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(54)

AN ACOUSTIC Baffle FOR AN EXHAUST DUCT OF A HEAT PUMP SYSTEM

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Providing an exhaust duct for a heat pump system, wherein the exhaust duct comprises a support surface and an acoustic baffle coupled to the support surface. The acoustic baffle reduces noise traveling with the air flow going through the exhaust duct.

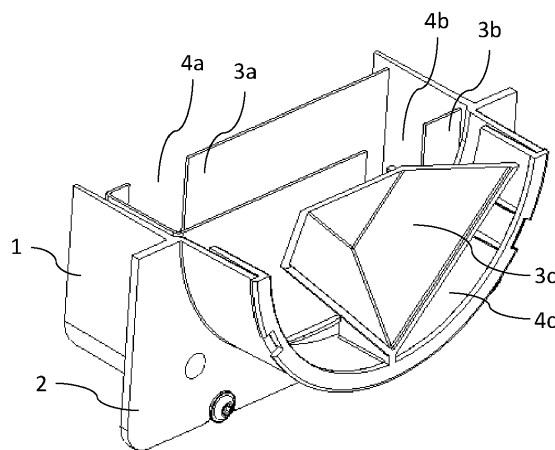


FIG. 5

Description

[0001] The invention relates to an exhaust duct for a heat pump system, wherein the exhaust duct comprises a support surface and an acoustic baffle coupled to the support surface. The invention further relates to a heat pump system comprising such an exhaust duct.

[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 typically comprises at least one first heat exchanger for capturing calories from a first source, at least one second heat exchanger for transferring captured calories to a second destination fluid, and a refrigerant loop between both heat exchangers to transport the captured calories from the at least one first heat exchanger to the at least one second heat exchanger. The at least one first and second heat exchangers together with the refrigerant loop form, at least a part of, a heat exchanging circuit.

[0004] The heat exchange achieved can be used to cool or heat the desired medium. Among the most commonly used circuits for a heat pump, the medium to be heated can be a heating water circuit and/or a sanitary water circuit.

[0005] With the advent of flammable refrigerants, components are preferably grouped in refrigerant components and non-refrigerant components (e.g. hydraulics and electronics) where both groups are preferably separated for safety reasons. Furthermore, while leakage of any of the refrigerant components is prevented as much as possible, there will always remain a slight chance of refrigerant leakage. As the refrigerant under regular room temperature and pressure is in a gaseous phase, this will create a fairly dense gas cloud within the heat pump system. With all sorts of electrical components within the heat pump system and the refrigerant being flammable, there is a risk of ignition and explosion of the refrigerant. Any such risk has to be mitigated.

[0006] Said risk may be mitigated by expelling any leaked refrigerant out of, and away from, the heat pump system by means of an exhaust duct. By using an exhaust duct, any leaked refrigerant may escape through the exhaust duct away from the heat pump system.

[0007] Such an opening, however, will allow noises generated within the heat pump system to travel directly into the environment of the heat pump system. For instance, noise from the compressor may travel via the

exhaust duct into the surroundings of the heat pump system. Similarly, any other component may generate unwanted noise within the heat pump system that could escape through the exhaust duct into the environment.

[0008] Additionally, a fan may be used to expel the leaked refrigerant. By using a brushless motor exhaust fan, any leaked refrigerant is forced out and away from the heat pump system in a safe and quick way. However, as the air flow will be disturbed by the fan even more noise will be created.

[0009] It is therefore desired to reduce the amount of noise, generated by any of the components within the heat pump system and/or of an exhaust fan, through the exhaust duct.

[0010] The object of the invention is obtained by providing an exhaust duct for a heat pump system, wherein the exhaust duct comprises a support surface perpendicular to the direction of the air flow and an acoustic baffle coupled to the support surface, wherein the acoustic baffle comprises at least two successive walls arranged at an angle to the direction of the air flow, wherein the at least two successive walls each have at least one opening wherein each opening is not in direct alignment with the other opening, thereby forming at least two successive openings which are staggered from each other.

[0011] The exhaust duct allows air to pass through from the inside of the heat pump system to the outside of the heat pump system. In case of a refrigerant leak, the leaked refrigerant is expelled outside of the heat pump through said exhaust duct. The exhaust duct comprises a support surface to allow the exhaust duct to be attached to the heat pump system. The exhaust duct has a general opening through which the air may flow. The exhaust duct may also comprise a guiding surface for attaching an air duct to the exhaust duct. The air duct attached to the guiding surface may be any tube, pipe or channel suitable to be used as an air duct. The guiding surface may be situated perpendicular to the support surface. The guiding surface may be straight or tapered.

[0012] The acoustic baffle reduces noise traveling via the air through the exhaust duct. The at least two successive walls may be arranged at any angle other than parallel to the direction of the air flow. As such, the air flow will hit the walls and the sound waves traveling via the air flow will bounce off the wall reducing the intensity and distance of the sound wave. By providing an opening in each wall, air flow may still continue to flow. By not directly aligning each opening, thus forming a staggered pattern of the openings, the air flow can still continue to flow but the sound waves traveling via the air flow will further bounce off and gradually further decrease in intensity and distance travelled. As such, the acoustic baffle absorbs the sound waves and thus reduces the noise traveling through the exhaust duct and thereby achieves the object of the invention.

[0013] In an embodiment, the acoustic baffle is situated between the support surface of the exhaust duct and the inside of a heat pump system, between the support sur-

face of the exhaust duct and the outside of the heat pump system, or a combination thereof. When situated between the support surface and the inside of the heat pump, the acoustic baffle may reduce noise when the air flow is still inside the heat pump system. The acoustic baffle may be for instance positioned closer to a compressor inside the heat pump system and thus cover the noise generated by the compressor. When situated on between the support surface and the outside of the heat pump, the acoustic baffle may also act as a barrier for physical objects to be inserted into the heat pump system. For instance, the acoustic baffle may thus obstruct a user to accidentally insert a finger. When situated between the support surface and both the inside and outside of the heat pump, both advantages can be realized. This can be achieved by, for instance, having one of the successive walls to be situated between the support surface and the inside of the heat pump system and the other successive wall between the support surface and the outside of the heat pump system.

[0014] In an embodiment, the at least two successive walls are parallel to each other. When the at least two successive wall are parallel to each other, the sound waves may bounce back and forth between both walls until their intensity and distance is reduced.

[0015] In an embodiment, the at least two successive walls are arranged at an angle of 70° to 90° in relation to the direction of the air flow. By arranged both walls at said angle, the air flow effectively hits the walls and thus the sound waves are properly bounced off the walls.

[0016] In an embodiment, each opening has a different shape or size. The openings may have any shape or size suitable to allow air flow to pass through the opening. The opening may, for instance, be rectangular, circular, triangular or any random shape.

[0017] In an embodiment, each opening has a surface area of at least 120 mm². By having an opening with a surface area of at least 120 mm², sufficient air flow can pass through the opening.

[0018] In an embodiment, each opening is situated in the bottom half of each wall. In case of a leakage of refrigerant, the refrigerant gas will mix with the air flow. As the refrigerant is heavier, denser, than air, it will naturally flow lower than the air. By providing the openings in the bottom half of each wall, the evacuation of the refrigerant is carried out in an optimal way and prevents the accumulation of flammable refrigerant in the heat pump unit. As the refrigerant is heavier than air, it will accumulate from the bottom of the unit to a height corresponding to the lowest point of the opening. Placing this opening at the bottom of the walls limits the accumulation and facilitates extraction.

[0019] In an embodiment, each opening is situated at a height within 200 mm of the base of the heat pump system. This is the distance between the lowest point of the opening and the base of the heat pump system. Upon a leakage, leaked refrigerant can only build-up up to 200 mm in height between both points. Any kind of electron-

ics, that could potentially be an ignition point, situated in the same compartment could then be positioned well above this area to prevent ignition of the leaked refrigerant.

5 **[0020]** In an embodiment, each opening is situated at a height within 200 mm of a mounting surface for a compressor of the heat pump system. This is the distance between the lowest point of the opening and the mounting surface of the compressor. Upon a leakage, leaked refrigerant can only build-up up to 200 mm in height between both points. Any kind of electronics, that could potentially be an ignition point, situated in the same compartment could then be positioned well above this area to prevent ignition of the leaked refrigerant.

10 **[0021]** In an embodiment, a sound absorbing material is attached to each wall. To even further reduce noise, any suitable acoustic foam or insulation material may be attached to each wall to absorb the sound waves traveling through the air flow.

15 **[0022]** In an embodiment, a sound absorbing material is positioned near at least one wall. For example, a piece of sound absorbing material is positioned between two walls to further reduce the noise.

20 **[0023]** In an embodiment, the walls of the acoustic baffle are made of panels of fine thickness in relation to their height and width. In particular, the acoustic baffle is made from folded sheet material, cut sheet material, molded material or a combination thereof, and the material used is rigid or deformable or a combination thereof. The acoustic baffle may thus be made from multiple panels of sheet material or can be molded as a single piece. Alternatively, some parts of the acoustic baffle can be made from panels of sheet material while other parts are made from molded material. When using molded material, said material may be formed using for instance injection molding or 3D printing.

25 **[0024]** In an embodiment, the material used is metal, plastic, foam, or a combination thereof.

30 **[0025]** In an aspect of the invention, an assembly for heating water in a building, in particular a heat pump system, is provided wherein the assembly comprising an exhaust duct according to any of the embodiments as disclosed above.

35 **[0026]** In an embodiment of the aspect of the invention, the exhaust duct is positioned between a compressor situated within the assembly and the external surface of the assembly.

40 **[0027]** 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.

Figure 1 shows a schematic representation of an exhaust duct according to the present invention.

55 Figure 2 shows a schematic representation of an exhaust duct according to the present invention.

Figure 3 shows a schematic representation of an exhaust duct according to the present invention.

Figure 4 shows a schematic representation of two acoustic baffle walls according to the present invention.

Figure 5 shows a cross-sectional representation of an exhaust duct according to the present invention.

[0028] With reference to Figure 1, an exhaust duct 1 is shown comprising a support surface 2 and one acoustic baffle wall 3c having an acoustic baffle opening 4c. Acoustic baffle wall 3c is partially parallel, positioned on the outer facing side of support surface 2, and partially perpendicular to the air flow traveling through the exhaust duct. Behind the support surface 2, two more acoustic baffle walls 3a and 3b are present but not visibly shown in Figure 1.

[0029] Figure 2 shows an exploded view of the exhaust duct 1 of Figure 1. The same elements are present but now acoustic baffle wall 3b is visible. Acoustic baffle wall 3b is completely parallel to the support surface 2 and is positioned on the inner facing side of support surface 2. Acoustic baffle wall 3b has an acoustic baffle opening 4b.

[0030] In Figure 3, the same exhaust duct 1 is shown as in Figure 1 but from a different angle. Again the same elements are present, but now acoustic baffle wall 3a is visible. Acoustic baffle wall 3a is also completely parallel to the support surface 2 and also positioned on the inner facing side of support surface 2. Acoustic baffle wall 3a has an acoustic baffle opening 4a.

[0031] Figure 4 shows at least a part of the acoustic baffle 5 having two successive acoustic baffle walls 3a and 3b, each having an opening 4a and 4b. It can be seen that the openings 4a and 4b are not directly aligned with each other, at least not horizontally, and are thus arranged in a staggered fashion.

[0032] Figure 5 shows a cross-section of the exhaust duct 1 as shown in Figures 1 to 3. The same elements are present again. Now, all successive acoustic baffle walls 3a, 3b, and 3c can be seen, including acoustic baffle openings 4a, 4b, and 4c. It can also be seen that acoustic baffle wall 3c has a geometrical shape that is only partly parallel to the support surface 2, and is partly arranged at an angle in relation to the air flow passing through the exhaust duct 2 via openings 4a, 4b, and 4c.

Reference Signs

[0033]

- | | |
|------------|-------------------------|
| 1 | exhaust duct |
| 2 | support surface |
| 3a, 3b, 3c | acoustic baffle wall |
| 4a, 4b, 4c | acoustic baffle opening |
| 5 | acoustic baffle |

Claims

1. An exhaust duct (1) for a heat pump system, wherein the exhaust duct (1) comprises:

- a support surface (2) perpendicular to the direction of the air flow; and
- an acoustic baffle (5) coupled to the support surface (2);

wherein the acoustic baffle (5) comprises at least two successive walls (3a, 3b, 3c) arranged at an angle to the direction of the air flow, wherein the at least two successive walls (3a, 3b, 3c) each have at least one opening (4a, 4b, 4c) wherein each opening (4a, 4b, 4c) is not in direct alignment with the other opening (4a, 4b, 4c), thereby forming at least two successive openings (4a, 4b, 4c) which are staggered from each other.

2. The exhaust duct (1) according to claim 1, wherein the acoustic baffle (1) is situated between the support surface (2) of the exhaust duct (1) and the inside of a heat pump system, between the support surface (2) of the exhaust duct (1) and the outside of the heat pump system, or a combination thereof.

3. The exhaust duct (1) according to any of the preceding claims, wherein the at least two successive walls (3a, 3b, 3c) are parallel to each other.

4. The exhaust duct (1) according to any of the preceding claims, wherein the at least two successive walls (3a, 3b, 3c) are arranged at an angle of 70° to 90° in relation to the direction of the air flow.

5. The exhaust duct (1) according to any of the preceding claims, wherein each opening (4a, 4b, 4c) has a different shape or size.

6. The exhaust duct (1) according to any of the preceding claims, wherein each opening (4a, 4b, 4c) has a surface area of at least 120 mm².

7. The exhaust duct (1) according to any of the preceding claims, wherein each opening (4a, 4b, 4c) is situated in the bottom half of each wall (3a, 3b, 3c).

8. The exhaust duct (1) according to any of the preceding claims, wherein each opening (4a, 4b, 4c) is situated at a height within 200 mm of the base of the heat pump system.

9. The exhaust duct (1) according to any of the preceding claims, wherein each opening (4a, 4b, 4c) is situated at a height within 200 mm of a mounting surface for a compressor of the heat pump system..

10. The exhaust duct (1) according to any of the preceding claims, wherein a sound absorbing material is attached to each wall (3a, 3b, 3c).
11. The exhaust duct (1) according to any of the preceding claims, wherein a sound absorbing material is positioned near at least one wall (3a, 3b, 3c). 5
12. The exhaust duct (1) according to any of the preceding claims, wherein the acoustic baffle (5) is made from folded sheet material, cut sheet material, molded material or a combination thereof, and wherein the material used is rigid, deformable or a combination thereof.. 10
13. The exhaust duct (1) according to claim 12, wherein the material used is metal, plastic, foam, or a combination thereof. 15
14. An assembly for heating water in a building, in particular a heat pump system, wherein the assembly comprising an exhaust duct (1) according to any of the preceding claims. 20
15. The assembly according to claim 14, wherein the exhaust duct (1) is positioned between a compressor situated within the assembly and the external surface of the assembly. 25

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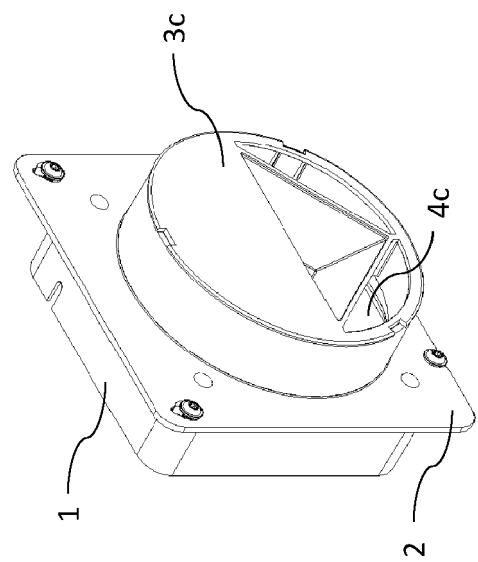


FIG. 1

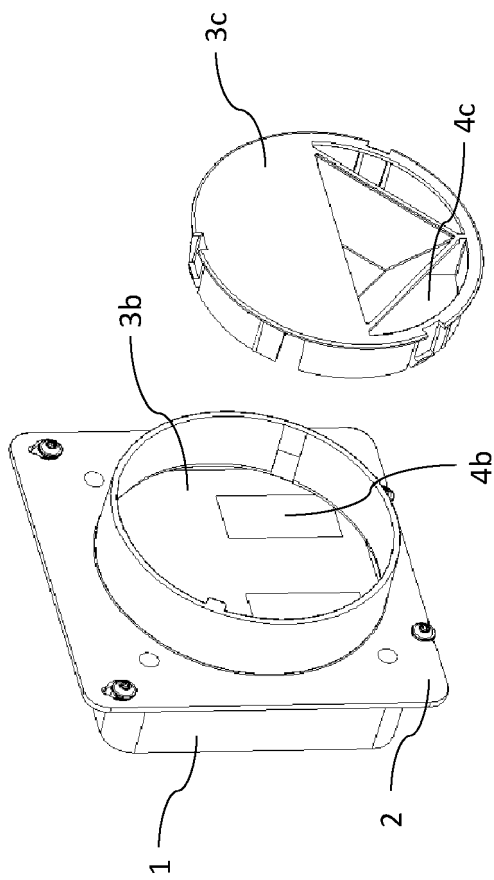


FIG. 2

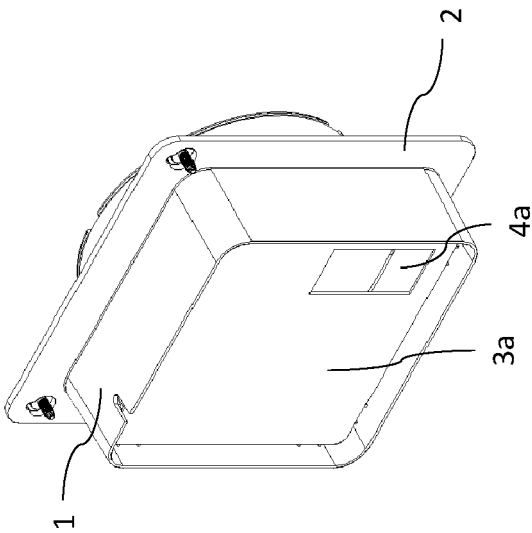


FIG. 3

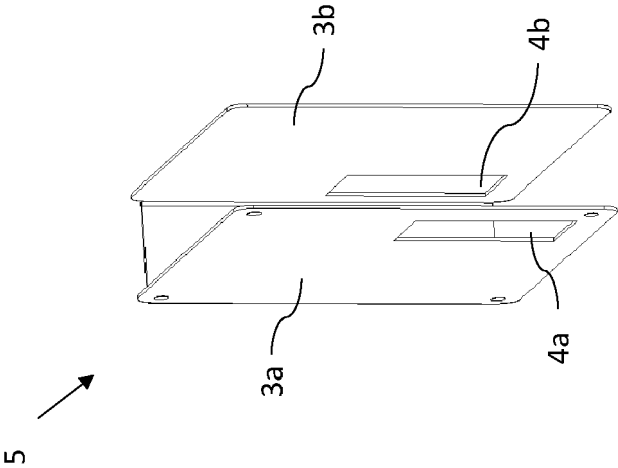


FIG. 4

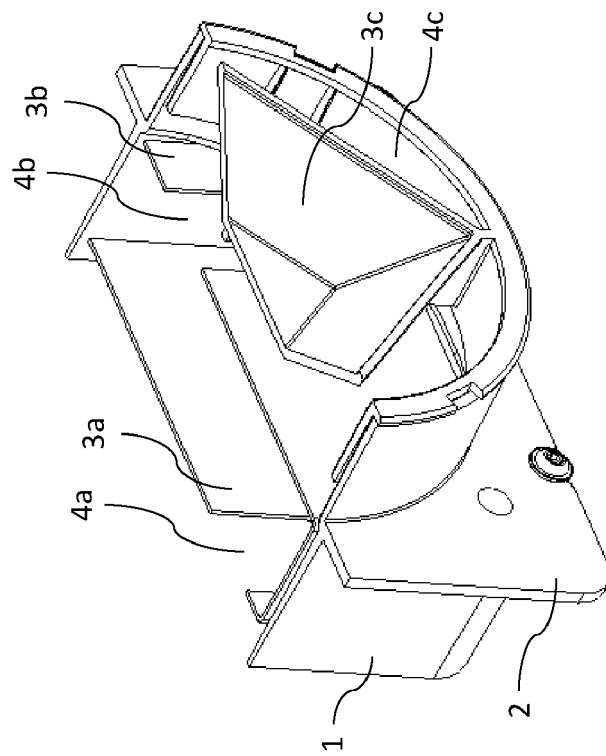


FIG. 5



EUROPEAN SEARCH REPORT

Application Number

EP 22 19 9451

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Place of search Munich		Date of completion of the search 27 February 2023	Examiner Valenza, Davide
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