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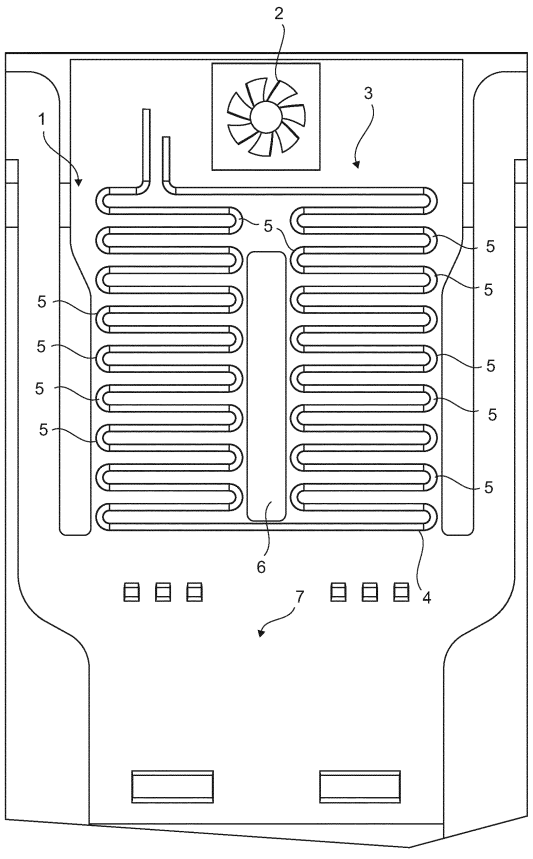
(54) A COOLING DEVICE COMPRISING AN EVAPORATOR

(57) The present invention relates to a cooling device comprising at least one fan (2); an air duct (1); a wall (6) which divides the air duct (1) in two in the direction of the air flow; and at least one evaporator (3) which is disposed in the air duct (1), which has an inlet and an outlet, which is formed by bending a tube (4), wherein the refrigerant circulates and wherein the wall (6) remains between the two serpentine forms in the same plane.

Figure 1



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Description

[0001] The present invention relates to a cooling device comprising an evaporator.

[0002] The cooling devices are composed of two compartments, one on top of the other, called fresh food and freezing compartments. In general, the freezing compartment is positioned above the fresh food compartment. The freezing compartment is cooled by means of the evaporator wrapped around the compartment. In the fresh food compartment, the evaporator is placed inside the rear wall. In conventional refrigerators, the fresh food compartment is cooled by natural convection. The hot and humid air rising along the door is cooled on the rear wall so as to leave its moisture.

[0003] Temperature-controlled compartments in the cooling devices are used more in recent years. In the application of such compartments, valve, direct or indirect cooling solutions are preferred. Moreover, integrated electronic control applications having a sensor are widely used. The temperature-controlled compartments create the need for extra capacity and/or efficient and distributed management of capacity. In this context, in addition to the factors mentioned above, it is observed that integrated evaporator solutions integrated with the air duct provide effective results in providing the desired capacities.

[0004] In the state of the art European Patent Application No. EP2370759, an evaporator is disclosed, having a rectangular plate, which is bent to form an open box at the front and back and placed on the inner surface of the freezing compartment, and tubes arranged in serpentine form on the parts of the plate corresponding to the freezing compartment side walls and ceiling.

[0005] In the state of the art European Patent Application No. EP0547310, a two-compartment cooling device is disclosed, comprising an evaporator which is arranged on the base, ceiling and rear wall of the freezing compartment and then extends to the fresh food compartment.

[0006] Another state of the art embodiment is explained in the Chinese Utility Model Document Application No. CN212378320. According to this document single-row, two-piece evaporator with different fin spacing is provided at the rear side of the fresh food compartment and is used for cooing the fresh food compartment.

[0007] The aim of the present invention is the realization of a cooling device wherein efficient and homogeneous cooling conditions are obtained and the operation times of the compressor are decreased, thus providing energy savings.

[0008] The cooling device realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof, comprises an air duct; a wall which divides the air duct in two in the direction of the air flow; and at least one evaporator which is disposed in the air duct, which has an inlet and an outlet, which is formed by bending a tube, wherein the refrigerant circulates and wherein the wall remains between the two serpentine forms in the same plane.

[0009] In an embodiment of the present invention, the neighbor passes at both sides of the evaporator extend in the same horizontal direction such that the wall remains therebetween.

[0010] In an embodiment of the present invention, the lengths of the tubes between the evaporator passes at both sides are equal to each other. In this embodiment, the two side-by-side serpentine forms are symmetrical although there is a wall therebetween.

[0011] In an embodiment of the present invention, the tube connecting the serpentine forms at both sides is flat, and extends parallel to the lower side of the wall.

[0012] In another embodiment of the present invention, the tube is bent so as to be parallel to both lateral sides and the upper side of the wall and connects the serpentine forms at both sides. In this embodiment, the tube connecting the serpentine forms at both sides partially surrounds the wall, but does not surround the lower side of the wall.

[0013] In another embodiment of the present invention, the tube is bent so as to be parallel to both lateral sides and the lower side of the wall and connects the serpentine forms at both sides. In this embodiment, the tube connecting the serpentine forms at both sides partially surrounds the wall, but does not surround the upper side of the wall.

[0014] In both embodiments of the present invention above, the neighbor passes at both sides separated by the wall do not extend in the same direction and are positioned in a staggered manner.

[0015] In an embodiment of the present invention, the neighbor passes at both sides of the evaporator extend in the vertical direction parallel to each other and the wall such that the wall remains therebetween.

[0016] In an embodiment of the present invention, the lengths of the tubes between the evaporator passes at both sides are equal to each other. In this embodiment, the two side-by-side serpentine forms are symmetrical although there is a wall therebetween.

[0017] In another embodiment of the present invention, the tube is bent so as to be parallel to both lateral sides and the upper side of the wall and connects the serpentine forms at both sides. In this embodiment, the tube connecting the serpentine forms at both sides partially surrounds the wall, but does not surround the lower side of the wall.

[0018] In an embodiment of the present invention, the evaporator pass distances are equal to each other.

[0019] In an embodiment of the present invention, the evaporator is used for cooling the fresh food compartment or the freezing compartment.

[0020] In an embodiment of the present invention, the evaporator is used for cooling the temperature-controlled compartment.

[0021] In an embodiment of the present invention, the evaporator is a finned tube evaporator.

[0022] In another embodiment of the present invention,

the evaporator is an open tube evaporator.

[0023] In yet another embodiment of the present invention, the evaporator is a wire-on-tube evaporator.

[0024] By means of the present invention, the fresh food and/or freezing and/or temperature-controlled compartment, where the evaporator is placed, can be cooled efficiently, and capacity can be used efficiently for all cooling volumes. Effective and homogeneous cooling conditions are provided by minimizing the amount of air escaping from the sides of the evaporator, and energy consumption savings are achieved by reducing compressor operating times with the effective use of heat transfer surface area.

[0025] A cooling device realized in order to attain the aim the object of the present invention is illustrated in the attached figures, where:

Figure 1 - is the front view of an air duct and the evaporator therein.

Figure 2 - is the perspective view of the air duct and the evaporator therein.

Figure 3 - is the front view of an air duct and the evaporator therein in another embodiment of the present invention.

Figure 4 - is the perspective view of the air duct and the evaporator therein in another embodiment of the present invention.

Figure 5 - is the front view of an air duct and the evaporator therein in another embodiment of the present invention.

Figure 6 - is the perspective view of the air duct and the evaporator therein in another embodiment of the present invention.

Figure 7 - is the front view of an air duct and the evaporator therein in another embodiment of the present invention.

Figure 8 - is the perspective view of the air duct and the evaporator therein in another embodiment of the present invention.

Figure 9 - is the front view of an air duct and the evaporator therein in another embodiment of the present invention.

Figure 10 - is the perspective view of the air duct and the evaporator therein in another embodiment of the present invention.

[0026] The elements illustrated in the figures are numbered as follows:

1. Air duct
2. Fan
3. Evaporator
4. Tube
5. Pass
6. Wall
7. Blowing duct

[0027] The cooling device of the present invention comprises at least one fan (2); an air duct (1); a wall (6) which divides the air duct (1) in two in the direction of the air flow; and at least one evaporator (3) which is disposed in the air duct (1), which has an inlet and an outlet, which is formed by bending a tube (4), wherein the refrigerant circulates and wherein the wall (6) remains between the two serpentine forms in the same plane.

[0028] The refrigerant passes through the inlet of the evaporator (3), circulates the serpentine form on one side of the wall (6) and reaches the outlet by passing to the other adjacent serpentine form on the other side of the wall (6), and in this case, the heat transfer surface area is further increased compared to evaporators where a single serpentine form is used in the same surface area. Thus, the amount of escaping air is minimized and efficient and homogeneous cooling conditions and effective use of the heat transfer surface area are ensured. Thus, energy consumption gains are provided by reducing compressor operating times.

[0029] In an embodiment of the present invention, the neighbor passes (5) at both sides of the evaporator (3) extend in the same horizontal direction such that the wall (6) remains therebetween.

[0030] In an embodiment of the present invention, the lengths of the tubes (4) between the evaporator (3) passes (5) at both sides are equal to each other. In this embodiment, the two side-by-side serpentine forms are symmetrical although there is a wall (6) therebetween.

[0031] In an embodiment of the present invention, the tube (4) connecting the serpentine forms at both sides is flat, and extends parallel to the lower side of the wall (6) (Figure 1 and Figure 2).

[0032] In another embodiment of the present invention, the tube (4) is bent so as to be parallel to both lateral sides and the upper side of the wall (6) and connects the serpentine forms at both sides. In this embodiment, the tube (4) connecting the serpentine forms at both sides partially surrounds the wall (6), but does not surround the lower side of the wall (6) (Figure 3 and Figure 4).

[0033] In another embodiment of the present invention, the tube (4) is bent so as to be parallel to both lateral sides and the lower side of the wall (6) and connects the serpentine forms at both sides. In this embodiment, the

tube (4) connecting the serpentine forms at both sides partially surrounds the wall (6), but does not surround the upper side of the wall (6) (Figure 5 and Figure 6).

[0034] In both embodiments of the present invention above, the neighbor passes (5) at both sides separated by the wall (6) do not extend in the same direction and are positioned in a staggered manner.

[0035] In an embodiment of the present invention, the neighbor passes (5) at both sides of the evaporator (3) extend in the vertical direction parallel to each other and the wall (6) such that the wall (6) remains therebetween.

[0036] In an embodiment of the present invention, the lengths of the tubes (4) between the evaporator (3) passes (5) at both sides are equal to each other. In this embodiment, the two side-by-side serpentine forms are symmetrical although there is a wall (6) therebetween.

[0037] In another embodiment of the present invention, the tube (4) is bent so as to be parallel to both lateral sides and the upper side of the wall (6) and connects the serpentine forms at both sides. In this embodiment, the tube (4) connecting the serpentine forms at both sides partially surrounds the wall (6), but does not surround the lower side of the wall (6) (Figure 7 and Figure 8).

[0038] In another embodiment of the present invention, the cooling device comprises a blowing duct (7) at the lower side of the air duct (1). In this embodiment of the present invention, the cooling device comprises an evaporator (3) having an additional serpentine form which is formed by bending the tube (4) and which extends towards the mouth of the air blowing duct (7) (Figure 9 and Figure 10). In this embodiment of the present invention, the ratio of the width of the blowing duct (7) to the width of the evaporator (3) is between 0.40 and 0.90.

[0039] In an embodiment of the present invention, the additional serpentine form can be horizontal or vertical.

[0040] In an embodiment of the present invention, the evaporator (3) pass (5) distances are equal to each other.

[0041] In an embodiment of the present invention, the evaporator (3) is used for cooling the fresh food compartment or the freezing compartment.

[0042] In an embodiment of the present invention, the evaporator (3) is used for cooling the temperature-controlled compartment.

[0043] In an embodiment of the present invention, the evaporator (3) is a finned tube evaporator.

[0044] In another embodiment of the present invention, the evaporator (3) is an open tube evaporator (3).

[0045] In yet another embodiment of the present invention, the evaporator (3) is a wire-on-tube evaporator (3).

[0046] In an embodiment of the present invention, the ratio of the spacing between the passes (5) of both serpentine forms adjacent to each other to the pass (5) distance (d) is between 50% and 200%.

[0047] By means of the present invention, the fresh food and/or freezing and/or temperature-controlled compartment, where the evaporator (3) is placed, can be cooled efficiently, and capacity can be used efficiently for all cooling volumes. Effective and homogeneous cooling conditions are provided by minimizing the amount of air escaping from the sides of the evaporator (3), and energy consumption savings are achieved by reducing compressor operating times with the effective use of heat transfer surface area.

Claims

1. A cooling device **comprising** at least one fan (2); an air duct (1), **characterized by** a wall (6) which divides the air duct (1) in two in the direction of the air flow; and at least one evaporator (3) which is disposed in the air duct (1), which has an inlet and an outlet, which is formed by bending a tube (4), wherein the refrigerant circulates and wherein the wall (6) remains between the two serpentine forms in the same plane.

2. A cooling device as in Claim 1, **characterized by** the evaporator (3) wherein the neighbor passes (5) at both sides thereof extend in the same horizontal direction such that the wall (6) remains therebetween.

3. A cooling device as in Claim 1, **characterized by** the evaporator (3) wherein the lengths of the tubes (4) between the passes (5) thereof at both sides are equal to each other.

4. A cooling device as in Claim 1 and 2, **characterized by** the evaporator (3) wherein the two side-by-side serpentine forms are symmetrical although there is a wall (6) therebetween.

5. A cooling device as in Claim 1, **characterized by** the evaporator (3) wherein the tube (4) connecting the serpentine forms at both sides is flat, and extends parallel to the lower side of the wall (6).

6. A cooling device as in Claim 1, **characterized by** the evaporator (3) comprising the tube (4) which is bent so as to be parallel to both lateral sides and the upper side of the wall (6) and which connects the serpentine forms at both sides.

7. A cooling device as in Claim 1, **characterized by** the evaporator (3) comprising the tube (4) which is bent so as to be parallel to both lateral sides and the lower side of the wall (6) and connects the serpentine forms at both sides.

8. A cooling device as in Claim 1, 6 and 7, **characterized by** the evaporator (3) wherein the neighbor passes (5) at both sides separated by the wall (6) are positioned in a staggered manner.

9. A cooling device as in Claim 1, **characterized by** the evaporator (3) wherein the neighbor passes (5) at both sides of the evaporator (3) extend in the vertical direction parallel to each other and the wall (6) such that the wall (6) remains therebetween.

10. A cooling device as in Claim 9, **characterized by** the evaporator (3) wherein the lengths of the tubes (4) between the passes (5) thereof at both sides are equal to each other.

11. A cooling device as in Claim 9 and 10, **characterized by** the evaporator (3) wherein the two side-by-side serpentine forms are symmetrical although there is a wall (6) therebetween.

12. A cooling device as in Claim 9, 10 and 11, **characterized by** the evaporator (3) comprising the tube (4) which is bent so as to be parallel to both lateral sides and the upper side of the wall (6) and which connects the serpentine forms at both sides.

13. A cooling device as in any one of the above claims comprising a blowing duct (7) at the lower side of the air duct (1), **characterized by** an evaporator (3) having an additional serpentine form which is formed by bending the tube (4) and which extends towards the mouth of the air blowing duct (7).

Figure 1

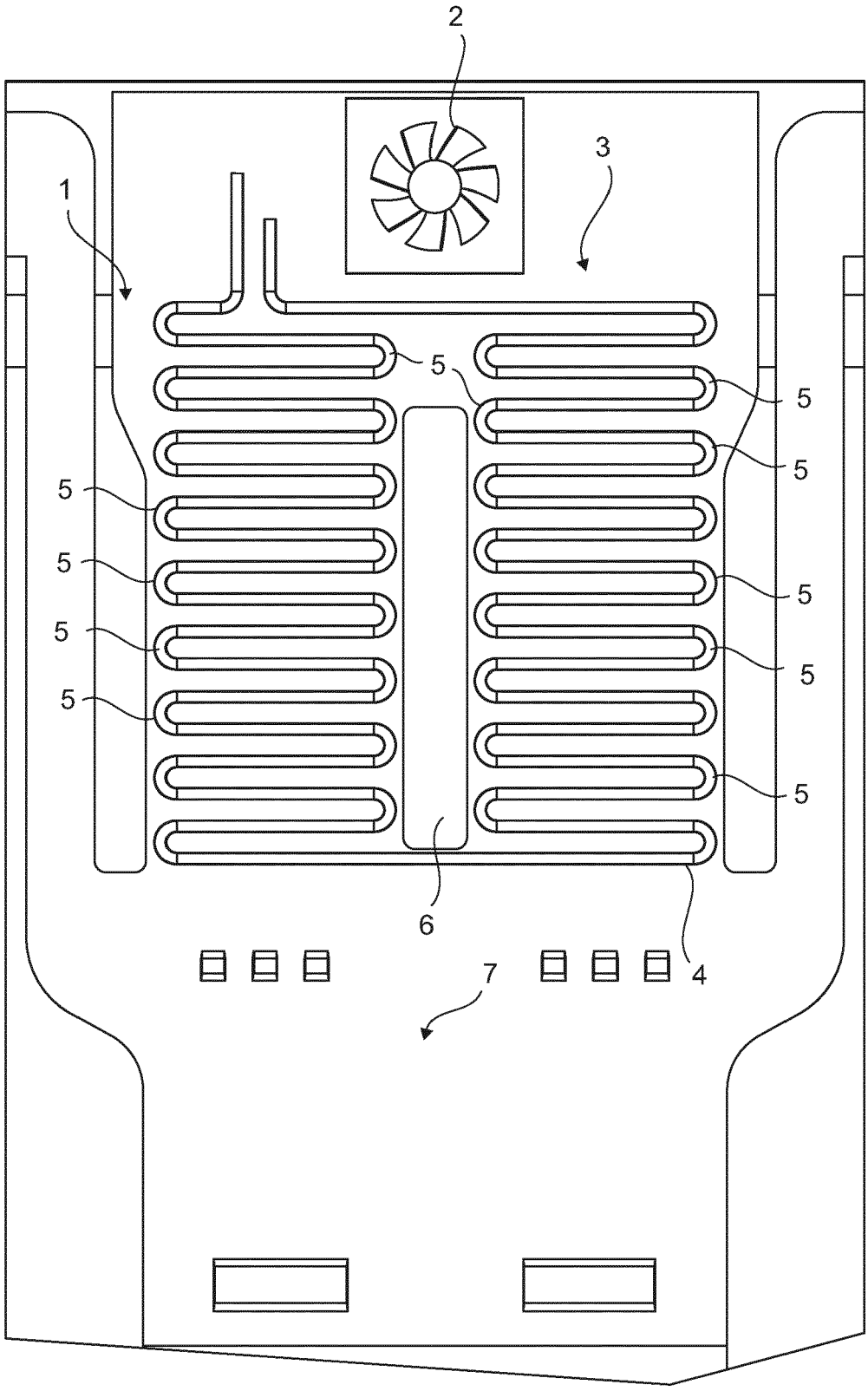


Figure 2

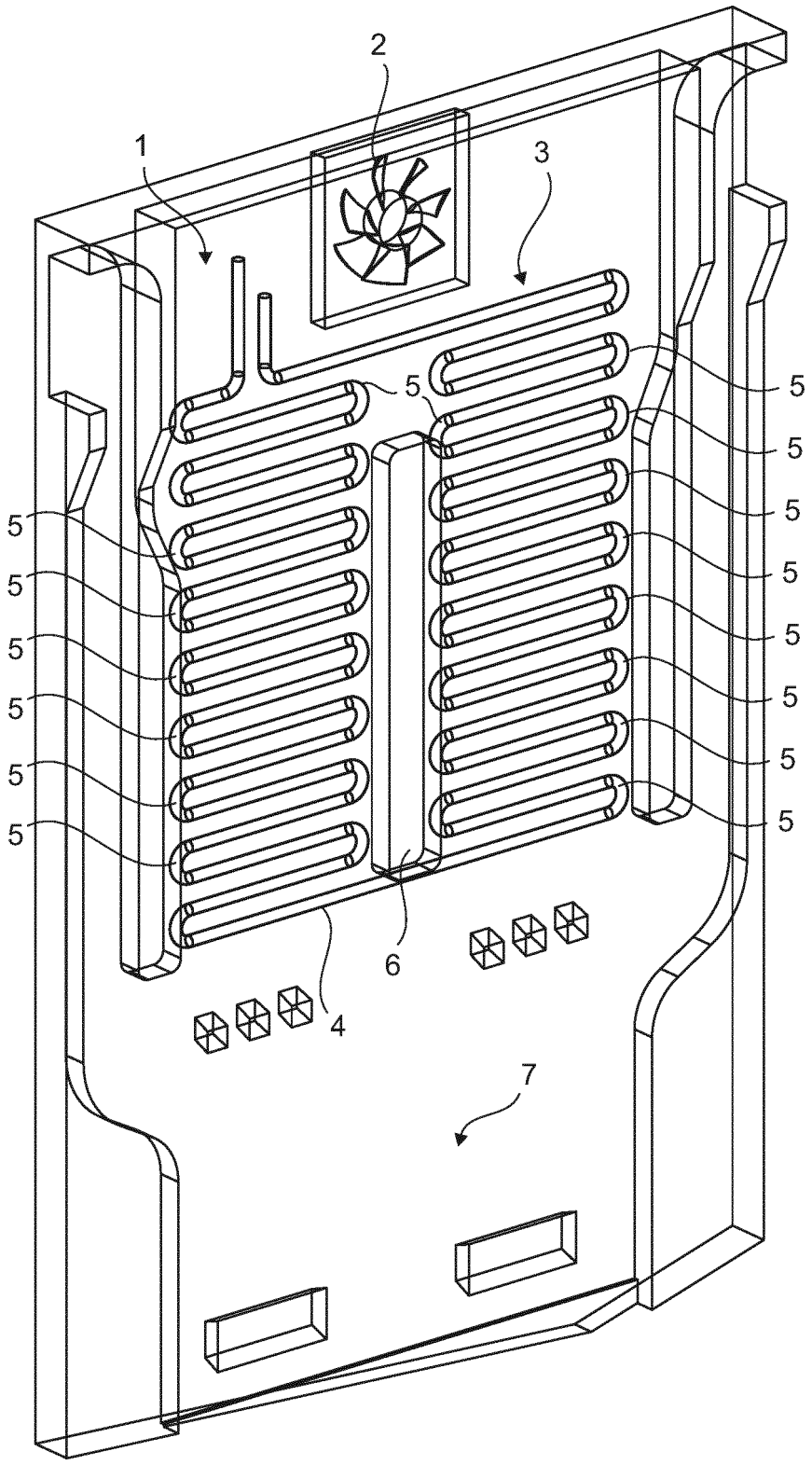


Figure 3

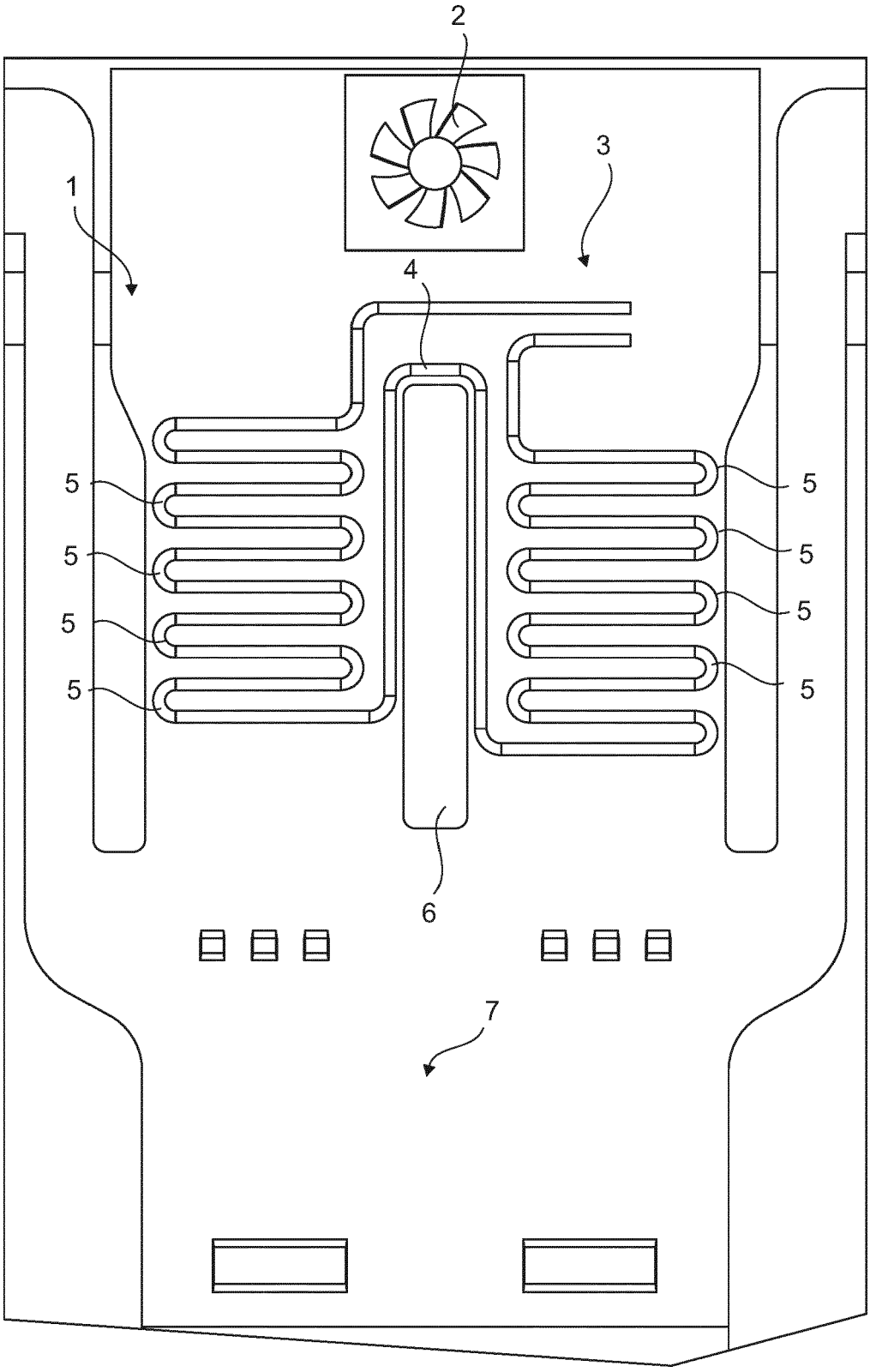


Figure 4

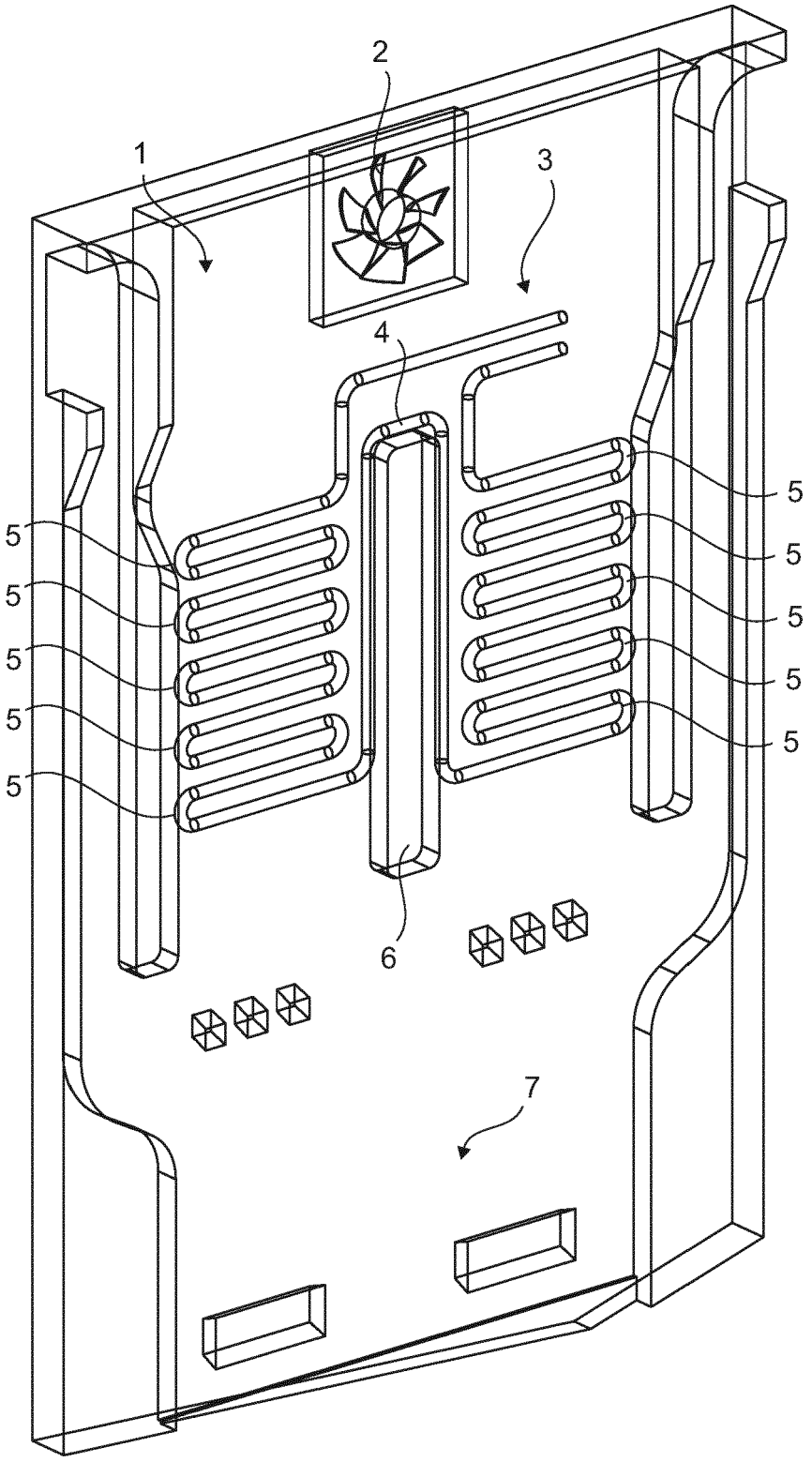


Figure 5

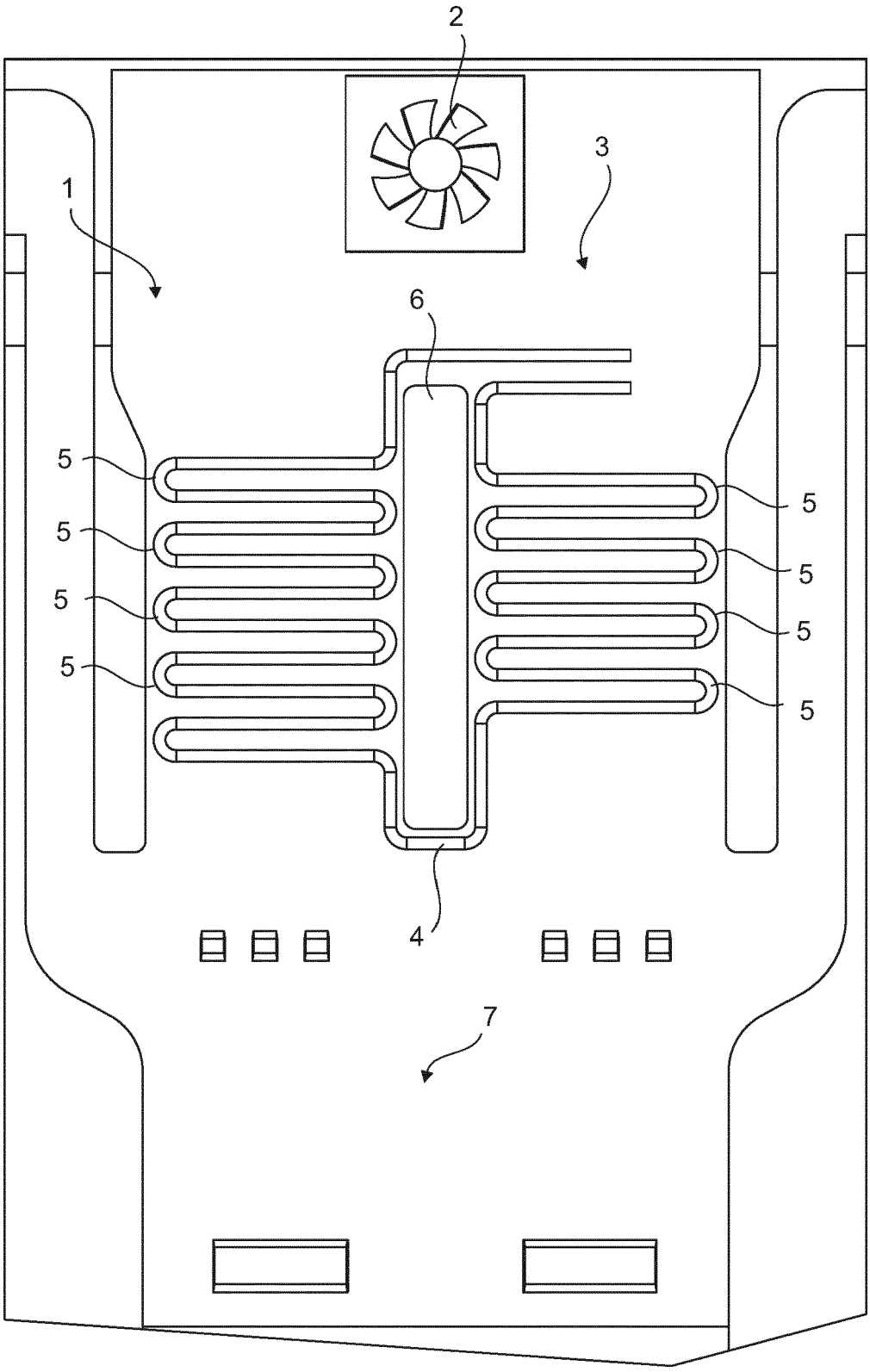


Figure 6

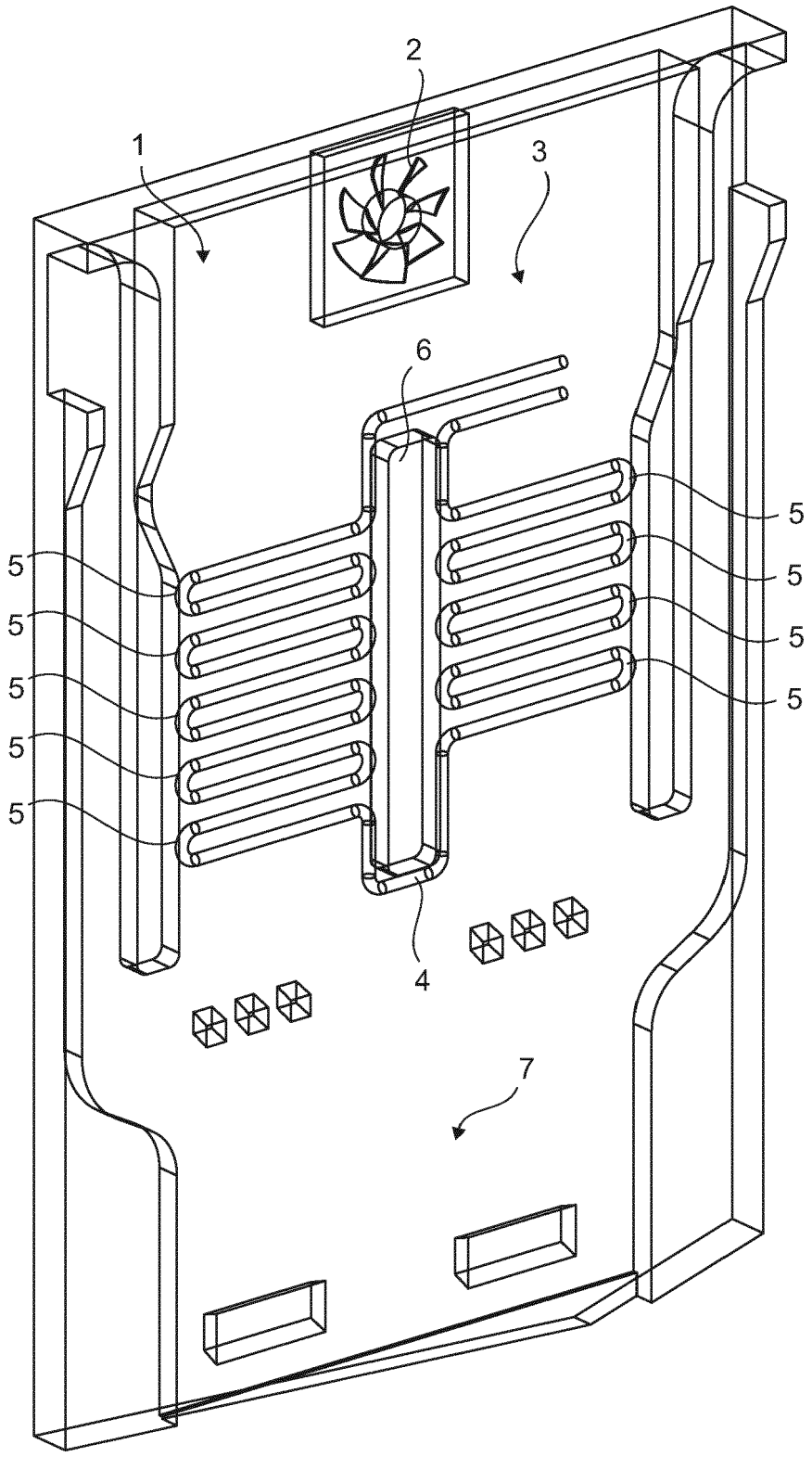


Figure 7

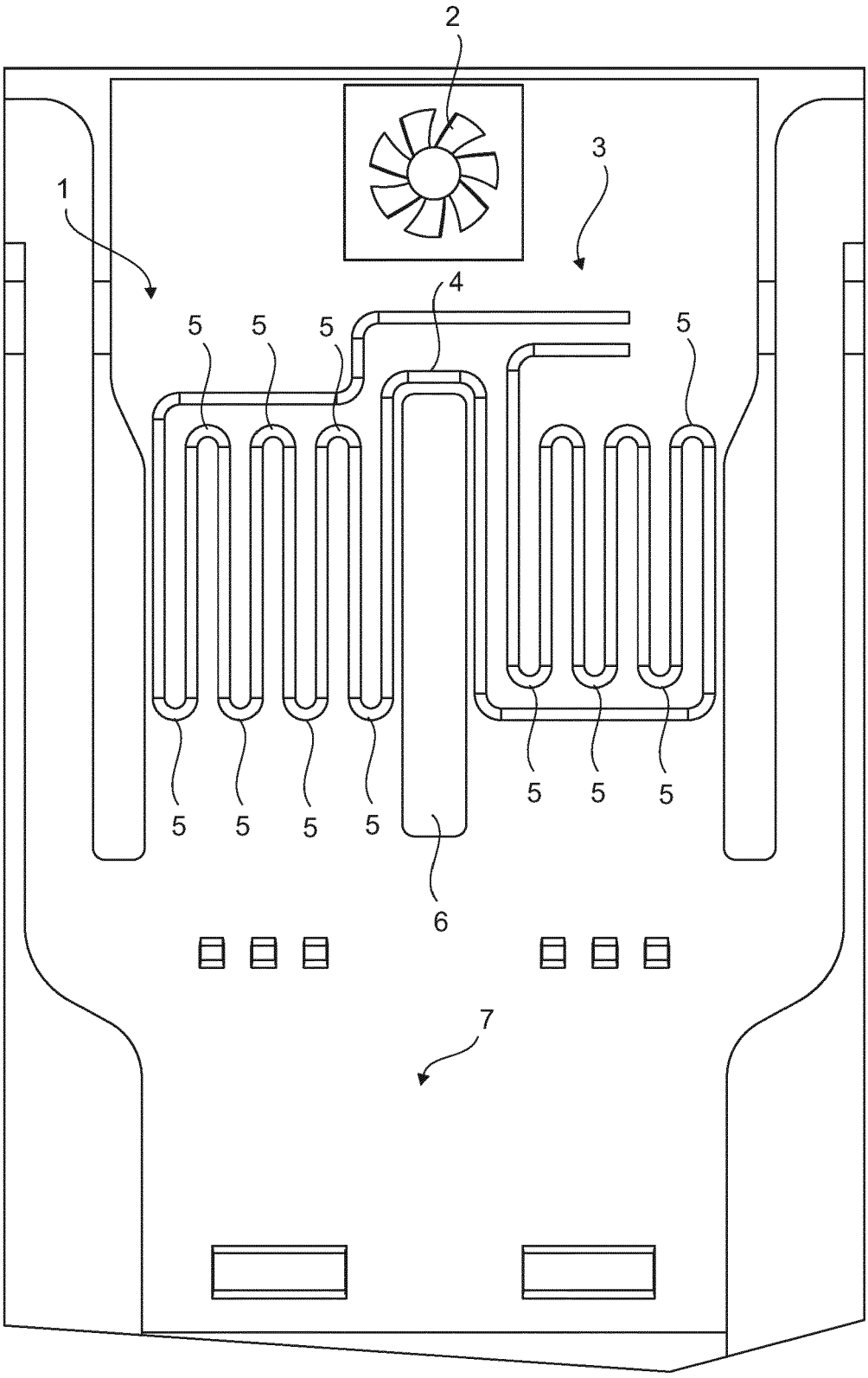


Figure 8

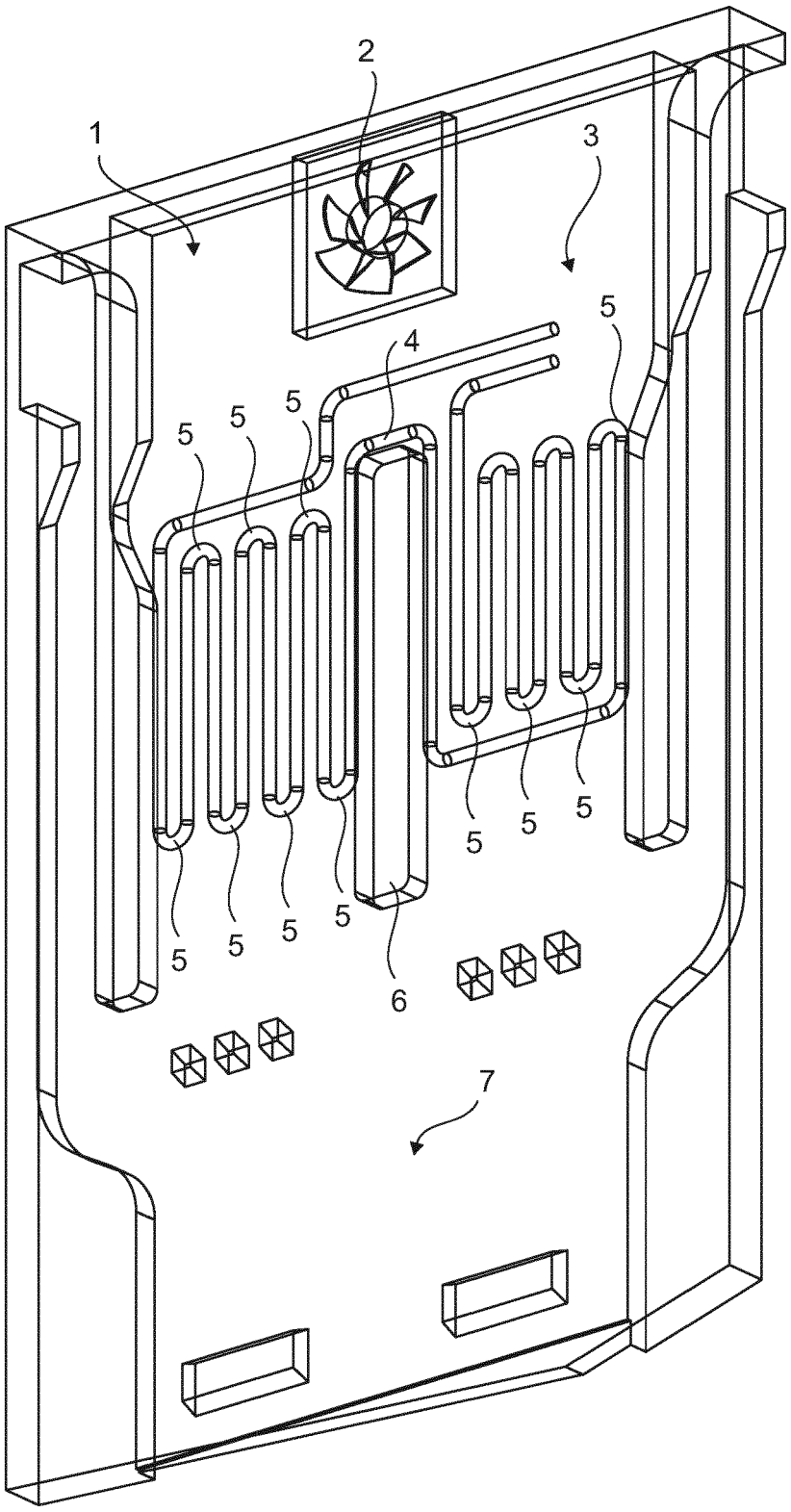


Figure 9

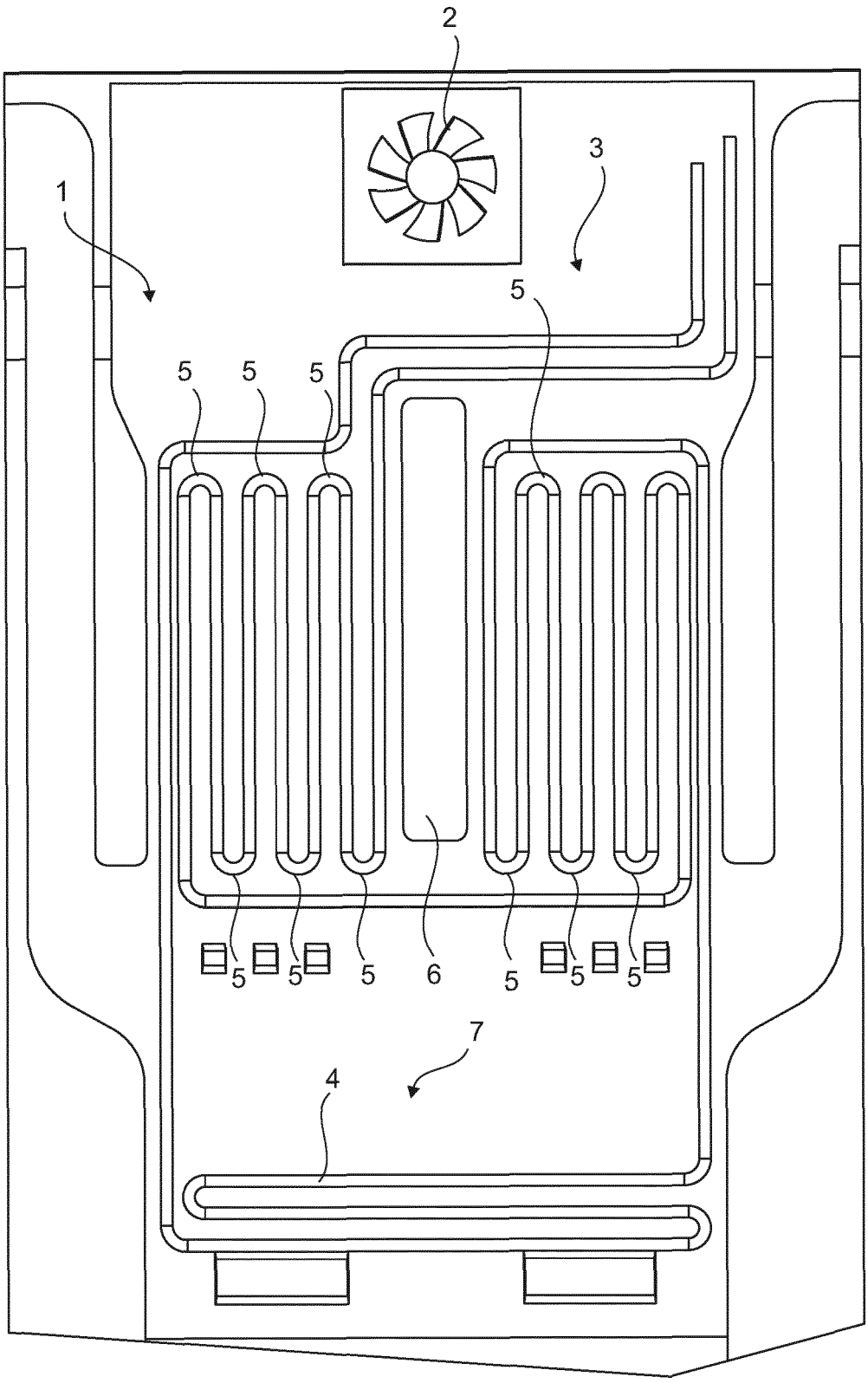
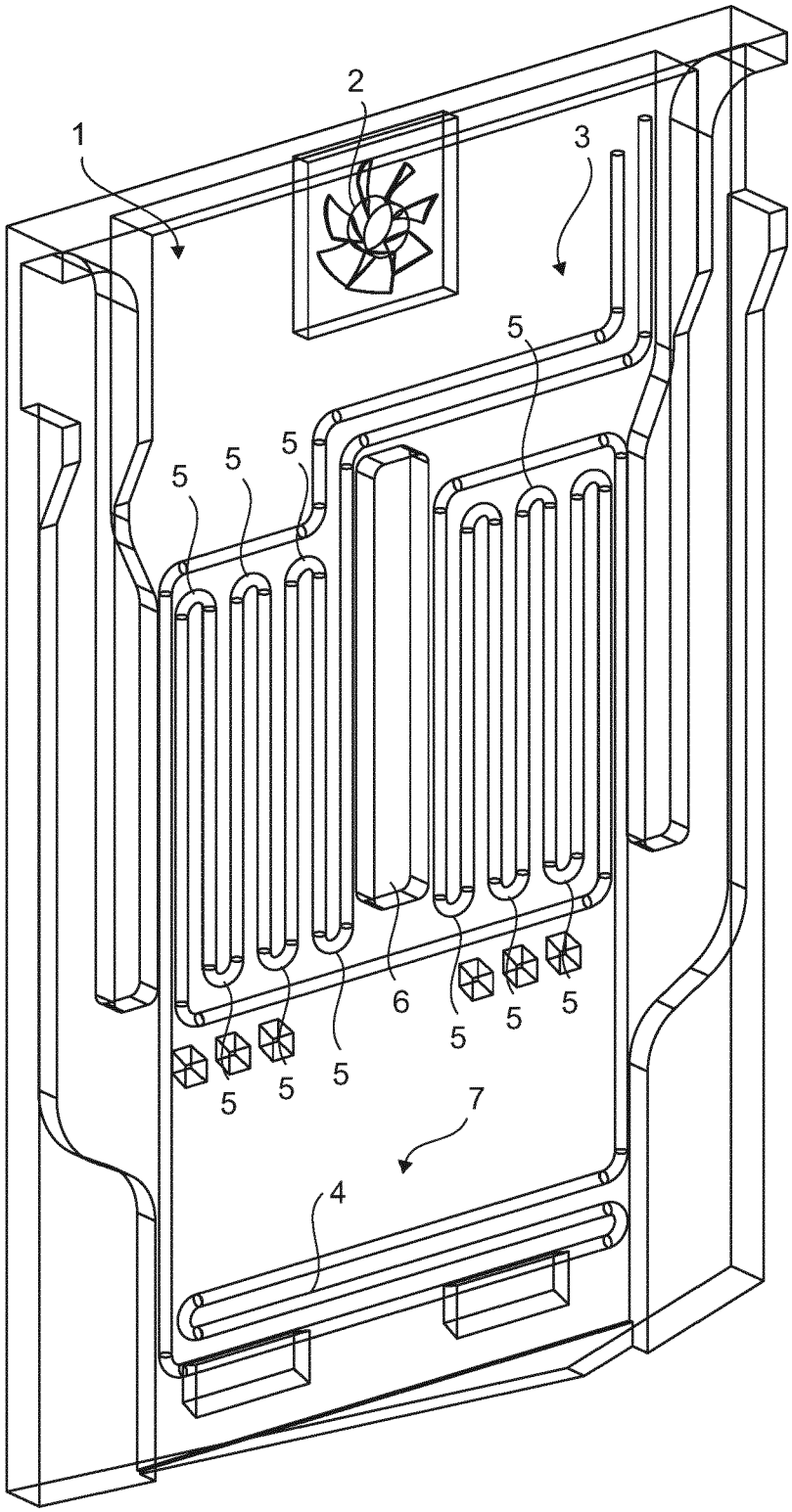


Figure 10



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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 9098

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2004/144128 A1 (JUNGE BRENT A [US] ET AL) 29 July 2004 (2004-07-29) * abstract; figures 1-4 * * paragraph [0032] - paragraph [0033] *	1-13	INV. F25D17/06
X	US 2018/306484 A1 (CHA KYUNGHUN [KR] ET AL) 25 October 2018 (2018-10-25) * abstract; figures 1-6 *	1-13	
X	US 2018/292121 A1 (KIM SOYOON [KR] ET AL) 11 October 2018 (2018-10-11) * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	21 April 2023	Bejaoui, Amin

CATEGORY OF CITED DOCUMENTS

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- EP 0547310 A **[0005]**
- CN 212378320 **[0006]**