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(54) OUTDOOR UNIT FOR A HEAT PUMP HAVING A GRILLE MADE OF SEPARATE PARTS

(57) Outdoor unit (10) for a heat pump comprising a refrigerant circuit, the outdoor unit (10) comprising a casing (11) comprising a front, a fan (50) accommodated in the casing, the fan (50) having fan blades (55) rotatable about an axis of rotation (56), a grille (100) arranged at the front and covering the fan blades (55), the grille (100) comprising a plurality of openings (102) along air to pass the grille, wherein the grille comprises at least two separate parts (113, 114) each of the parts comprising at least one of the openings (102) .

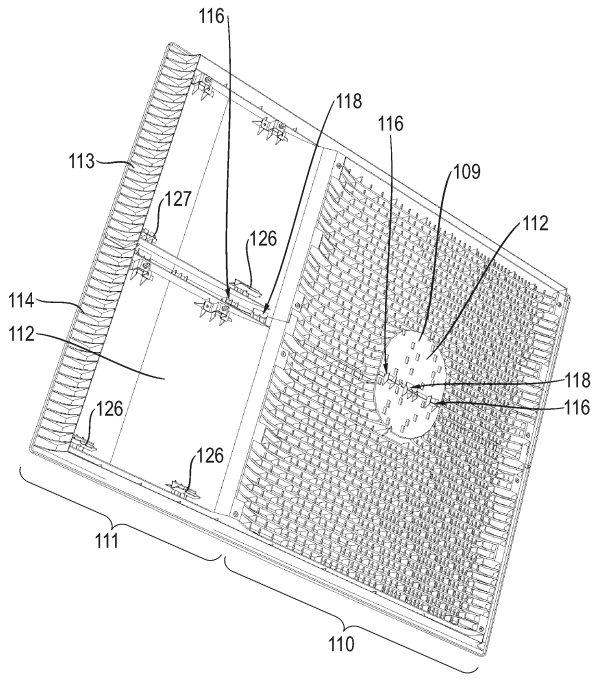

Fig. 6

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Description

Technical Field

[0001] The present disclosure relates to heat pumps for cooling and/or heating purposes. In particular, the disclosure relates to split-type heat pumps comprising an outdoor unit and at least one indoor unit. Even more particular, the disclosure relates to a heat pump using air as heat source.

Background

[0002] Outdoor units of air heat pumps comprise a casing accommodating a portion of the refrigerant circuit of the heat pump, including a heat source heat exchanger, and a fan for inducing an air flow through the heat source heat exchanger enabling heat exchange between the air flow and a refrigerant flowing through the heat source heat exchanger.

[0003] The fan has fan blades rotatable about an axis of rotation. In order to comply with industrial standards and regulations, particularly relating to finger safety (EN 60335-1:2012), a grille or fan guard is provided covering the fan blades. An example showing such an outdoor unit may be found in EP 3 348 842 A1.

[0004] Whereas outdoor units were in the past primarily arranged in hidden locations, such as on the roofs of buildings, the outdoor units are nowadays often installed in front of residential buildings and sometimes even right beside the front door.

[0005] From this perspective, there is a desire to improve the outer appearance of the outdoor units. In most of these outdoor units the grille is oriented vertically covering a portion of the front of the casing. Thus, the grille has a significant influence on the outer appearance of the entire outdoor unit. In addition, the outdoor units tend to become larger and/or the grille covers an entire front of the outdoor unit. This leads to an increased size of the grille. In general, the will is manufactured in an injection molding process. In case the grille becomes larger, the problem arises that it is in some cases no longer possible to mold the grille in a standard injection molding machine. The use of specified machines, however, will increase the costs. In addition large injection molded pieces tend to large tolerances and weak spots.

Summary

[0006] In view of the above, there is the desire to provide an outdoor unit for a heat pump allowing a larger grille at reasonable manufacturing costs and still fulfilling its original purpose of meeting the respective standards and regulations, particularly with respect to finger safety.

[0007] This aim may be achieved by an outdoor unit as defined in claim 1. Embodiments may be found in the dependent claims, the following description and the accompanying drawings.

[0008] According to a first aspect, an outdoor unit for a heat pump comprising a refrigerant circuit is suggested. The refrigerant circuit may at least comprise a heat source heat exchanger disposed in the outdoor unit, a heat consumer heat exchanger, disposed in the indoor unit, an expansion valve and a compressor connected by refrigerant pipes. The outdoor unit comprises a casing (may also be referred to as outer casing). The casing may have a front, a bottom, a top and opposite sides. A fan is accommodated in the casing, the fan having fan blades rotatable about an axis of rotation, and a grille (may also be referred to as fan guard) covering the fan blades. In this context, the grille comprises a plurality of openings allowing air to pass the grille. To put it differently, air is sucked in or blown out through the openings in a fan portion of the grille by the air flow generated by the fan. According to an embodiment, a bell mouth may be provided having an air flow opening, such as a circular airflow opening, centered relative to the axis of rotation of the fan blades. The grille may at least cover the air flow opening of the bell mouth.

[0009] An outer surface of the grille may be outwardly curved. Thus, the outer surface is curved from the left to the right and one may see the curvature in a top view of the outdoor unit. For example, the outer surface may be continuously curved in at least one direction such as a horizontal direction. Further, an inner surface of the grille may be curved parallel to the outer surface.

[0010] In the first aspect, the grille comprises at least two separate parts, wherein each of the parts comprises at least one of the plurality of openings (i.e. a part of the fan portion). To put it differently, at least some of the openings of the fan portion are located in one of the parts and some of the openings of the fan portion are located in the other one of the parts.

[0011] Due to the separation of the grille into the two parts, it is possible to use standard injection molding machines so that the grille may be produced at reasonable costs. To put it differently, even if the entire grille cannot be molded in a standard injection molding machine, each of the parts can.

[0012] According to a second aspect, the grille is horizontally separated into the two parts comprising an upper part and a lower part. To put it differently, the line of separation extends from the left to the right and, hence in a horizontal direction. In a particular example, the line of separation is a horizontal line.

[0013] Because the openings in the fan portion extends from the bottom to the top of the casing with only small portions of the grille having a closed surface at the very top and the very bottom, it is difficult to connect the two parts in these portions and achieve the necessary strength of the grille. Yet, by horizontally separating the grille, the two parts may be connected at the left and at the right so that a desired strength may be realized. As far as strength is concerned and in the mechanical finger safety test, which is defined in the standard EN 60335-1:2012, the test probe is pressed against the grille

with a force of 5N for a normal finger probe and 2.5N for a small finger probe. The grille has to withstand these forces against a front face of the grille.

[0014] According to a third aspect, the grille comprises a hub portion, the hub portion being arranged, in a view perpendicular to the front, in a region corresponding to a fan hub, the hub portion comprising a closed surface, wherein each of the parts comprises a part of the hub portion. In addition, the hub portion may be relatively thick in a direction parallel to the axis of rotation of the fan blades thus providing sufficient strength and rigidity. The hub portion may comprise an opening or openings but a major proportion of the hub portion should have the closed surface. An inner surface of the hub portion may protrude from the inner edge of at least some of the ribs towards the hub of the fan thus providing for a sufficient rigidity in this portion.

[0015] According to this aspect, the strength of the grille may be further enhanced in that it becomes possible to also connect the two parts to each other in the hub portion because the hub portion comprises a sufficiently strong closed surface.

[0016] According to a fourth aspect, the casing is in a view perpendicular to the grille separated into a machine chamber and a heat exchanging area, the heat exchanging area comprising the fan and the machine chamber comprising components of the refrigerant circuit of the heat pump, wherein the grille has the fan portion comprising the plurality of openings allowing air to pass the grille and a machine chamber portion having a closed surface, the machine chamber portion corresponding to the portion of the machine chamber, wherein each of the parts comprising a part of the machine chamber portion.

[0017] Accordingly, the grille may resemble a front panel of the casing. Thus, the grille provides for an improved outer appearance of the entire outdoor unit.

[0018] According to a fifth aspect, one of the parts has, in the part of the hub portion, an engagement member and the other of the parts has, in the part of the hub portion an engaging member being engaged with the engagement member. Alternatively or in addition, one of the parts has, in the part of the machine chamber portion, an engagement member and the other of the parts has, in the part of the machine chamber portion, an engaging member being engaged with the engagement member.

[0019] Consequently, means are provided for connecting the two parts enhancing the strength of the grille.

[0020] According to a sixth aspect, the engagement member/-s and the engaging member/-s at least form fittingly fix the two parts to each other in a direction perpendicular to the front of the casing.

[0021] As previously mentioned, in the mechanical finger safety test, which is defined in the standard EN 60335-1:2012, the test probe is pressed against the grille with a force of 5N for a normal finger probe and 2.5N for a small finger probe. The form fit of this aspect that provides strength to the grille at the connection between the two parts so that the test may be performed without the two parts separating from each other at the connection.

[0022] According to a seventh aspect, one of the parts has, in the part of the hub portion and/or in the part of the machine chamber portion, a fixation member and the other of the parts has, in the part of the hub portion and/or in the part of the machine chamber portion, an fixing member being engaged with the fixation member to fix the two parts to each other. Consequently the two parts look like one part and the strength is even further increased.

[0023] According to an eighth aspect, the grille extends from one side of the casing to another opposite side of the casing. As a consequence, the casing is, in a front view on the grille, not visible at the opposite sides. To put it differently, the grille extends at least to the opposite sides (edges) of the casing. In one example, the grille may even extend a short distance past the opposite sides (edges) of the casing. For instance, the grille may extend from one side of the casing to another opposite side of the casing in a horizontal direction. Alternatively, the grille may extend from one side of the casing to another opposite side of the casing in a vertical direction. In an even further example, the grille extends from one side of the casing to another opposite side of the casing in a vertical direction and in a horizontal direction.

[0024] According to this aspect, the grille may resemble a front panel of the casing. Thus, the grille provides for an improved outer appearance of the entire outdoor unit.

[0025] According to a ninth aspect, the two parts are independently fixed at the casing.

[0026] This may simplify mounting of the grille to the casing and thereby provides for ease of manufacture.

[0027] According to a tenth aspect, the two parts are fixed to each other independent from the casing.

[0028] This aspect provides for the advantage that the visual alignment between the two parts is increased for improved visual appearance and that the strength for the finger test is increased between the parts.

Brief Description of the Drawings

[0029] A more complete appreciation of the present disclosure and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings.

[0030] In the drawings,

Figure 1 shows a perspective view of an outdoor unit in accordance with the present disclosure;

Figure 2A shows a perspective front view of the outdoor unit of figure 1;

Figure 2B shows an enlarged perspective view of a portion of figure 2A;

Figure 3A shows a perspective top view of the outdoor unit of figure 1 with the top plate of the casing being removed;

Figure 3B shows a perspective top view of the outdoor unit of figure 1 with the top plate and the bell mouth of the casing being removed;

Figure 4 shows an enlarged perspective view of the grille of the outdoor unit in figure 1;

Figure 5 shows a rearview of the grille of the outdoor unit in figure 1;

Figure 6 shows a perspective rearview of the grille of the outdoor unit in figure 1;

Figure 7 shows an enlarged perspective view of the hub portion of figure 6;

Figure 8 shows a cross-section along the line 8-8 in figure 7;

Figure 9 shows the two parts of figure 8 being separated; and

Figure 10 shows an enlarged perspective view of the machine chamber portion of figure 6.

Detailed Description

[0031] An embodiment will now be explained with reference to the drawings. It will be apparent to those skilled in the field of heat pumps from this disclosure that the following description of the embodiment is provided for illustration only and not for the purpose of limiting the invention as defined by the appended claims.

[0032] Figure 1 shows a perspective view of an outdoor unit 10 of a split type heat pump. The heat pump comprises a refrigerant circuit, at least comprising a heat source heat exchanger 30, a compressor (not visible), a heat consumer heat exchanger (not shown), such as an indoor heat exchanger, and an expansion valve connected by refrigerant pipes.

[0033] The shown outdoor unit 10 comprises a casing 11. The casing 11 has a bottom plate 12. Feet 13 (see figure 2A) for mounting the outdoor unit on a horizontal surface or via brackets to a vertical wall are fixed to the bottom plate 12. Further, the casing 11 has a top plate 14 and a side plate 15. In the shown embodiment, the side plate 15 extends around a rearward corner of the outdoor unit 10 being connected to (integrally formed with/forming a one piece structure with) a back plate 16 of the casing 11.

[0034] As will be best visible from figure 3A and 3B, having the top plate 14 removed, the heat source heat exchanger 30 occupies a part of the rear side of the casing 11 and the side of the casing 11 opposite to the side plate 15. The heat source heat exchanger 30 is "L" - shaped in a top view.

[0035] The front side of the casing 11 is closed by a front plate 17 and a bell mouth 18. The front plate 17 also extends around the forward corner of the casing 11 forming part of the side of the casing 11.The bell mouth 18 defines an air flow opening 19 (see also figure 2A). In the shown embodiment, the air flow opening 19 is circular.

[0036] Further and as best visible in figure 3A and 3B, the casing 11 is separated by a partition wall 20 into a machine chamber 21 and an air chamber 22 (heat exchanging area). In the shown configuration, the separation is in a horizontal direction, that is from the left to the right, wherein the machine chamber 21 is disposed on the right and the air chamber 22 is disposed on the left.

[0037] The machine chamber 21 is, thus, formed by the back plate 16, the side plate 15, the front plate 17 and the partition wall 20. The air chamber 22 is formed by the heat source heat exchanger 30, the bell mouth 18 and the partition wall 20.

[0038] The machine chamber 21 may accommodate components of the refrigerant circuit such as the compressor and the expansion valve and/or portions of the control of the heat pump. In addition, the heat source heat exchanger 30 may at one end extend into the machine chamber 21 so as to connect refrigerant pipes of the heat source heat exchanger 30 to the remainder of the refrigerant circuit.

[0039] The casing 11 further accommodates a fan 50. The fan 50 is accommodated in the air chamber 22. More particularly, the fan 50 is supported on the bottom plate 12 via a support structure 51. A fan motor 52 is mounted to the support structure 51. The fan 50 further comprises a fan rotor 53 having a fan hub 54 mounted to the fan motor 52. A plurality of fan blades 55 (in the present embodiment three) extend radially outwardly from the fan hub 54. The fan rotor 53 and, hence, the fan blades 55 are rotatable about an axis of rotation 56 by the fan motor 52.

[0040] The fan 50 is mounted with the axis of rotation 56 concentric to the air flow opening 19 of the bell mouth 18. Even further and as apparent from figure 3A, the bell mouth 18 has an annular rim 23 at the circumference of the air flow opening 19. The fan blades 55 partly enter the rim 23 of the bell mouth 18.

[0041] A grille 100 is, as a fan guard, attached to the casing 11 opposite to the back plate 16/a back side of the casing 11 at a front side of the casing 11. In particular, the grille 100 is mounted to the bell mouth 18 and the front plate 17. One purpose of the grille 100 is to meet e.g. the standard EN 60335-1:2012, relating to finger safety, that is to prevent that a finger comes into contact with the fan blades 55 of the fan 50 and consequently to avoid injuries.

[0042] In the shown embodiment, an outer surface 101 of the grille 100 is outwardly curved (see top view in figure 3A and 3B). As a result, the distance D (minimum dis-

tance) between the fan blades 55 and the outer surface 101 of the grille 100 differs at different locations of the outer surface 101. In particular, the distance D differs along the horizontal direction (from the left to the right) in which the outer surface 101 is curved.

[0043] The distance D between the fan blades 55 and the outer surface 101, particularly the minimum distance is indicated in figure 3B. In particular, the distance D is defined as the distance of that point on the fan blades 55, which is closest to the outer surface 101 of the grille 100, to the outer surface 101 of the grille 100. Also visible from figure 3B is that the maximum distance D_{Max} is offset relative to the axis of rotation 56 to the right and, hence, situated in the area A2 (see later).

[0044] Finger safety according to the standard EN 60335-1:2012 may, on the one hand, be achieved by defining a sufficiently large safety distance between the outer surface 101 of the grille 100 and the fan blades 55.

[0045] Referring to figure 2A, the grille 100 is divided into a fan portion 110 covering the fan 50 or more particularly the bell mouth 18 and a machine chamber portion 111 covering a portion of the casing 10 defining the machine chamber 21.

[0046] As shown in figure 2A and 2B as well as figure 4, the grille 100 comprises, in the fan portion 110, at least in the area of the air flow opening 19, a plurality of openings 102. The openings 102 allow air to flow through the grille 100 and, hence, through the heat source heat exchanger 30. Thus, the size of the openings 102 influences the flow resistance of the air flow through the grille 100. However, depending on the safety distance between the outer surface 101 of the grille 100 and the fan blades 55, the smallest dimension of the openings 102 is additionally limited by the standard EN 60335-1:2012 relating to finger safety.

[0047] In the particular embodiment, the outer surface 101 is particularly defined by a front edge 103 of a plurality of parallel horizontal ribs 104 (first horizontal ribs). The horizontal ribs 104 are equally distanced to each other and extend over the entire front of the grille 100. Hence, one may consider the front edges 103 of the horizontal ribs 104 to be outwardly curved relative to a plane defined by the most forward point on each of the fan blades 55.

[0048] The openings 102 are formed by a plurality of vertical ribs 105 (second vertical ribs) extending between two adjacent horizontal ribs 104. The vertical ribs 105 also extend substantially parallel to each other. In this context "substantially" means that due to the curvature, a slight deviation from the parallel orientation between the vertical ribs 105 may occur. In particular, if a front edge 106 of the vertical ribs 105 is always oriented parallel to the front edge 103 of the horizontal ribs 104, the vertical ribs 105 will not be perfectly parallel to each other.

[0049] The vertical ribs 105 comprise smaller ribs 107 and the larger ribs 108. The smaller ribs 107 have a smaller depth in the direction of or parallel to the direction of the axis of rotation 56 than the larger ribs 108. Thus, the front edge 106 of the smaller ribs 107 is displaced towards the back with respect to the front edges 106 of the larger ribs 108 relative to the front edge 103 of the horizontal ribs 104. As a consequence, in some viewing angles (see figure 4) the smaller ribs 107 are not visible, enhancing the entire outer appearance of the grille 100 and, therefore, the outdoor unit 10.

[0050] In addition, as will be best visible from figures 2B and 4, the larger ribs 108 are in a vertical direction not aligned. Rather, larger ribs 108 in adjacent rows in a vertical direction are offset to each other in the horizontal direction. Thus, any strict geometric arrangement of the ribs is diluted and the outer appearance is enhanced.

[0051] In addition and as will be apparent from particularly figures 2A and 2B, the distances between adjacent smaller ribs 107 are different over the entire front of the grille 100. In one example, the distances between smaller ribs 107 between two adjacent larger ribs 108 in the horizontal direction may be the same.

[0052] To the contrary, the distances between adjacent larger ribs 108 may be the same over the entire front of the grille 100. As the smaller ribs 107 are under certain angles not visible as mentioned above, the outer appearance is, hence, dominated by the larger ribs 18. Again this has an influence on and improves the outer appearance of the outdoor unit 10.

[0053] Generally, two requirements may be used to comply with the standard EN 60335-1:2012 for mechanical finger safety. One requirement is the (minimum) safety distance D between the fan blades 55 and the outer surface 101 of the grille 101. The other requirement is the maximum allowable size (smallest dimension) of the openings of the grille. In regard of the latter, the smallest dimension of each of the openings is relevant.

[0054] In the present embodiment, the openings are defined by the horizontal ribs 104 and the vertical ribs 105 and are rectangular, particularly slot shaped. The smallest dimension of the openings 102 in regard of finger safety is in the present example defined by the distance between adjacent vertical ribs 105.

[0055] In order to test whether the outdoor unit complies with said standard, test probes as defined in IEC 61032 are used. In particular, a test probe B as defined in IEC 61032, as normal finger test probe (resembling fingers as of the age of 14 and older), and a test probe 18 as defined in IEC 61032, as small finger test probe (resembling fingers as of the age of 3 until the age of 14), are used. In the test, which is defined in the standard EN 60335-1:2012, the test probe is pressed against the grille with a force of 5N for the normal finger probe and 2.5N for the small finger probe.

[0056] Further, in the present example, the outer surface 101 of the grille 100 is curved so that the distance D between the fan blades 55 and the outer surface 101 of the grille 100 differs.

[0057] Accordingly, in the present embodiment, the grille 100 has in its fan portion 110 two areas A1 and A2. In the present example, the areas A1 and A2 are separated by a vertical line, which may be centered on the

axis of rotation 56 of the fan 50 (see figure 2A).

[0058] In the area A2, the distance D is larger than a first threshold, wherein the first threshold represents the required safety distance for both a first group of humans, such as humans from the age of 3 to 14 (children) and a second group of humans, such as humans from the age of 14 and older (adults). Thus, the first threshold may be 80.0 mm (±0.2mm tolerance).

[0059] Thus, in the area A2, the size of the openings may be "freely" selected as regards the smallest dimension at a minimum safety distance of the first threshold. Thus, the distance between the vertical ribs 105 is not of high relevance in the area A2 and may be larger.

[0060] To the contrary, in the area A1, the distance D is not more than the first threshold, but may be selected to be larger than a third threshold. The third threshold represents the required safety distance for humans from the age of 3 to 14 (children). Thus, the third threshold may be 57.9mm (±0.15mm tolerance).

[0061] In this case, however, the safety distance D in the area A1 is not sufficient for humans from the age of 14 and older (adults). Accordingly, the smallest dimension of the openings 102 must be reduced to meet the standard for finger safety.

[0062] In the present example the smallest dimension of the openings 102, even though the smallest dimension may be different between different openings 102 in the area A1, is selected to be not more than a second threshold. The second threshold represents the maximum allowable smallest dimension for openings if the safety distance for humans from the age of 14 and older (adults) is not met or not more than the first threshold. Thus, the second threshold may be 12mm +0.00/- 0.05.

[0063] Accordingly, in the area A1, the finger safety for both children and adults is achieved by both the distance D (for children) and the smallest dimension of the openings 102 (for adults).

[0064] In the area A2, the finger safety for both children and adults is achieved by mainly the distance D.

[0065] As indicated above, the distance between the vertical ribs 105 differs between the area A1 and the area A2. In order not to have an abrupt change of the distance between adjacent vertical ribs 105 from the first area A1 to the second area A2, the distance between adjacent vertical ribs gradually changes (increases) at least in the first area A1 towards the second area A2. Yet, according to another embodiment, the distance between adjacent vertical ribs 105 may gradually increase over the entire fan portion 110 in the horizontal direction from the first area A1 to the second area A2, that is from the left to the right in the present embodiment. In this context, "gradually increase" does not necessarily mean that the distance between each and every adjacent vertical ribs 105 needs to change. As previously mentioned, the distance between smaller ribs 107 arranged between two adjacent larger ribs 108 may be the same. Thus, "gradually" also encompasses that the distance between the vertical ribs changes in groups.

[0066] As can be seen from figure 2A and figure 5, the grille 100 has in its machine chamber portion 111 a closed surface 112 without openings 10 and 2. However, the horizontal ribs 104 also extend into and over the machine chamber portion 111.

[0067] In addition, the grille 100 has a hub portion 109 corresponding to the fan hub 54 in which no or less openings 102 are provided.

[0068] Moreover, figure 5 represents that the grille 100 in the example consists of a first part 113 and a second part 114. This particularly simplifies the molding process of the grille 100. In particular, each part 113 and 114 is smaller as compared to the entire grille 100. Accordingly, the parts 113 and 114 may be manufactured in a standard injection molding machine and small tolerances and fewer weak points may be achieved.

[0069] In the example, the two parts 113 and 114 are separated along a horizontal line of separation 119 (figure 5) into an upper part 113 and a lower part 114.

[0070] In order to connect and fix the parts 113 and 114 together, engagement members 115 and engaging members 116 as well as fixation members 117 and fixing members 118 are provided on the upper part 113 and the lower part 114, respectively.

[0071] The engagement members 115 and engaging members 116 primarily serve for a better alignment of the parts 113 and 114 to each other, support the aesthetic appearance of the grille 100 and compensate for tolerances of the two parts 113, 114 resulting from the molding process. In addition, the engagement members 115 and engaging members 116 serve to increase the strength of the grille 100 in a direction perpendicular to the front of the grille 100. The engagement members 115 and engaging members 116 are engaged in order to create from fit between them in a direction along the axis of rotation 56 of the fan 50, preferably in both directions towards and away from a front of the grille 100.

[0072] The upper part 113 comprises a plurality of horizontal hooks 120 hooking behind a top edge 121 of the lower part 114, whereby the upper part 113 cannot be pulled forward and be separated from the lower part 114.

[0073] The lower part 114 comprises a plurality of protrusions 122 forming a support for a lower edge 123 of the upper part 113 and preventing pushing of the upper part 113 toward the fan 50 away from the lower part 114.

[0074] The combination of the hooks 120 and the top edge 121 as well as the combination of the protrusions 122 and the lower edge 123 may respectively be considered as the engagement members 115 and engaging members 116.

[0075] The fixation members 117 and the fixing members 118 rather serve for connecting the parts 113 and 114 in a vertical direction preventing separation of the parts 113 and 114 from each other.

[0076] In this context, the fixation member 117 is configured as a shoulder 124 protruding from an inner surface of the hub portion 109 toward the fan 50, particularly the fan hub 54. The fixing member 118 is configured as

a clip 125. Thus when moving the upper part 113 and the lower part 114 towards each other as indicated by the arrow in figure 9, the clip 125 catches over an upper surface of the shoulder 124 thus creating a form fit in a vertical direction preventing separation of the parts 113 and 114.

[0077] Moreover, as best visible in figures 2A, 3B and 6, the horizontal ribs 104 pass over to hub portion 109. Moreover, the hub portion 109 protrudes towards the fan hub 54 and has a substantially closed surface 112 at a side facing the fan 50. Thus, a certain material thickness of the grille 100 is achieved in the hub portion 109.

[0078] A plurality of the protrusions 122 and a plurality of the hooks 121 are provided in the hub portion 109. Additionally, also a clip 125 is provided in the hub portion.

[0079] In addition and as previously mentioned, the grille 100 comprises a closed surface 112 in the machine chamber portion 111. Accordingly also this portion is used to arrange engagement members 115 and engaging members 116 as well as fixation members 117 and fixing members 118. In particular, two clips 125 and a plurality of protrusions 122 and hooks 120 are provided in the machine chamber portion 111.

[0080] To put it differently, those portions of the grille providing for a sufficient rigidity are provided with the engagement members 115 / engaging members 116 as well as fixation members 117 / fixing members 118.

[0081] Connecting the parts 113 and 114 guarantees the visual alignment of the parts 113 and 114 and enhances the stability of the grille 100. In particular, during the finger test as mentioned above, a force is applied when pressing the finger into the openings 102. The grille 100 needs to withstand at least those forces. Particularly the use of the hub portion 109 for this purpose has significant advantages as it is located in the center of the fan portion 110.

[0082] In addition, the parts 113 and 114 are respectively connected to the casing 10.

[0083] For this purpose, the lower part 114 and the upper part 113 comprise attachment preparations.

[0084] In one example, the lower part 114 and the upper part 113 each comprise a hanger 126 for example mounted to an inner surface of the grille 100 by the means of screws 127.

[0085] Additionally, fingers 128 may be attached to the inner surface of the grille 100.

[0086] In order to mount the grille 100 on a front of the casing 11, the hangers 126 are placed on respective counterparts on the front side of the casing 11 with the lower part 114 being slighted tilted forward so that the lower part 114 is supported in a vertical direction by the hangers on the counterparts on the casing. Subsequently, the lower part 114 is tilted towards the casing 11, whereby the fingers 128 are inserted in respective catching holes on the casing 11 for fixing the lower part 114 to the casing 11.

[0087] Subsequently, the lower edge 123 of the upper part 113 is placed or engaged with the respective protrusions 122 and the hooks 120 are hooked onto the top edge 121 of the lower part 114 with the upper part 113 being slightly tilted forward. At the same time, the hangers 126 of the upper part 113 are supported on the respective counterparts on the front side of the casing 11 with the upper part 113 being slightly tilted forward. Finally, the upper part 113 is tilted towards the casing 11 and the fingers 128 are inserted into respective catching holes on the casing 11 for fixing the upper part 113 to the casing 11. During this process also the clips 125 catch behind or over the upper surface of the respective shoulders 124, thus fixing the lower part 114 and the upper part 113 together in a vertical direction.

[0088] Due to the alignment of and the connection between the parts 113 and 114, the outer surface 101 of the grille 100 provides the impression of a single part grille 100. In addition, a sufficiently strong grille 100 to satisfy the requirements of the finger safety test mentioned above is realized.

[0089] As explained earlier, the grille 100 extends over the entire front side of the casing and therefore resembles or represents a front panel of the outdoor unit 10. As a regular maintenance of the outdoor unit, particularly of components within the machine chamber 21, is required, the outdoor unit 10 needs to be configured to allow access to the machine chamber 21. However, it may be cumbersome to each and every time detach the entire grille 100. Thus, in order to enhance serviceability, at least the back plate 16 (in the present example the back plate 16 and the side plate 15) is detachable so as to give access to the machine chamber 21.

It is to be understood that the present description of an embodiment is not considered to be limiting. Rather several modifications may be realized by the skilled person. For example, more than the two areas A1 and A2 may be defined. In addition, the two areas do not necessarily have to be arranged side-by-side and be separated by a straight line. Rather, the areas can also be separated by non-straight lines or be defined by concentric circles.

[0090] Further, the outer surface 101 of the grille 100 is curved in only one direction, namely the horizontal direction. It may be curved in a different direction such as the vertical direction and it may be curved in more than one direction such as in the horizontal and the vertical direction.

[0091] Furthermore, the present description has been made in view of the standard EN 60335-1:2012 for finger safety. In different countries, different standards may apply so that the thresholds given above may differ from country to country. Thus, the present disclosure is to be understood in that the thresholds are distinguished between a first group and a second group of humans as indicated above and not necessarily limited to the groups as defined above and given in EN 60335-1:2012.

[0092] In addition, the grille 100 may as well be separated into more than two parts. Also, the grille may be separated along different lines such as into a left part and a right part with a line of separation being substantially

vertically.

Reference List

[0093]

10 outdoor unit
11 casing
12 bottom plate
13 feet
14 top plate
15 side plate
16 back plate
17 front plate
18 bell mouth
19 air flow opening
20 partition wall
21 machine chamber
22 air chamber
23 rim

30 heat source heat exchanger

50 fan
51 support structure
52 fan motor
53 fan rotor
54 fan hub
55 fan blade
56 axis of rotation

100 grille
101 outer surface
102 opening
103 front edge
104 horizontal rib
105 vertical rib
106 front edge
107 smaller rib
108 larger rib
109 hub portion
110 fan portion
111 machine chamber portion
112 closed surface
113 first part (upper part)
114 second part (lower part)
115 engagement member
116 engaging member
117 fixation member
118 fixing member
119 line of separation
120 hook
121 top edge
122 protrusion
123 lower edge
124 shoulder
125 clip
126 hanger
127 screw
128 fixing finger

Claims

1. Outdoor unit (10) for a heat pump having a refrigerant circuit, the outdoor unit (10) comprising:

   a casing (11) comprising a front,
   a fan (50) accommodated in the casing, the fan (50) having fan blades (55) rotatable about an axis of rotation (56),
   a grille (100) arranged at the front and covering the fan blades (55), the grille (100) comprising a plurality of openings (102) allowing air to pass the grille,
   characterized in that
   the grille comprises at least two separate parts (113, 114) each of the parts comprising at least one of the openings (102) .

2. Outdoor unit according to claim 1, wherein the grille is horizontally separated into the two parts comprising an upper part (113) and a lower part (114).

3. Outdoor unit according to claim 1 or 2, wherein the grille (100) comprises a hub portion (109), the hub portion (109) being arranged, in a view perpendicular to the front, in a region corresponding to a fan hub (54), the hub portion (109) comprising a closed surface, wherein each of the parts (113, 114) comprises a part of the hub portion (109).

4. Outdoor unit according anyone of the preceding claims, wherein the casing (11) is in a view perpendicular to the grille (100) separated into a machine chamber (21) and a heat exchanging area (22), the heat exchanging area comprising the fan (50) and the machine chamber (21) comprising components of the refrigerant circuit of the heat pump, wherein the grille (100) has a fan portion (110) comprising the plurality of openings (102) and a machine chamber portion (111) having a closed surface (112), the machine chamber portion (111) corresponding to the portion of the machine chamber (21), wherein each of the parts comprising a part of the machine chamber portion (111).

5. Outdoor unit according to claim 3 or 4, wherein one of the parts has, in the part of the hub portion (109) and/or in the part of the machine chamber portion (111), an engagement member (115) and the other of the parts has, in the part of the hub portion (109) and/or in the part of the machine chamber portion (111), an engaging member (116) being engaged with the engagement member (115).

6. Outdoor unit according to claim 5, wherein the engagement member/-s (115) and the engaging member/-s (116) are engaged and at least form fittingly fix the two parts (113, 114) to each other in a direction perpendicular to the front of the casing.

7. Outdoor unit according to any one of claims 3 to 6, wherein one of the parts has, in the part of the hub portion (109) and/or in the part of the machine chamber portion (111), a fixation member (117) and the other of the parts has, in the part of the hub portion (109) and/or in the part of the machine chamber portion (111), an fixing member (118) being engaged with the fixation member (117) to fix the two parts (113, 114) to each other.

8. Outdoor unit according to anyone of the preceding claims, wherein the grille (100) extends from one side of the casing (13) to another opposite side of the casing (11), particularly in a horizontal direction.

9. Outdoor unit according to anyone of the preceding claims, wherein the two parts (113, 114) are independently fixed at the casing (11).

10. Outdoor unit according to anyone of the preceding claims, wherein the two parts (113, 114) are fixed to each other independent from the casing (11).

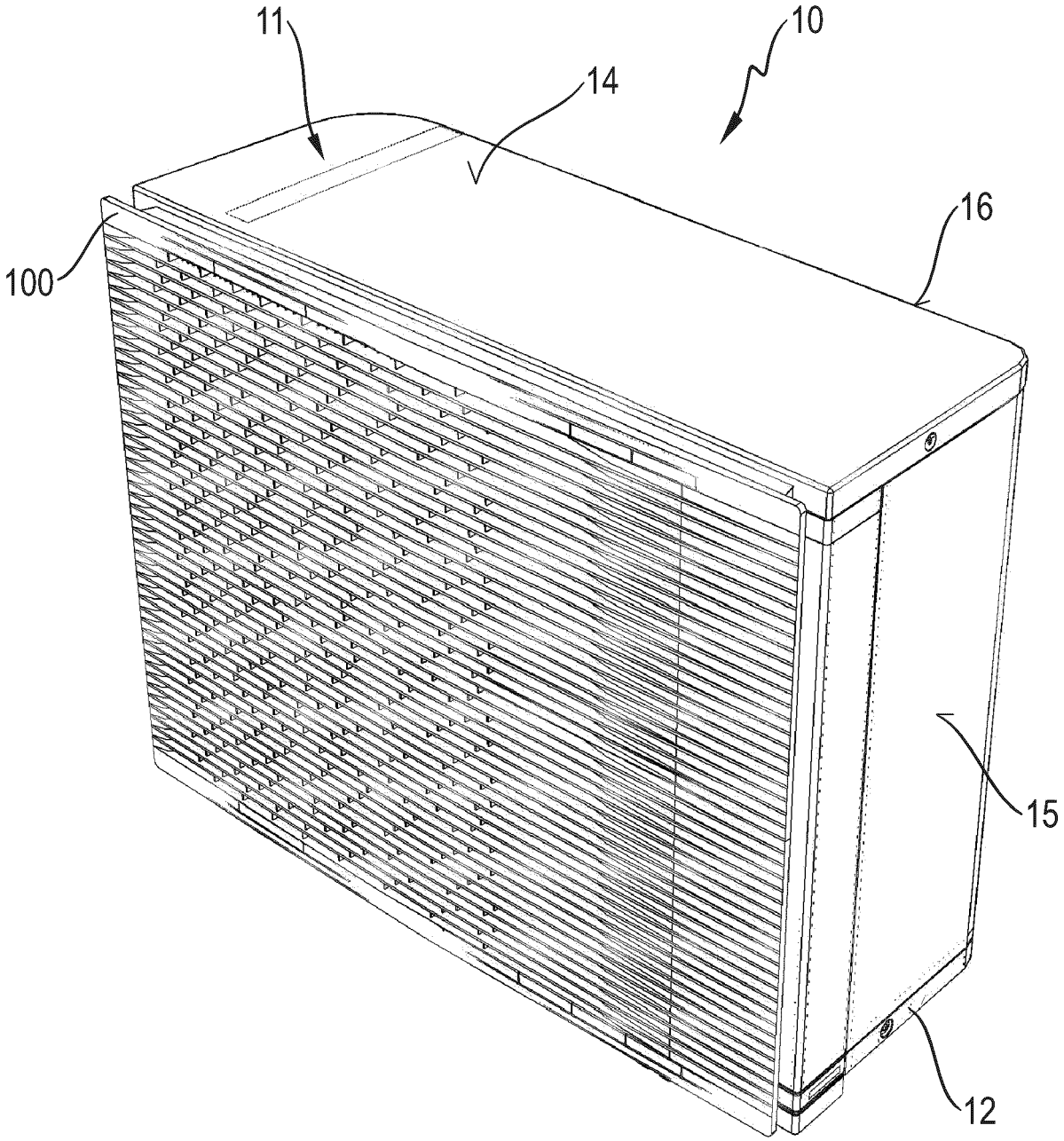

Fig. 1

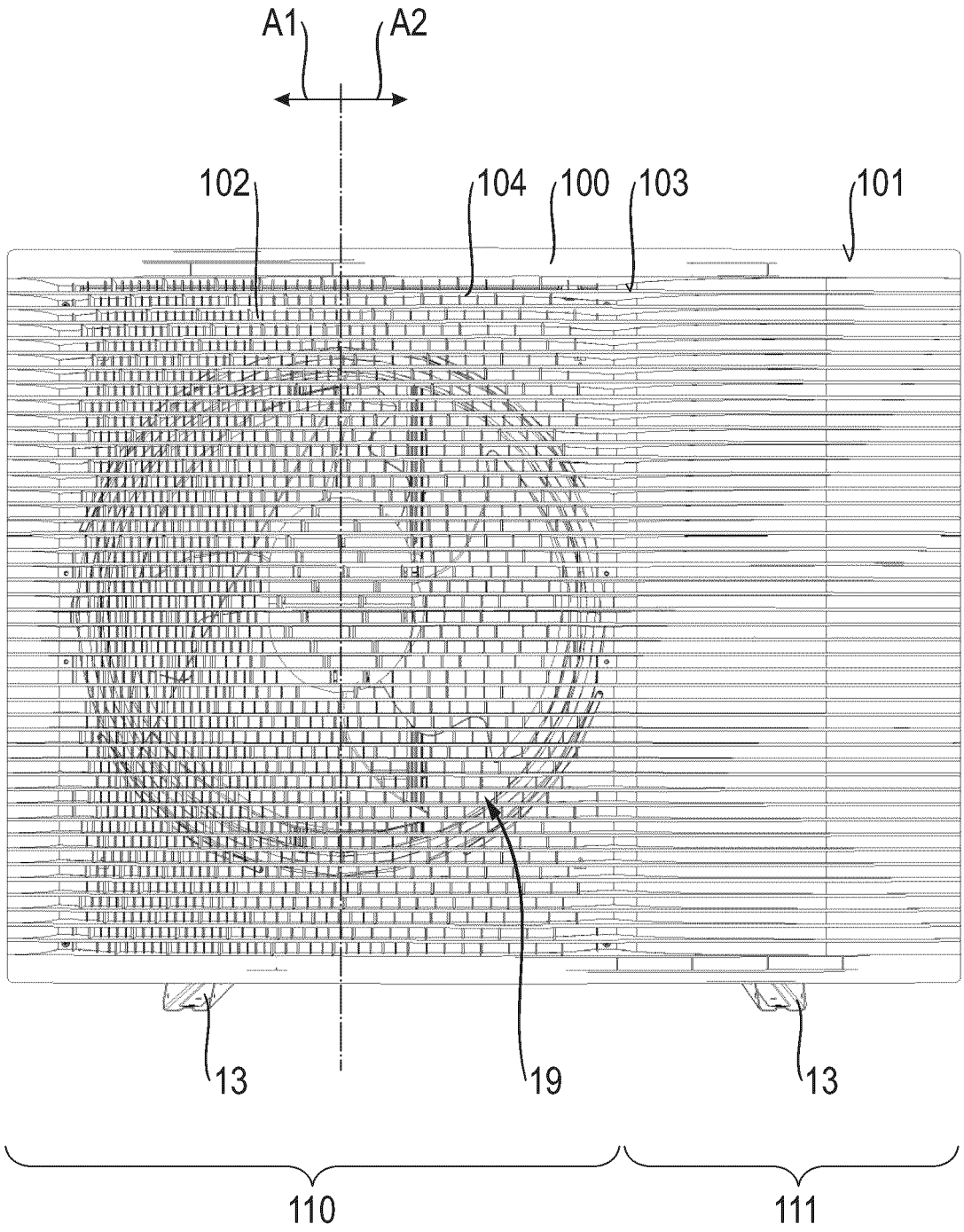

Fig. 2A

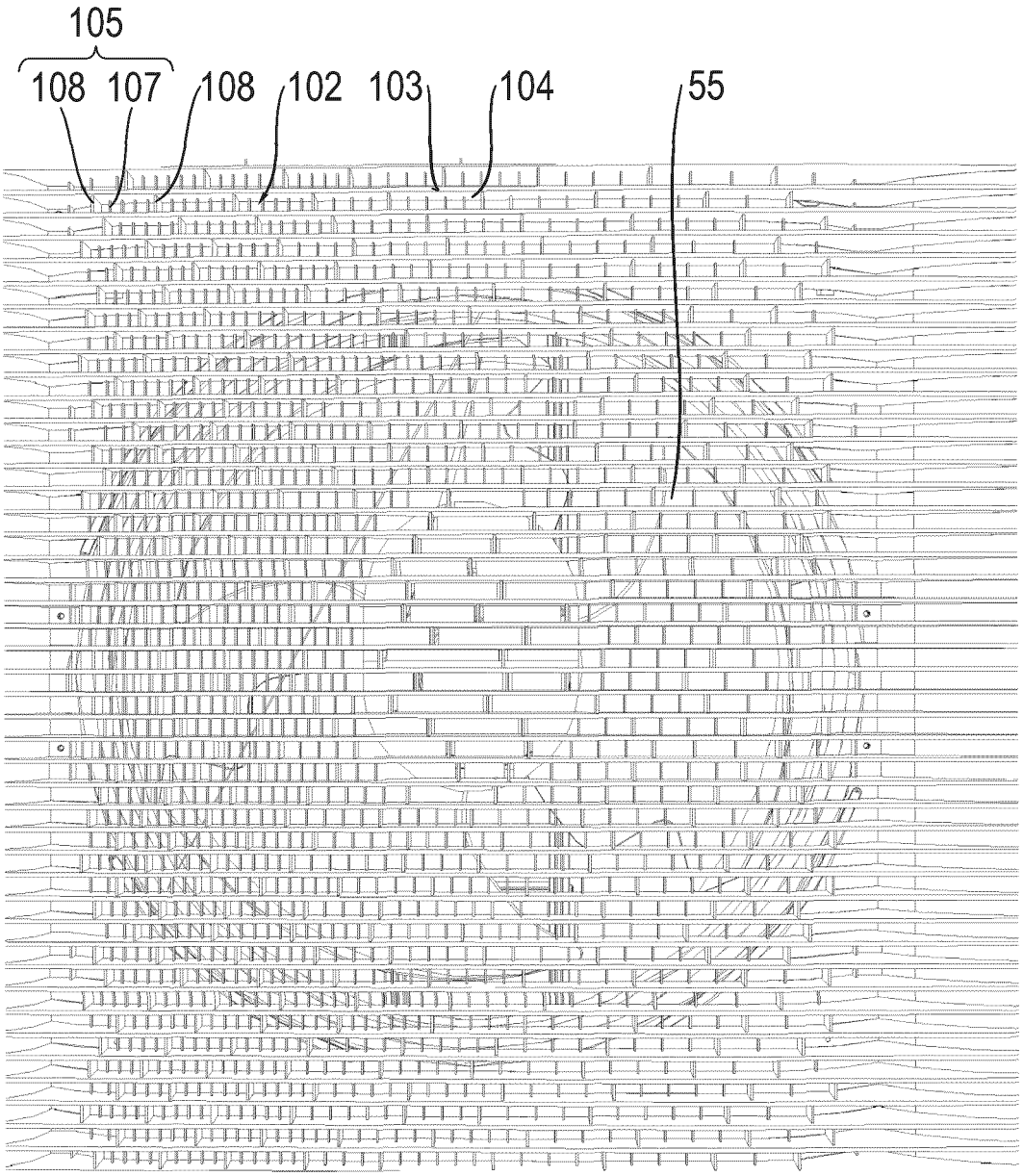

Fig. 2B

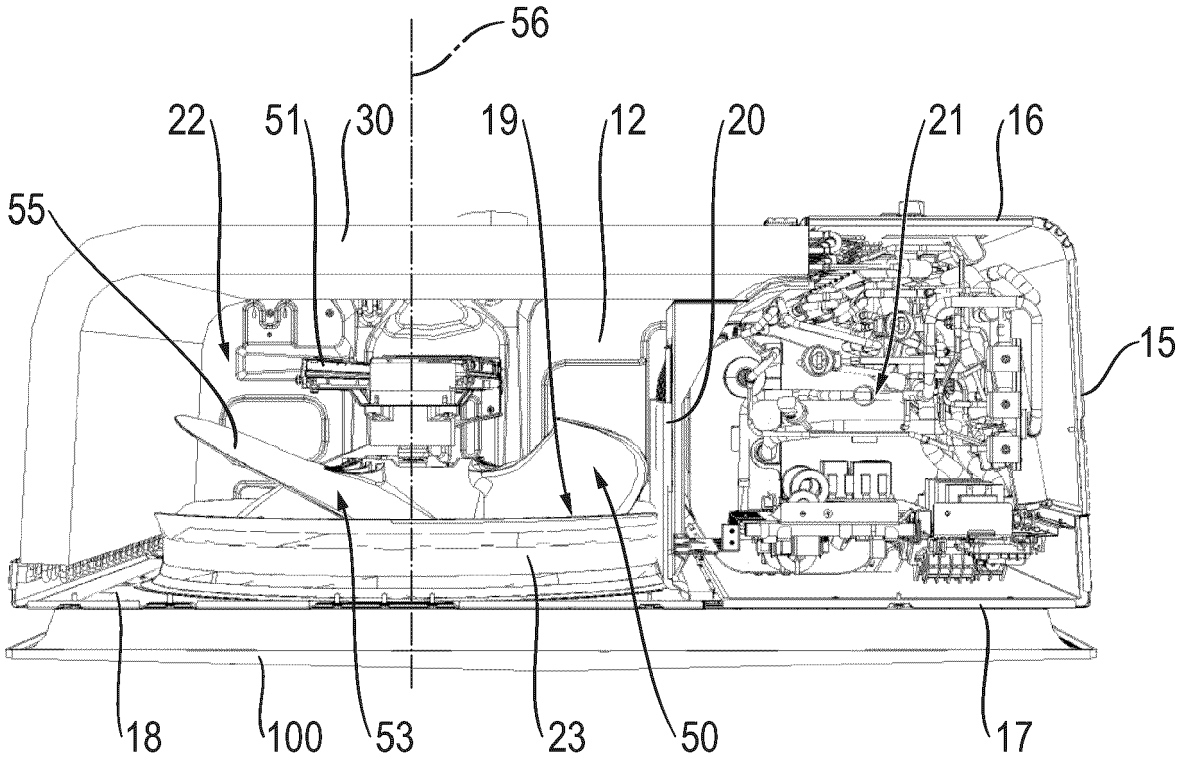

Fig. 3A

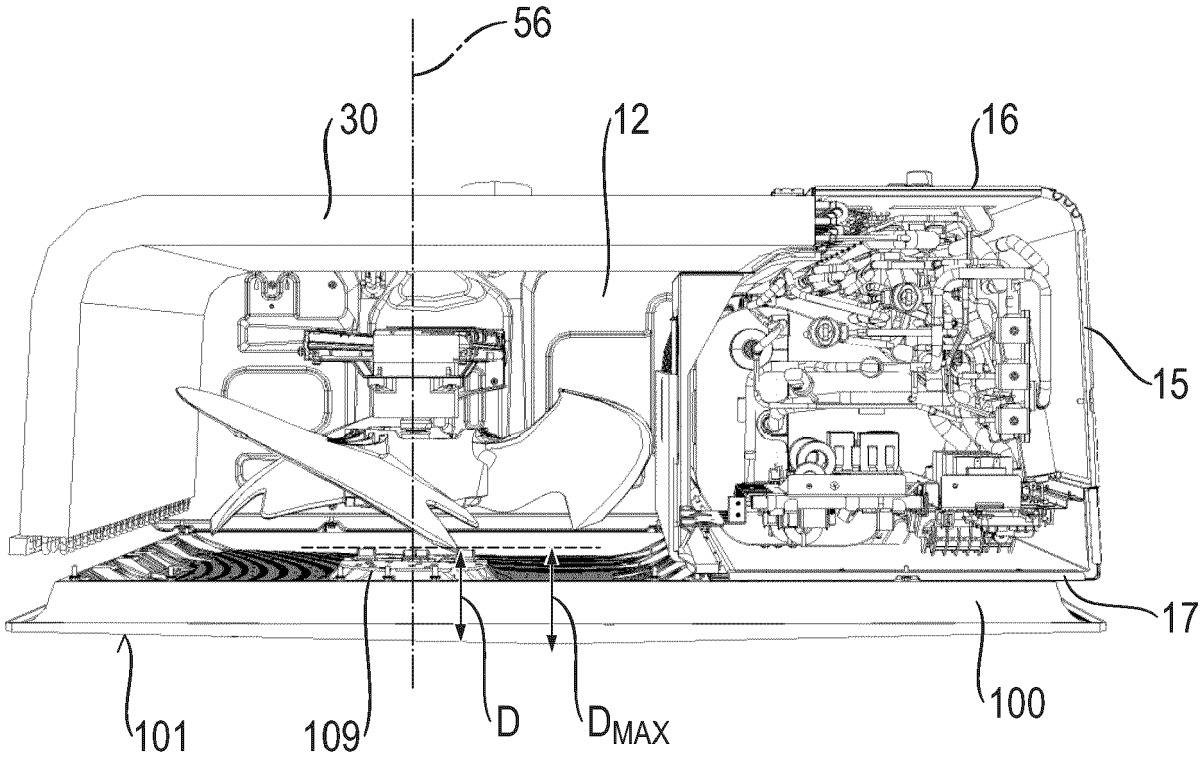

Fig. 3B

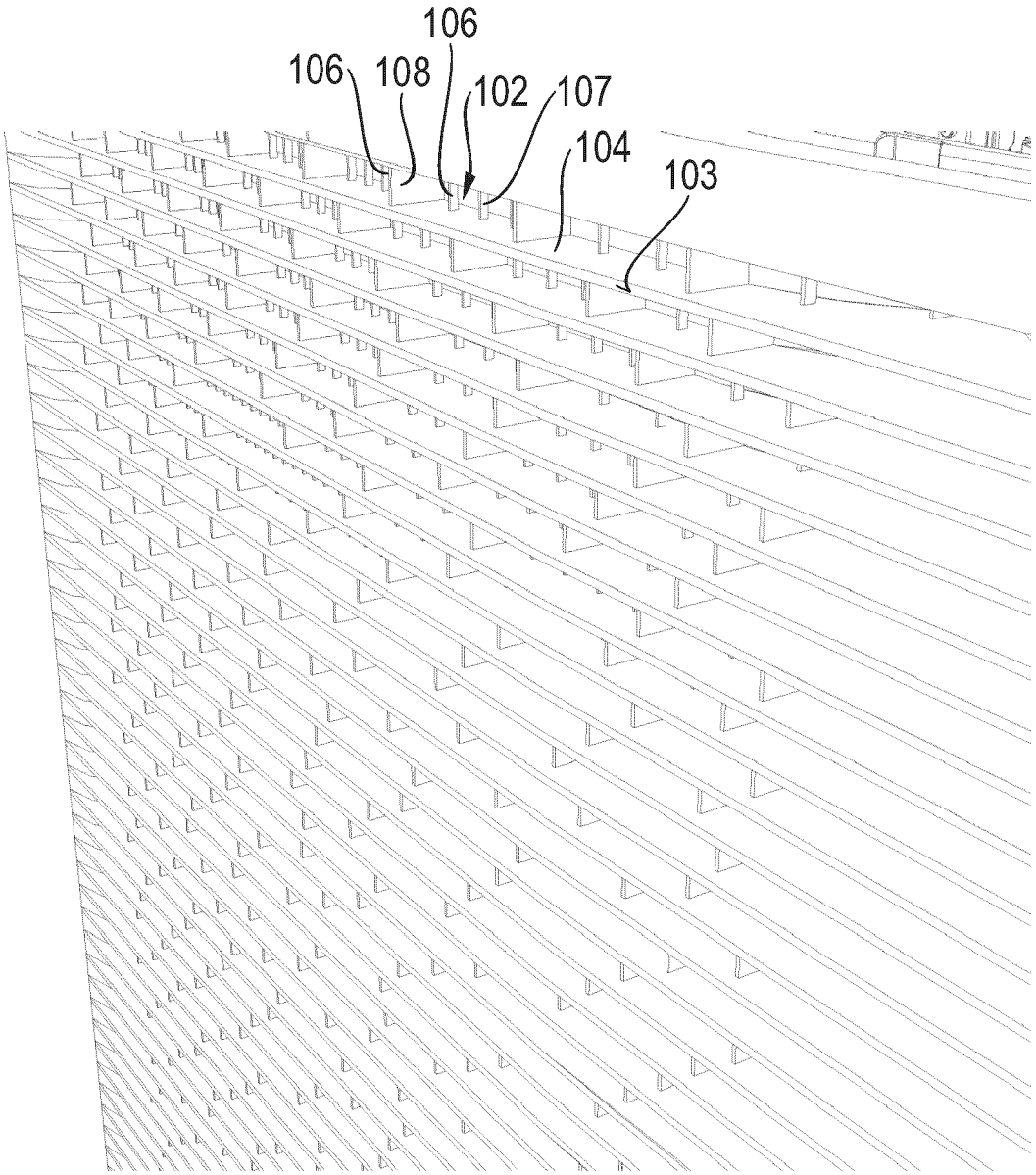

Fig. 4

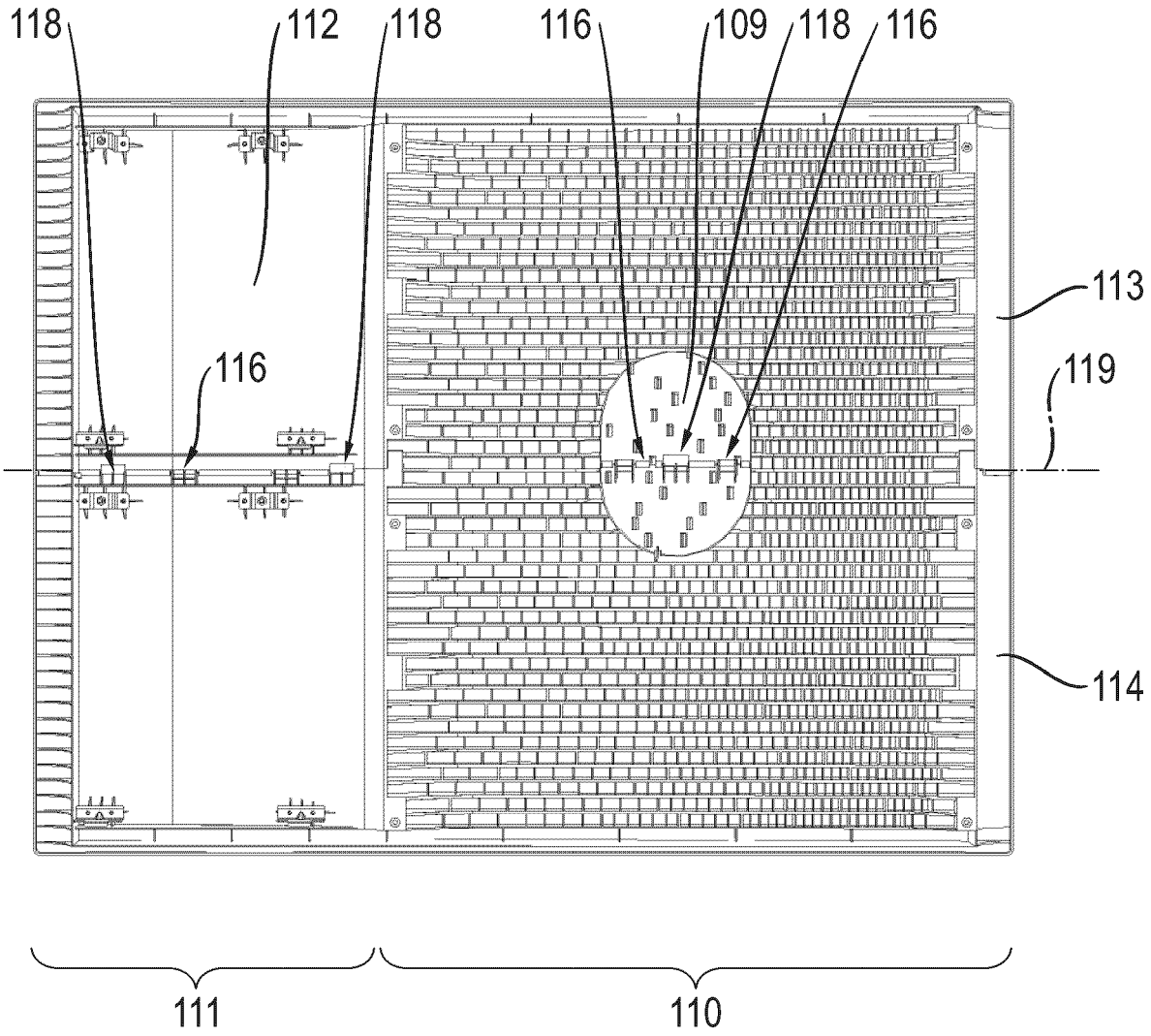

Fig. 5

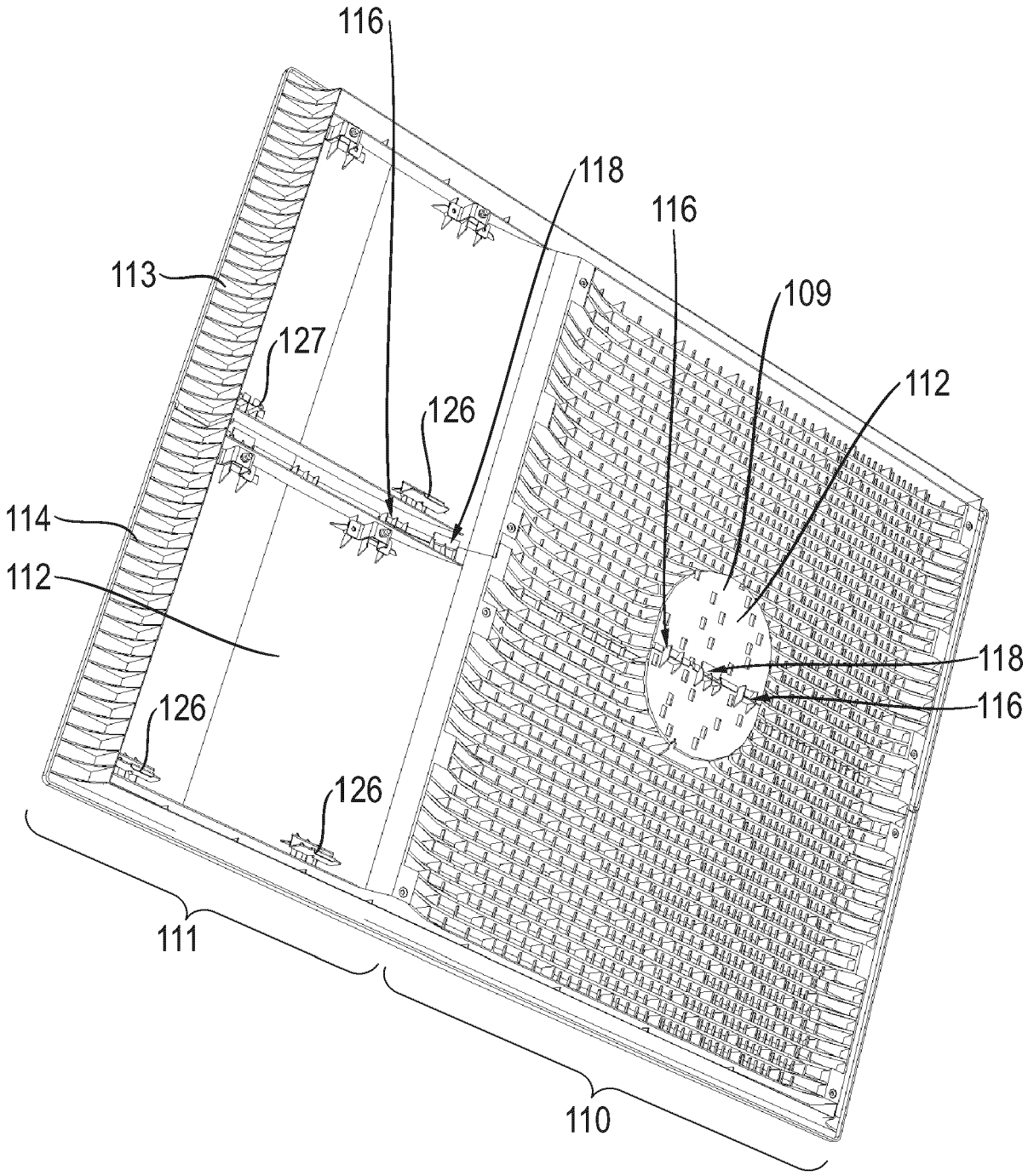

Fig. 6

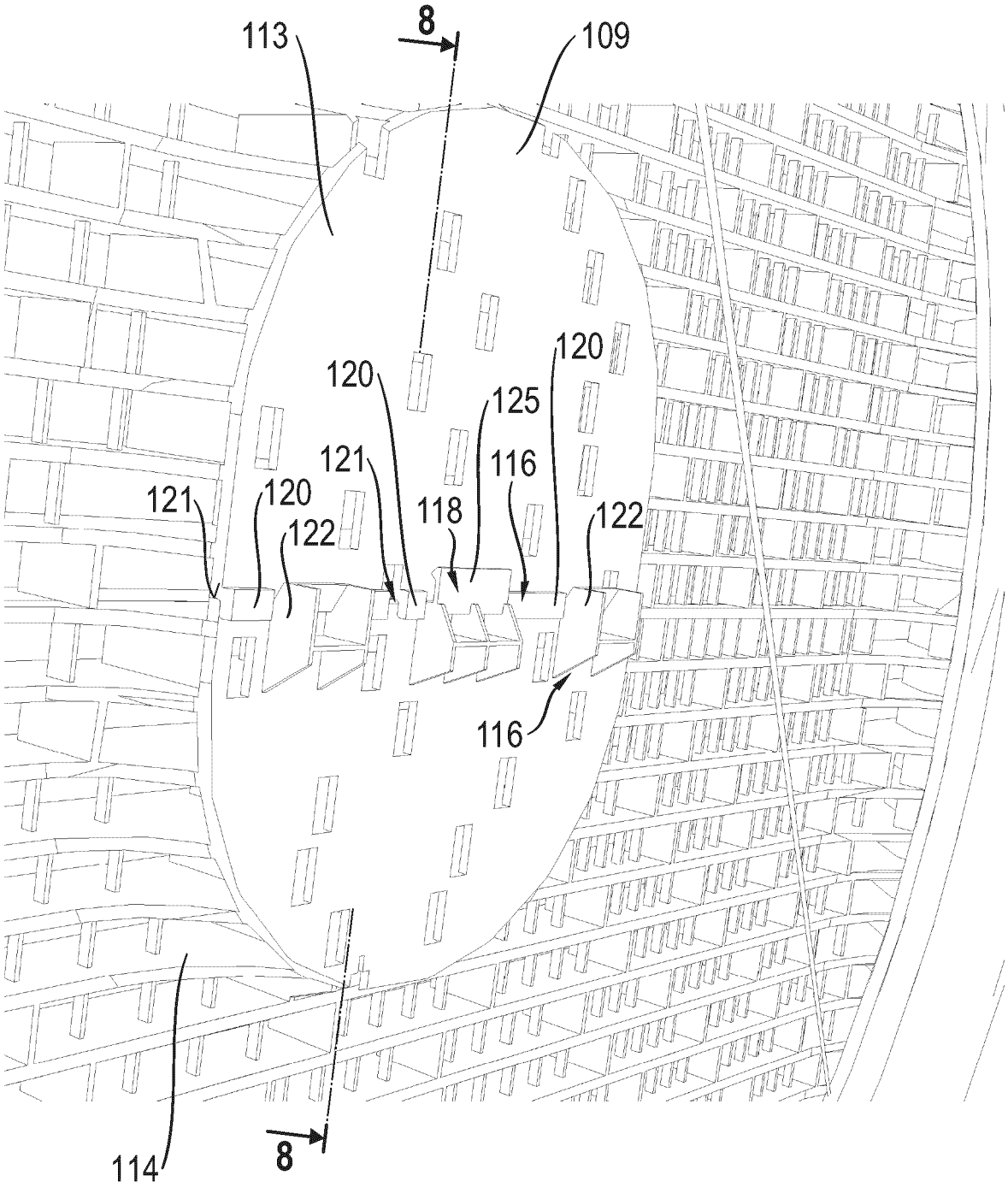

Fig. 7

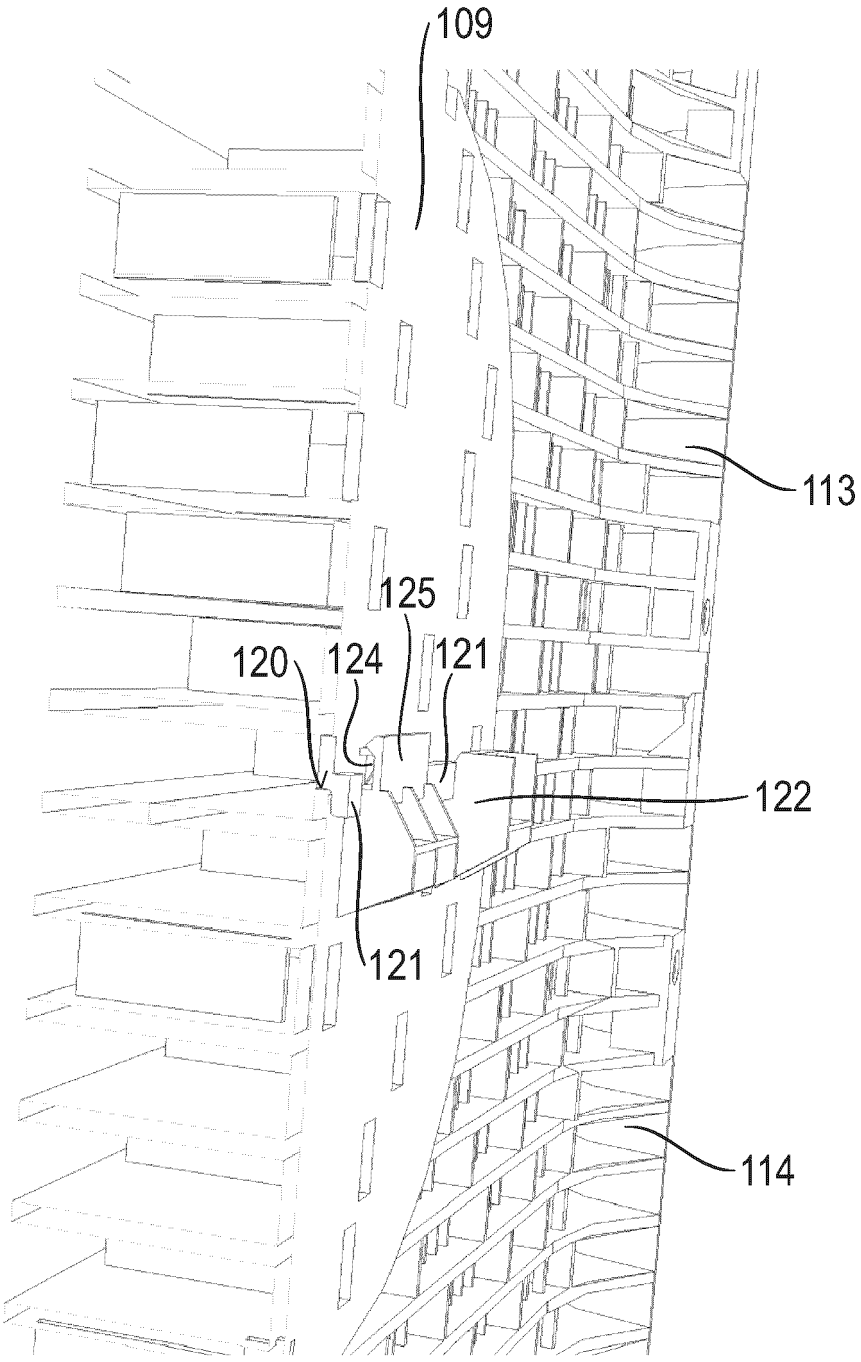

Fig. 8

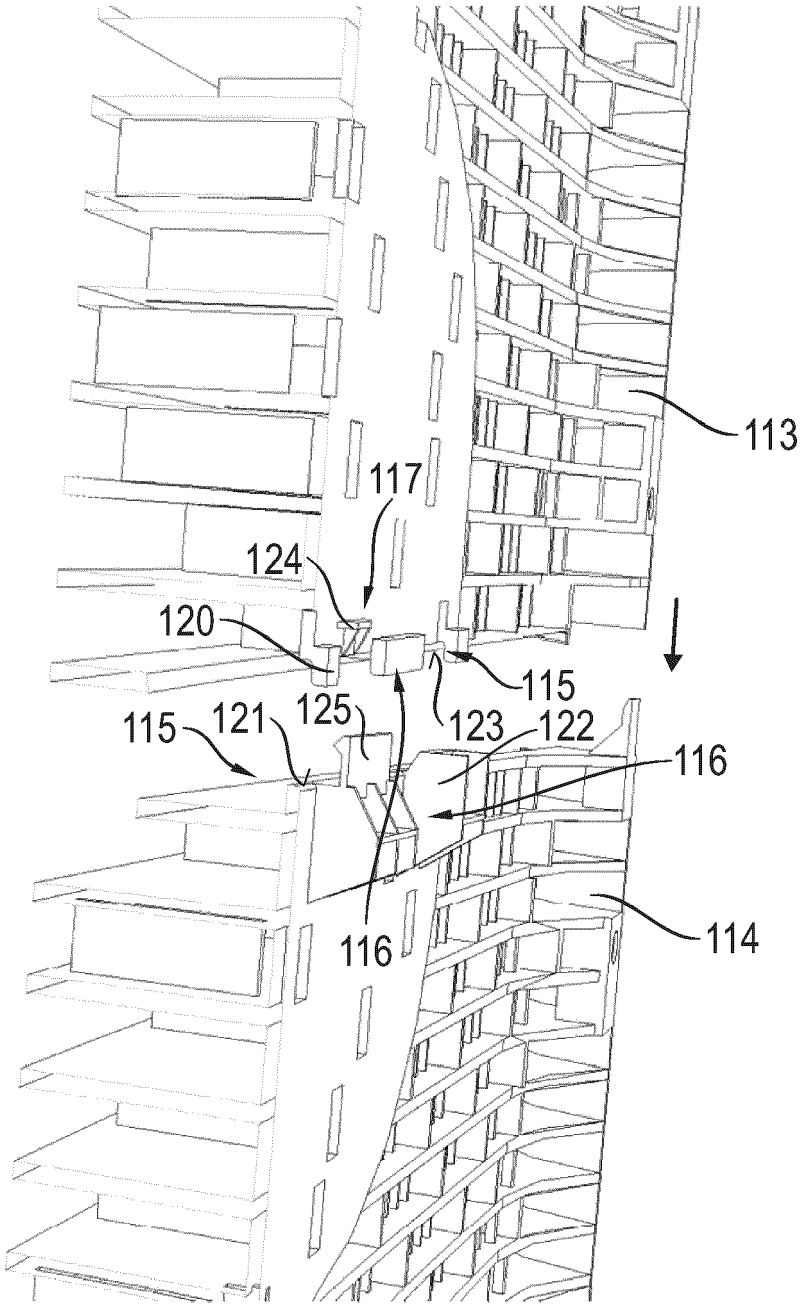

Fig. 9

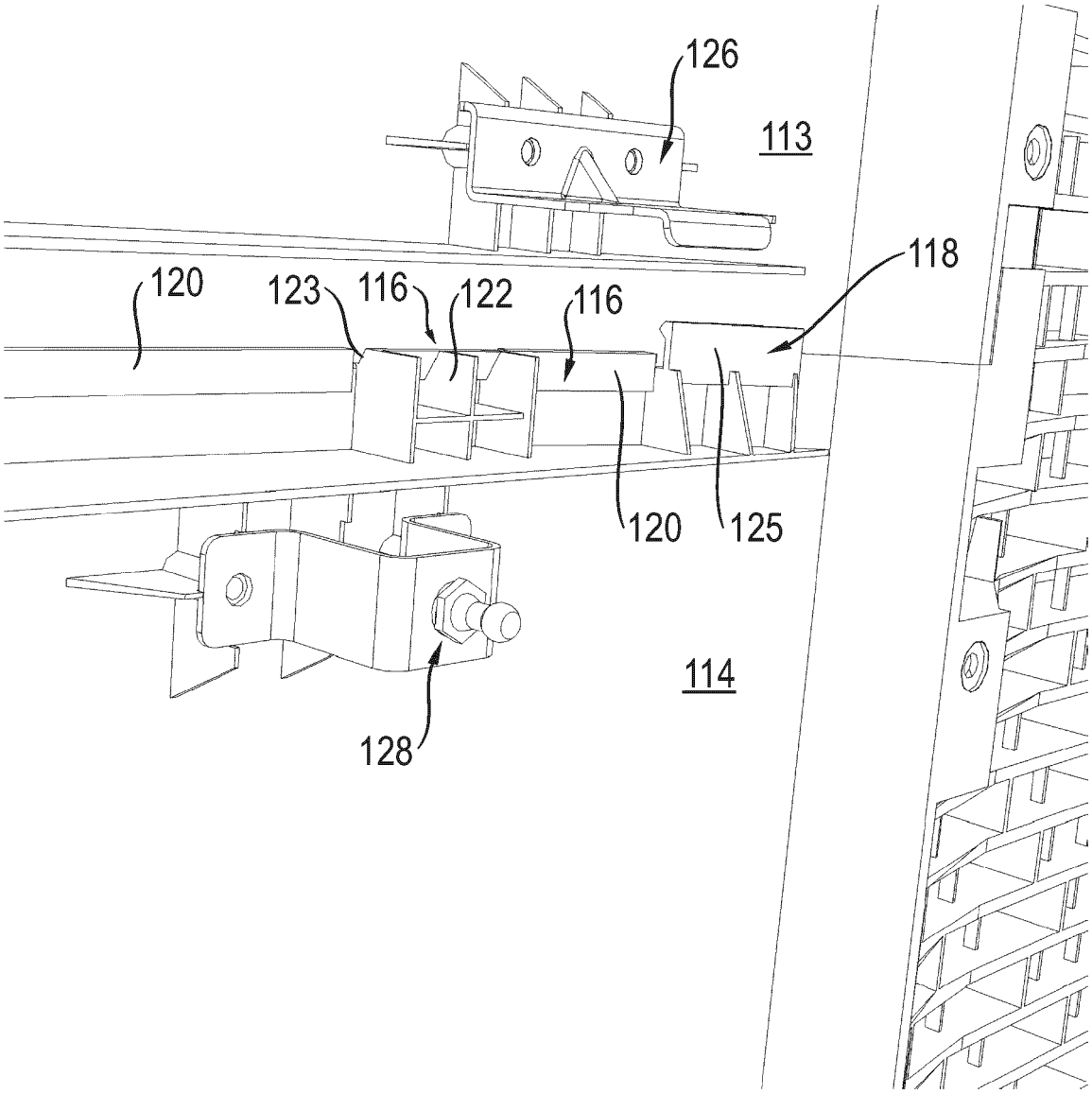

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 19 16 1584

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Place of search	Date of completion of the search	Examiner
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