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(54) **HEAT PUMP GRILLE**

(57) Providing an apparatus comprising a heat exchanging unit on an inner side of the apparatus, a fan on a first side of the apparatus , and a grille on an outer side of the apparatus parallel to the fan comprising a plurality of fins, wherein the distance between the fan and the outer surface of the grille and the depth of any of the fins both are set to ensure both a low visibility of the fan and a limited pressure drop of the air flow wherein the air flow rate through the grille is at least 65%.

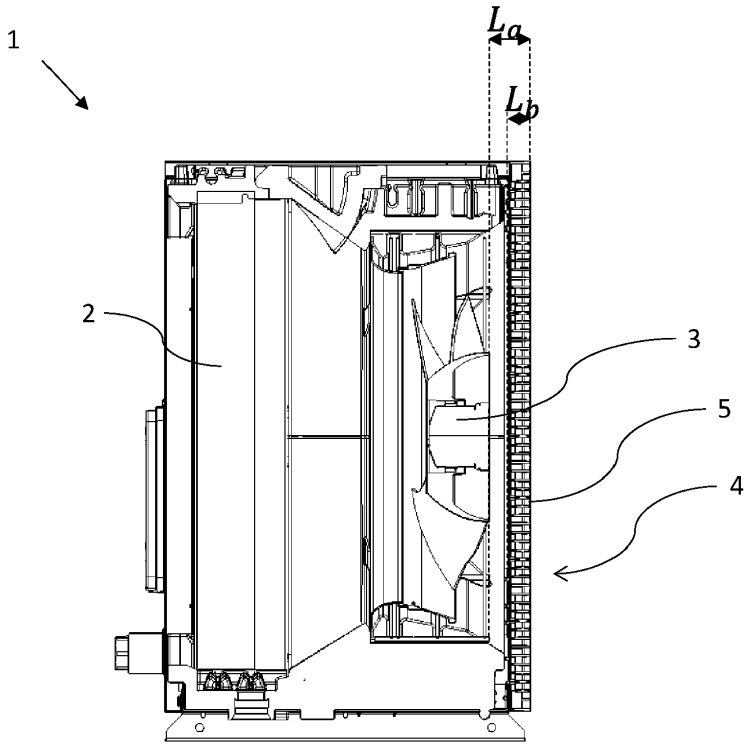

FIG. 2

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Description

[0001] The invention relates to an apparatus for heating water in a building, such as an outdoor unit of an air source heat pump, wherein the apparatus comprises a heat exchanging unit on an inner side of the apparatus, a fan on a first side of the apparatus, and a grille on an outer side of the apparatus comprising a plurality of fins situated substantially horizontal in at least the area directly in front of the fan, wherein the distance between the fan and the outer surface of the grille and the depth of any of the fins both are set to ensure both a low visibility of the fan and a limited pressure drop of the air flow wherein the air flow rate through the grille is at least 65%. The invention further relates to a grille for use in such an apparatus.

[0002] Heating of water in buildings, such as heating water of a central heating system or heating of water for domestic use, may be accomplished by means of a heat pump system. Such a heat pump system may either be a ground source heat pump (GSHP) system or an air source heat pump (ASHP) system. In a GSHP system, calories are exchanged between the ground, or ground water, and a fluid, the fluid in particular being air or water. The calories in the ground may be extracted by capturing calories in a water table or by circulating a water-based circuit in the ground. In an ASHP system calories are exchanged between the air and a fluid, in particular air or water.

[0003] A heat pump system may comprise an outdoor unit for extracting heat from an external source. In case of an ASHP system, such an outdoor unit may extract heat from the air by having an airflow pass over, a part of, a heat exchanger which transfers the heat calories in the air via the surface of the heat exchanger to a refrigerant fluid within the heat exchanger. Such an outdoor unit thus usually comprises a fan and a heat exchanger.

[0004] The fan is a moving part, activated by a motor. The blades of the fan may be relatively sharp, especially when the fan is turning around. To prevent a user from accidentally touching the fan or inserting an object between the fan blades, a grille has to be placed in front of the fan to limit access to the fan while ensuring sufficient air flow to pass through the fan.

[0005] Furthermore, the grille also is beneficial to hide the fan. By hiding the fan, rendering it nearly invisible for a person close to the heat pump system, the relative perception of noise is impacted. The person would be less aware of the noise and would as such be more tolerant of the noise generated by the fan. It also hides the visible movement of the fan and therefor attract less attention to any person close to it, making the heat pump system more discreet and less disturbing in the neighborhood. This would ultimately lead to a better acceptance of heat pump systems in general. It is thus important to reduce the visibility of, and the perception of noise made by, the fan.

[0006] The grille, however, plays a double role. Beside acting as a barrier against access and to hide the fan, the grille also has to maximize the passage of airflow and minimize airflow disturbances. Known solutions either hide the fan while creating disturbances and air pressure drop or generate low disturbances without properly hiding the fan. It is therefore an object of the invention to have a heat pump system comprising a grille that both hides the fan while minimizing airflow disturbances.

[0007] The object of the invention is obtained by means of providing an apparatus for heating water in a building, such as an outdoor unit of an air source heat pump, wherein the apparatus comprises a heat exchanging unit on an inner side of the apparatus, a fan on a first side of the apparatus, and a grille on an outer side of the apparatus comprising a plurality of fins situated substantially horizontal in at least the area directly in front of the fan, wherein the distance L_a between the fan and the outer surface of the grille is at least 50 mm, wherein the depth L_b of any of the fins located directly in front of the fan is at least 15 mm and at most 35 mm, and wherein the air flow rate through the grille is at least 65%.

[0008] The distance L_a between the fan and the outer surface of the grille of at least 50 mm in conjunction with the depth L_b of any of the fins located directly in front of the fan of at least 15 mm and at most 35 mm ensures that the fan is barely visible to the eye of a user of the apparatus., By having both the x and y axis of the fins situated substantially horizontal in at least the area directly in front of the fan, a reduced pressure drop of the air flow is ensured, in comparison to other grille designs, and thus minimizes the air flow disturbances thus realizing the object of the invention. The x-axis of the fins in front of the fan are preferably in the same horizontal plane as the x-axis of the fan which is also situated in a horizontal plane. The y-axis of the fins, or at least a part of the y-axis of the fins, in front of the fan is situated along the length of the fins going from left to right when looking directly to the grille. While it is necessary to have at least the fins located directly in front of the fan to have said depth, all the fins on the grille may have said depth. The grille may be made by means of injection molding of plastic. The grille may also be made by means of 3D printing such as 3D metal or plastic printing.

[0009] In an embodiment, the depth L_b of any of the fins is at least 20 mm and at most 30 mm. This further reduces the visibility of the fan behind the fins.

[0010] In an embodiment, the fins have a first area and a second area wherein the first area substantially diverges to the second area and wherein the second area substantially converges from the first area. This creates a wing-shaped design further minimizing any air flow disturbances and pressure drops. Preferably, both ends of the fin are rounded to limit turbulence in the air flow. Furthermore, depending on the production method of the fins the fins preferably have a minimal thickness of at least 2 mm. Also, a flat area may be added perpendicular to the core of the fin to facilitate demolding of the fin. This flat area preferably is at least 0.05 mm, more preferably

0.1 mm. This flat area is necessary when the grille is produced by means of injection molding of plastic. The flat are forms a junction portion between the first and second area, thus creating a joint plane substantially perpendicular to the axis of the fins.

[0011] In an embodiment, the x-axis of the fins, situated along the depth of the fins, is substantially in the same direction as the fan axis. By having the x-axis of the fins going in the same direction as the fan axis, and as such in the same direction as the air flow generated by the fax, the x-axis is substantially horizontal. This greatly reduces the pressure drop compared to fins wherein the x-axis is oriented in an angle diverging from the fan axis. This also reduces the noise generated by the air flow going over the fins.

[0012] In an embodiment, the distance between each of the fins is at least 8 mm and at most 12 mm, preferably at least 9.5 mm and at most 10.5 mm. To maximize airflow, the distance between the fins should be as large as possible but to prevent external access to the fan behind the grille the distance between the fans should be kept at a minimum. In order to satisfy a sufficient air flow, the distance between the fins is at least 8 mm, preferably at least 9.5 mm. In order to prevent external access to the fan, the distance between the fins is at most 12 mm, preferably at most 10.5 mm.

[0013] In an embodiment, the fan has an outer diameter of at least 500 mm. With this outer diameter, a minimum desired air flow may be achieved as the rotation speed can be kept low enough due to the size of the fan and its fan blades thus avoiding any additional disturbances generated.

[0014] In an embodiment, the grille has a side of at least 800 mm. Having a grille with a side of at least 800 mm, the surface for the air crossing the grille and entering the apparatus is large enough to allow a sufficient amount of air to be passed through the grille and through the fan for collecting calories from the air by the heat exchanger situated within the apparatus.

[0015] In an embodiment, the fan has a light absorption rate of at least 70%, preferably at least 90%. By having a light absorption rate of at least 70%, the reflection of light on the fins is limited, ensuring a lower level of brightness of the fan. This can be realized by either special coatings increasing the light absorption rate or by providing the fan in a darker colour.

[0016] In an aspect of the invention, a grille is provided for use in an apparatus, such as an air source heat pump, wherein the grille comprises a plurality of fins, wherein the depth L_b of any of the fins is at least 15 mm and at most 35 mm, and wherein the air flow rate through the grille is at least 65%. The distance L_a between the fan and the outer surface of the grille of at least 50 mm in conjunction with the depth L_b of any of the fins located directly in front of the fan of at least 15 mm and at most 35 mm ensures that the fan is barely visible to the eye of a user of the apparatus. The grille may be made by means of injection molding of plastic. The grille may also be made by means of 3D printing such as 3D metal or plastic printing.

[0017] In an embodiment, the depth L_b of any of the fins is at least 20 mm and at most 30 mm. This further reduces the visibility of the fan behind the fins.

[0018] In an embodiment, the fins have a first area and a second area wherein the first area substantially diverges to the second area and wherein the second area substantially converges from the first area. This creates a wing-shaped design further minimizing any air flow disturbances and pressure drops. Preferably, both ends of the fin are rounded to limit turbulence in the air flow. Furthermore, depending on the production method of the fins the fins preferably have a minimal thickness of at least 2 mm. Also, a flat area may be added perpendicular to the core of the fin to facilitate demolding of the fin. This flat area preferably is at least 0.05 mm, more preferably 0.1 mm.

[0019] In an embodiment, the x-axis of the fins, situated along the depth of the fins, is substantially horizontal. This greatly reduces the pressure drop compared to fins wherein the x-axis is oriented in an angle diverging from the fan axis. This also reduces the noise generated by the air flow going over the fins.

[0020] In an embodiment, the distance between each of the fins is at least 8 mm and at most 12 mm, preferably at least 9.5 mm and at most 10.5 mm. To maximize airflow, the distance between the fins should be as large as possible but to prevent external access to the fan behind the grille the distance between the fans should be kept at a minimum. In order to satisfy a sufficient air flow, the distance between the fins is at least 8 mm, preferably at least 9.5 mm. In order to prevent external access to the fan, the distance between the fins is at most 12 mm, preferably at most 10.5 mm.

[0021] In an embodiment, the grille has a side of at least 800 mm. Having a grille with a side of at least 800 mm, a sufficient amount of air can be passed through the grille.

[0022] In the figures, the subject-matter of the invention is schematically shown, wherein identical or similarly acting elements are usually provided with the same reference signs.

Fig. 1	shows a schematic representation of an apparatus according to the present invention.
Fig. 2	shows another schematic representation of an apparatus according to the present invention.
Fig. 3A-3B	show a schematic representation of a fin according to the present invention.

[0023] In Figure 1, a schematic representation of an apparatus 1 is shown comprising a fan 3 and a grille 4. The grille 4 comprises a plurality of fins 5. It can be seen that by providing a distance L_a between the fan 3 and the outer surface of the grille 4, a shadow area 20 is

realized. When the eye of a user 10 would look at the apparatus 1 at daylight, especially when the user looks at a higher level than the fan 3, the fan 3 is barely visible as there is no direct path between the eye of the user 10 and the fan 3. As sunlight usually comes from a higher level than the fan 3, a shadow area 20 is created thus if a user would be looking at a level closer to the fan 3 level, the fan 3 is also less visible due to the shadow area 20. In addition, the fan may have a light absorption rate of at least 70% to further reduce its visibility.

[0024] Figure 2 shows the same apparatus 1 as shown in Figure 1. In addition to the details shown in Figure 1, a heat exchanging unit 2 can be seen in Figure 2.

[0025] With reference to Figures 3A and 3B, a fin 5 can be seen having a first area 5a and a second area 5b. The X-axis can be clearly seen situated in the same direction as the depth L_b of the fin 5. It can be seen that the first area 5a diverges towards the second area 5b. It can also be seen that the second area 5b converges from the first area 5b. Furthermore, a flat area 5c resulting from plastic injection molding can also be seen.

Reference Signs

[0026]

1	apparatus
2	heat exchanging unit
3	fan
4	grille
5	fin of grille
5a	first area of the fin
5b	second area of the fin
5c	flat area of the fin
10	eye of a user
20	shadow area

Claims

1. An apparatus (1) for heating water in a building, such as an outdoor unit of an air source heat pump, wherein the apparatus (1) comprises:

- a heat exchanging unit (2) on an inner side of the apparatus (1);
- a fan (3) on a first side of the apparatus (1); and
- a grille (4) on an outer side of the apparatus (1) comprising a plurality of fins (5) situated substantially horizontal in at least the area directly in front of the fan (3); wherein the distance L_a between the fan and the outer surface of the grille is at least 50 mm, wherein the depth L_b of any of the fins (5) located directly in front of the fan (3) is at least 15 mm and at most 35 mm, and wherein the air flow rate through the grille is at least 65%.

2. The apparatus (1) according to claim 1, wherein the depth L_b of any of the fins (5) is at least 20 mm and at most 30 mm.

3. The apparatus (1) according to any of the preceding claims, wherein the fins (5) have a first area (5a) and a second area (5b) wherein the first area (5a) substantially diverges to the second area (5b) and wherein the second area (5b) substantially converges from the first area (5a).

4. The apparatus (1) according to claims 1 or 2, wherein the x-axis of the fins (5), situated along the depth of the fins (5), is substantially in the same direction as the fan (3) axis.

5. The apparatus (1) according to any of the preceding claims, wherein the distance between each of the fins (5) is at least 8 mm and at most 12 mm, preferably at least 9.5 mm and at most 10.5 mm.

6. The apparatus (1) according to any of the preceding claims, wherein the fan (3) has an outer diameter of at least 500 mm.

7. The apparatus (1) according to any of the preceding claims, wherein the grille (4) has a side of at least 800 mm.

8. The apparatus (1) according to any of the preceding claims, wherein the fan (3) has a light absorption rate of at least 70%, preferably at least 90%.

9. A grille (4) for use in an apparatus (1) according to any of the preceding claims comprises a plurality of fins (5), wherein the depth L_b of any of the fins (5) is at least 15 mm and at most 35 mm, and wherein the air flow rate through the grille is at least 65%.

10. The grille (4) according to claim 9, wherein the depth L_b of any of the fins (5) is at least 20 mm and at most 30 mm.

11. The grille (4) according to claims 9 or 10, wherein the fins (5) have a first area (5a) and a second area (5b) wherein the first area (5a) substantially diverges to the second area (5b) and wherein the second area (5b) substantially converges from the first area (5a).

12. The grille (4) according to any of claims 9 to 11, wherein the x-axis of the fins, situated along the depth of the fins (5), is substantially horizontal.

13. The grille (4) according to any of claims 9 to 12, wherein the distance between each of the fins (5) is at least 8 mm and at most 12 mm, preferably at least 9.5 mm and at most 10.5 mm.

14. The grille (4) according to any of claims 9 to 14, wherein the grille (4) has a side of at least 800 mm.

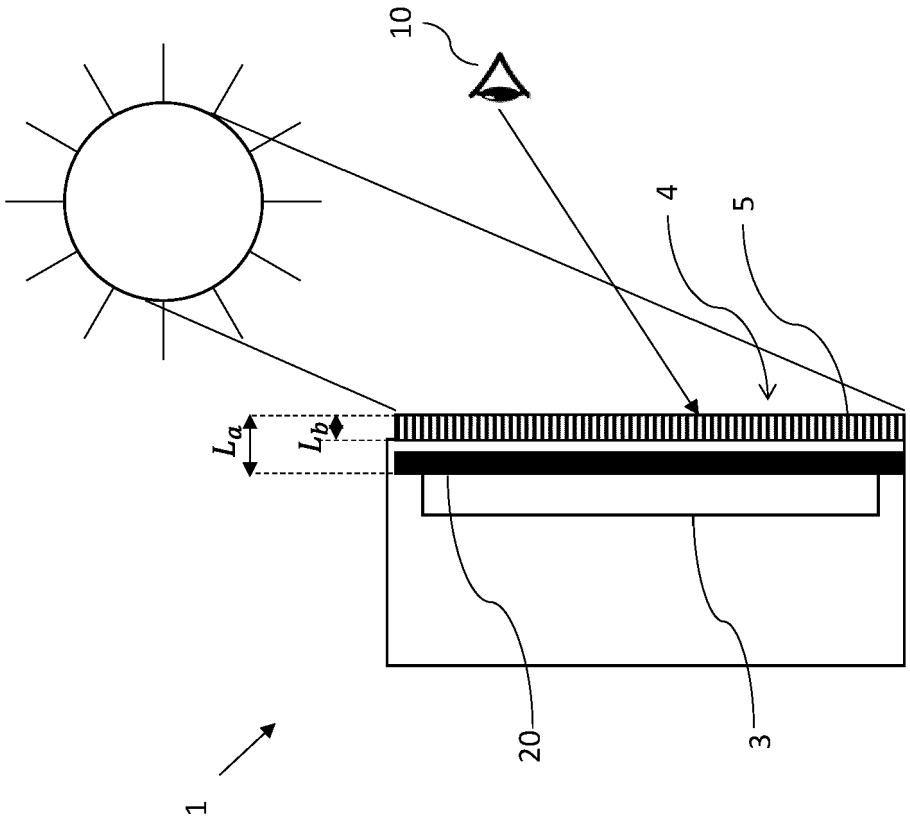

FIG. 1

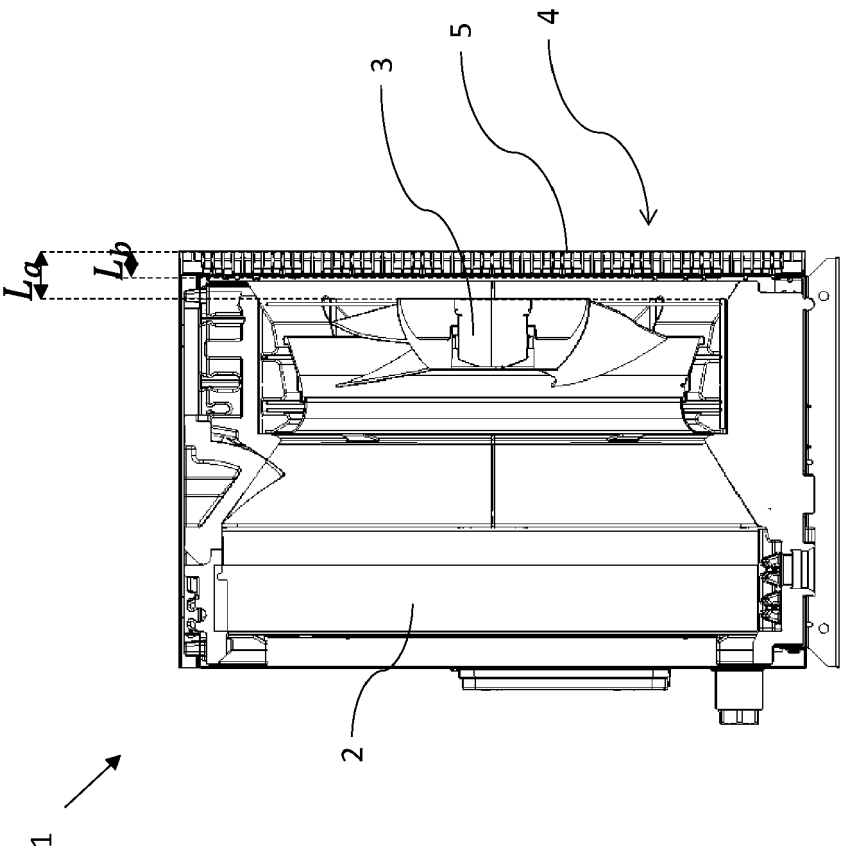

FIG. 2

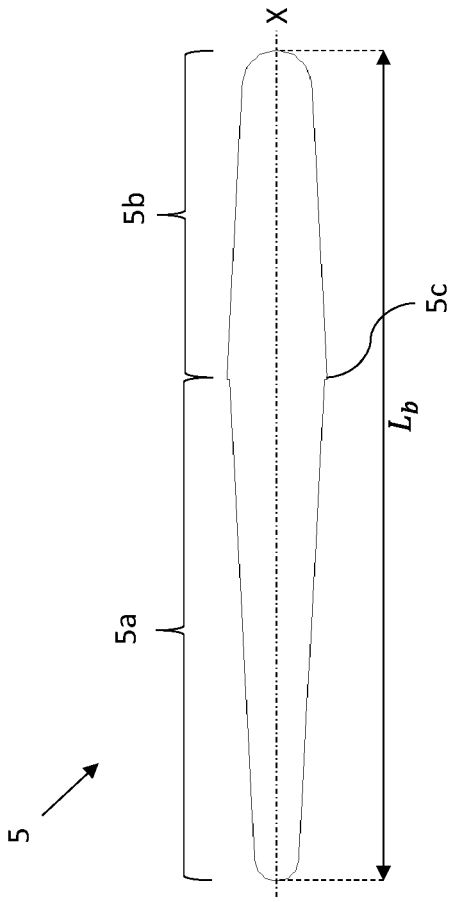

FIG. 3A

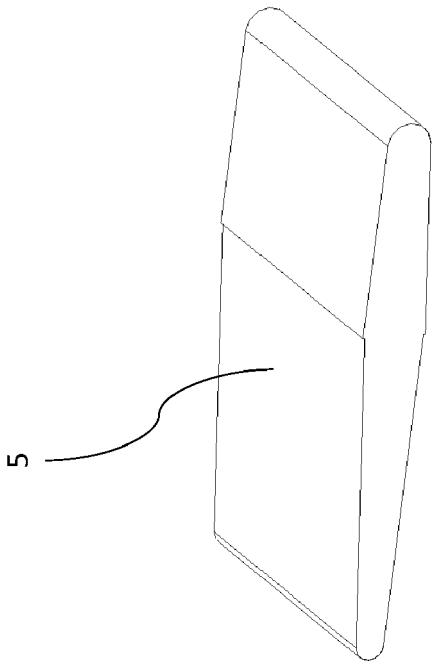

FIG. 3B

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EUROPEAN SEARCH REPORT

Application Number
EP 23 16 1205

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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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X	EP 2 916 081 A1 (MITSUBISHI ELECTRIC CORP [JP]) 9 September 2015 (2015-09-09) * paragraph [0015] - paragraph [0061]; claims 1-7; figures 1-6 *	1-14	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 August 2023	Silex, Anna

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 16 1205

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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