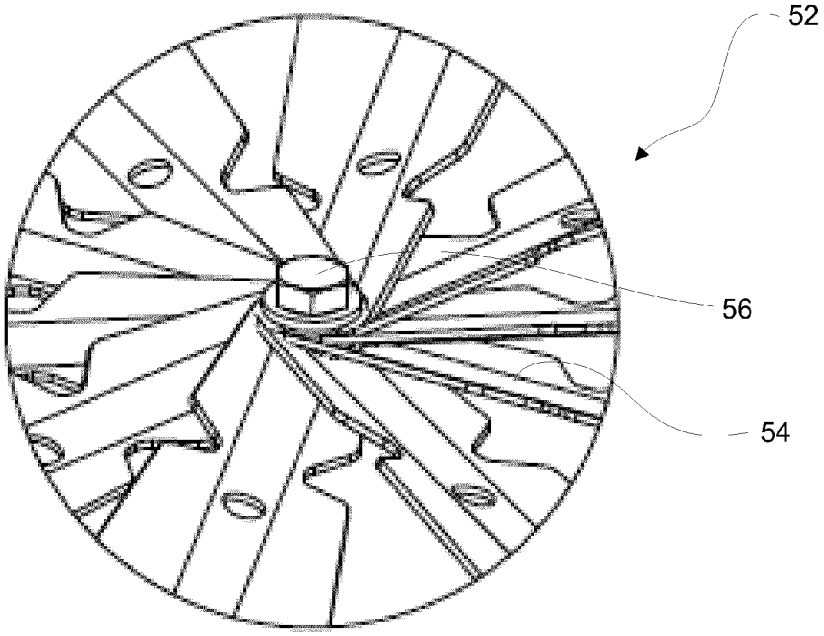

Fig. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 15 16 9078

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	WO 2007/004542 A1 (BOC EDWARDS JAPAN LTD [JP]; SAKAGUCHI YOSHIYUKI [JP]; TAKAADA TSUTOMU) 11 January 2007 (2007-01-11) * paragraphs [0024] - [0026] * * figures 2a-2c *	1-15	

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F04D
F01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 November 2015	De Tobel, David

CATEGORY OF CITED DOCUMENTS

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82