



(51) International Patent Classification:

F24H 1/00 (2006.01) *F24H 7/04* (2006.01)
B60H 1/32 (2006.01) *F25D 21/08* (2006.01)
F24H 1/12 (2006.01) *F28D 20/02* (2006.01)
F24H 1/14 (2006.01) *F24H 4/02* (2006.01)
F24H 7/02 (2006.01) *F28D 7/10* (2006.01)

(21) International Application Number:

PCT/EP2018/061046

(22) International Filing Date:

30 April 2018 (30.04.2018)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1753793 28 April 2017 (28.04.2017) FR

(71) Applicant: VALEO SYSTEMES THERMIQUES
[FR/FR]; ZA l'Agiot, 8 rue Louis Lormand, CS 80517 LA
VERRIERE, 78322 LE MESNIL SAINT DENIS Cedex
(FR).

(72) Inventors: ROBILLON, Lionel; C/o Valeo Systèmes
Thermiques, Lieu dit le Pré Sec, CS 10016, 72210 LA SUZE
SUR SARTHE (FR). BELLENFANT, Aurélie; C/o Valeo
Systèmes Thermiques, Lieu dit le Pré Sec, CS 10016, 72210
LA SUZE SUR SARTHE (FR). TISON, Frédéric; C/o Va-

leo Systèmes Thermiques, Lieu dit le Pré Sec, CS 10016,
72210 LA SUZE SUR SARTHE (FR). JOVET, Bastien; C/
o Valeo Systèmes Thermiques, ZA l'Agiot, 8 rue Louis Lormand,
CS 80517 La Verrière, 78322 LE MESNIL SAINT DENIS
CEDEX (FR). MOREAU, Sylvain; C/o Valeo Sys-
tèmes Thermiques, Lieu dit le Pré Sec, CS 10016, 72210 LA
SUZE SUR SARTHE (FR). GOUR, Josselin; C/o Valeo
Systèmes Thermiques, ZA l'Agiot, 8 rue Louis Lormand,
CS 80517 La Verrière, 78322 LE MESNIL SAINT DENIS
CEDEX (FR).

(74) Agent: TRAN, Chi-Hai; VALEO SYSTEMES THER-
MIQUES, ZA L'Agiot, 8 rue Louis Lormand, CS 80517 La
Verrière, 78322 LE MESNIL SAINT-DENIS Cedex (FR).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,
KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(54) Title: DUCT FOR A HEAT EXCHANGER OF AN AUTOMOBILE

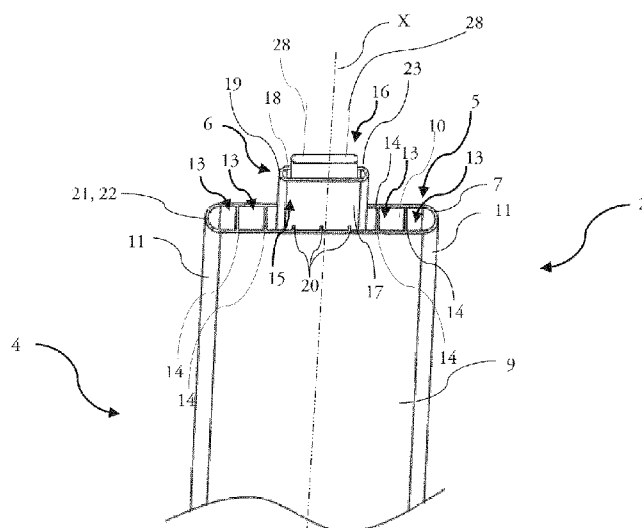


Fig. 2

(57) Abstract: The invention relates to a duct (4) for a heat exchanger, comprising at least a first tube (5) bounding off at least one duct
able to receive a flow of refrigerant fluid, and a second tube (6) lodged in the first tube (5), characterized in that at least one electric
heating element extends in the second tube (6).



(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

DUCT FOR A HEAT EXCHANGER OF AN AUTOMOBILE

The invention deals with the field of air conditioning systems for an automobile, more particularly the thermal modules of these systems, especially for electric vehicles.

5 A vehicle is at present outfitted with an air conditioning system to thermally process the air present in or supplied to the passenger compartment of the vehicle. Such a system comprises a circuit of refrigerant fluid inside which a refrigerant fluid circulates. In succession, following the direction of circulation of the refrigerant fluid through it, the circuit of refrigerant fluid comprises basically a compressor, a condenser, an expansion device and
10 an evaporator.

This air conditioning system may be utilized as an air cooling system, but it may also operate in the reverse way, and then the system functions as a heat pump and so makes it possible to heat the passenger compartment of the vehicle.

15 This heat pump operating mode is turned on in particular when the power demand is sizeable, for example, when starting the vehicle and more particularly when the outside temperatures are low.

20 In the operation of the circuit of refrigerant fluid in heat pump mode, the temperature of the passenger compartment is moderated by the circulation of the refrigerant fluid between the condenser, situated in the vehicle in the vicinity of the passenger compartment, and the evaporator, placed in contact with the outside air of the vehicle, more precisely, located at the front face of the vehicle.

In the heat pump operating mode of such a circuit of refrigerant fluid, the refrigerant fluid takes up the heat in the area of the evaporator and the refrigerant fluid surrenders the heat in the area of the condenser.

25 However, in the aforementioned configuration of the evaporator, the evaporator is directly exposed to the outside air around the vehicle. But in the heat pump operating mode, upon starting an automobile, a lot of power is needed in order to heat the air of the passenger compartment of the vehicle to reach the desired temperature for a passenger of the vehicle.

In automobiles, especially in the case of electric or hybrid vehicles, this power needed to reach the desired temperature has the effect of causing a frosting of the evaporator, especially when the temperature of the outside air is very low, for example between 0° C and -5° C, thus causing a significant drop in the air flow through the evaporator of the refrigerant fluid circuit. This drop in the air flow reduces the efficiency of the evaporator, resulting in poor functioning of the circuit of refrigerant fluid.

It is therefore known how to associate a thermal module with such a circuit. In fact, such a thermal module may be placed in the refrigerant fluid circuit in parallel with the evaporator. This thermal module may then comprise a plurality of ducts designed to receive the flow of the same refrigerant fluid as that of the refrigerant fluid circuit.

This thermal module also comprises a phase change material and is utilized as a thermal storage, so as to absorb heat and then take part in the raising of the temperature of the refrigerant fluid passing through it, especially during the aforementioned starting phase of the automobile.

Nevertheless, such thermal modules are limited in their operation. In particular, the conformation and the disposition of the ducts and of the phase change material arranged in this thermal module are not able to quickly achieve the temperature of the passenger compartment desired by a passenger.

Moreover, the methods of manufacturing these ducts and thus the thermal modules comprising these ducts are costly and complicated.

The present invention thus intends to remedy at least one of these drawbacks by proposing at least one duct designed to be installed in a thermal module of an automobile, where the duct comprises a first tube receiving the flow of refrigerant fluid and in contact with the phase change material, as well as a second tube received in the first tube and forming a casing for an electric heating element. This makes it possible to promote the heat exchange between this phase change material and the refrigerant fluid flowing through this duct. The increasing of the enthalpy of the refrigerant fluid is thus accelerated, while avoiding a full-load operation of the evaporator of the refrigerant fluid circuit operating in heat pump mode.

The subject matter of the present invention thus relates to a duct for a heat exchanger,

comprising at least a first tube bounding off at least one conduit able to receive a flow of refrigerant fluid, and a second tube lodged in the first tube. According to the present invention, at least one electric heating element extends in the second tube.

5 The first tube and the second tube have similar configurations. Each of these tubes thus has a first major face and a second major face, opposite the first major face. The first major face and the second major face of a same tube may be joined together by lateral edges.

According to the present invention, the first major face of the first tube may be arranged next to the first major face of the second tube, such that the second major face of the first tube may be respectively arranged next to the second major face of the second tube.

10 By “arranged next to” it is meant that these two major faces are disposed facing each other, looking along a line perpendicular to the first major face of the first tube, without there being a direct contact between them.

According to one characteristic of the present invention, the first tube and the second tube may be concentric.

15 According to one aspect of the present invention, at least one connecting wall may join the first tube and the second tube.

This connecting wall joins the first major face of the first tube to the first major face of the second tube and the second major face of the first tube to the second major face of the second tube. It may thus participate in the diffusion of the heat emitted by the electrical
20 heating element to the refrigerant fluid and to the phase change material.

More precisely, this connecting wall is able to conduct the heat generated by the electrical heating element from one surface of the first major face of the second tube to a surface of the first major face of the first tube. Likewise, this connecting wall is able to conduct the heat generated by the electrical heating element from one surface of the second
25 major face of the second tube to a surface of the second major face of the first tube.

Advantageously, the duct may have several connecting walls.

According to one characteristic of the present invention, the first tube has a length

measured along a longitudinal axis of extension of the duct which is less than a length of the second tube, measured along this longitudinal axis.

The first tube may comprise a series of conduits configured to allow the circulation of a refrigerant fluid.

5 According to one aspect of the present invention, at least one intermediate wall may bound off at least one conduit. This intermediate wall may then extend from the first major face of the first tube to the second major face of this first tube, along an axis perpendicular to a plane in which the first major face of the first tube is inscribed.

10 Advantageously, several intermediate walls may extend between the first major face of the first tube and the second major face of this first tube, thus bounding off several conduits in which the refrigerant fluid may circulate.

15 According to one aspect of the present invention, the connecting wall joining the first major face of the first tube to the first major face of the second tube and the connecting wall joining the second major face of the first tube to the second major face of the second tube likewise take part in the bounding off of these conduits disposed between the first tube and the second tube.

According to the present invention, the first tube may respectively have a first longitudinal end edge bounding off a first opening, and a second longitudinal end edge, opposite the first longitudinal end edge, bounding off a second opening.

20 This first opening and this second opening allow the refrigerant fluid to enter and leave the series of conduits devised in the first tube of the duct.

25 According to the present invention, the second tube may respectively have a first open longitudinal end ridge from which emerges at least one electrical connector able to power the electrical heating element, and a second closed longitudinal end ridge, opposite the first longitudinal end ridge.

This second longitudinal end ridge may be closed for example by a brazing process, by bending, or by crushing.

According to one characteristic of the present invention, the duct may be extruded.

According to a first exemplary embodiment of the present invention, the electrical heating element may be, for example, a resistive film comprised of a plate of synthetic material on which one or more electrical heating tracks may be arranged.

5 According to a second exemplary embodiment of the present invention, the electrical heating element may be a resistive wire.

According to a third exemplary embodiment, the electrical heating element may comprise a positive temperature coefficient resistor. According to this third exemplary embodiment, at least one electrode is disposed in the second tube, in contact with this positive
10 temperature coefficient resistor.

Advantageously, two electrodes may be disposed around the positive temperature coefficient resistor. These electrodes may then be disposed on either side of the positive temperature coefficient resistor, between the latter and one of the major faces of the second tube. According to this exemplary embodiment, an electrical insulating material is interposed
15 between these major faces bounding off the second tube and the electrodes placed in contact with the positive temperature coefficient resistor. Such a positive temperature coefficient resistor may be formed by a plurality of flat stones.

The present invention likewise relates to a heat exchanger comprising at least a first distribution box, a second distribution box and a plurality of ducts as claimed in the present
20 invention, each of the distribution boxes being disposed at the longitudinal ends of the plurality of ducts.

The heat exchanger may likewise comprise, in addition to at least one duct as claimed in the present invention, “plain” ducts, that is, not comprising the electrical heating element. For example, the heat exchanger according to the present invention may comprise one duct
25 according to the invention for every three plain ducts.

By a “plain” duct is meant any duct having at least one conduit for circulation of a refrigerant fluid. Advantageously, the “plain” duct is identical in conformation to the duct as claimed in the invention except for the heating element, thus making it possible to streamline the production and the logistics with regard to the ducts.

According to one characteristic of the present invention, at least a first longitudinal end edge of the first tube of a duct may extend inside the first distribution box of the heat exchanger, and at least a first longitudinal end ridge of the second tube of this duct may extend outside the first distribution box.

5 By “extend outside the first distribution box” is meant that this first longitudinal end ridge extends beyond this first distribution box, along the longitudinal axis, after having passed straight through it.

According to this characteristic of the present invention, the first distribution box has at least a first orifice designed to be traversed by the first longitudinal end edge of the first tube
10 and by the first longitudinal end ridge of the second tube and at least a second orifice designed to be traversed solely by the first longitudinal end ridge of the second tube. This first orifice and this second orifice of the first distribution box are arranged next to one another.

According to another characteristic of the present invention, at least one second longitudinal end edge of the first tube of the duct and at least one second longitudinal end
15 ridge of the second tube of this duct may extend inside the second distribution box of the heat exchanger.

According to one embodiment of the present invention, the first distribution box may comprise a return collector and the second distribution box may respectively comprise an inlet collector and an outlet collector.

20 According to this embodiment of the present invention, the heat exchanger may thus present a U-shaped circulation of refrigerant fluid, each duct forming the arms of this U, and the first distribution box forming the base of this U. Thus, the first tube and the second tube of a duct according to the present invention jointly form one arm of the U shape.

According to one aspect of the present invention, at least one heat dissipation element
25 may be disposed between at least two ducts.

Advantageously, a heat dissipation element may be disposed between each duct, whether it be a duct according to the present invention or a “plain” duct as previously mentioned. This heat dissipation element may be, for example, a fin or an insert.

The present invention also comprises a thermal module for an automobile comprising a housing bounding off an internal volume in which may be disposed at least one heat exchanger as claimed in the present invention and a phase change material, this phase change material being able to be placed in direct contact with the plurality of ducts of the at least one heat exchanger.

It will thus be understood that the heat exchanger may be at least partly immersed in the phase change material which fills the available space between this heat exchanger and the housing. This phase change material may thus be in direct contact with the duct according to the invention, in particular with the first tube of the duct according to the invention.

By “direct contact” shall be meant a physical contact between a first element and a second element.

On the other hand, the term “immersed” shall not be construed as being limited to a liquid element. Thus, according to the invention, the term “immersed” may refer to a solid element. For example, in the case where the phase change material is formed by micro beads, the heat exchanger may be at least partly immersed in the micro beads.

According to one characteristic of the present invention, the thermal module may have a cover closing the housing, this cover having at least one cavity through which emerges at least one electrical connector making possible a power supply for the electrical heating element of the heat exchanger.

According to another characteristic of the present invention, the thermal module may be covered by a thermal insulator so as to reduce the heat losses.

According to the present invention, a thermal insulator may be arranged around the at least one heat exchanger, making it possible to reduce the heat losses.

Other characteristics, details and advantages of the present invention will emerge more clearly from a reading of the following detailed description, given as an illustration, with regard to the different embodiments represented in the following figures:

- figure 1 is a schematic illustration of a circuit of refrigerant fluid of an air conditioning system of a vehicle in an operation corresponding to that of a heat pump and in which there is

shown one possible configuration of a thermal module according to the invention;

- figures 2 and 3 are perspective views of a first end and a second end of a duct according to the present invention;

- figure 4 is a cross sectional and perspective illustration of the duct according to one exemplary embodiment of the present invention, showing electrical heating elements;

- figure 5 is a schematic representation of a heat exchanger comprising a plurality of ducts according to the present invention;

- figures 6 and 7 are perspective views of a thermal module according to two exemplary embodiments of the present invention.

10 In figure 1, an air conditioning system 12 for a passenger compartment of a vehicle, especially an automobile, comprises a circuit of refrigerant fluid 100 inside which there is circulating a refrigerant fluid FR in a direction of circulation S. As is shown, the circuit of refrigerant fluid 100 basically comprises, in succession and following the same direction of circulation S as the refrigerant fluid FR, a compressor 200, a condenser 300 or gas cooler, an
15 expansion device 400 and at least one evaporator 500.

It will be understood that in the description of the invention we are particularly interested in an operating mode of such an air conditioning system 12 in a heat pump mode, this operation being associated with a use of the air conditioning system 12 for heating, and this principally in order to raise the temperature of the passenger compartment of the vehicle.

20 It will likewise be noted that the example illustrated for a minimal architecture of the circuit of refrigerant fluid 100 is given as an instance and is not limiting for the scope of the invention as regards different possible architectures of the circuit of refrigerant fluid 100.

We shall now describe the operating cycle of such a circuit of refrigerant fluid 100 utilized in heat pump mode.

25 The compressor 200 of the circuit of refrigerant fluid 100 has the function of increasing the pressure of the refrigerant fluid FR. At the inlet of the compressor 200, the refrigerant fluid FR is in a low-pressure gas phase. At the outlet of the compressor 200, the refrigerant

fluid FR is in a high-pressure gas phase.

The refrigerant fluid FR leaving the compressor 200 in the high-pressure gas phase is then condensed by the condenser 300. This condensation is chiefly accomplished by a heat exchange realized by the walls of the condenser 300 between the refrigerant fluid FR circulating in the condenser 300 and an air flow FA passing through the condenser 300 and routed into the passenger compartment of the vehicle. The condensation thus makes it possible to raise the temperature of the air flow FA which is then routed into the passenger compartment of the vehicle to heat it.

The condenser 300 realizes a phase change of the refrigerant fluid FR, from a gas phase to a liquid phase, in order to supply an inlet of the expansion device 400. The circulation of the refrigerant fluid FR between the outlet of the compressor 200 and the inlet of the expansion device 400 corresponds to a high-pressure section HP of the circuit of refrigerant fluid 100. The expansion device 400 makes it possible to lower the pressure of the refrigerant fluid FR to provide at its outlet a refrigerant fluid FR in a low-pressure liquid phase designed to supply the evaporator 500.

This evaporator 500 then enables the evaporation of the refrigerant fluid FR. This evaporation is primarily accomplished by a heat exchange realized by the walls of the evaporator 500 between the refrigerant fluid FR circulating in the evaporator 500 and an air flow external to the passenger compartment and passing through the evaporator 500. The evaporator 500 then realizes a phase change of the refrigerant fluid FR from a liquid phase to a gas phase, before arriving at the inlet of the compressor 200. The circulation of the refrigerant fluid FR between the outlet of the expansion device 400 and the inlet of the compressor 200 corresponds to a low-pressure section BP of the circuit of refrigerant fluid 100. The low-pressure section BP and the high-pressure section HP together form the circuit of refrigerant fluid 100.

The present invention relates to a thermal module 1 designed to outfit such a circuit of refrigerant fluid 100. The thermal module 1 may be disposed in the low-pressure section BP of refrigerant fluid FR of the circuit of refrigerant fluid 100. According to one preferred configuration, the thermal module 1 may be disposed in parallel with the evaporator 500 of the low-pressure section BP.

In this latter configuration, upon starting the vehicle the thermal module 1 is configured to exchange heat with the refrigerant fluid FR, which advantageously enables an increasing of the enthalpy of the refrigerant fluid FR circulating in the low-pressure section BP of the circuit of refrigerant fluid 100. This heat exchange is realized once a phase change material of the thermal module 1 is able to transfer heat to the refrigerant fluid FR.

The passage of the refrigerant fluid FR through the thermal module 1 ensures an increasing of the enthalpy of the refrigerant fluid FR greater than what it would have had by going in traditional manner through the evaporator 500, and thus the heat previously stored in the thermal module 1 is utilized to heat the refrigerant fluid FR and to maintain it in adequate conditions for the heating of the air flow FA taken through the condenser 300 in order to supply the passenger compartment.

Moreover, upon starting the vehicle, especially in very cold conditions, when the thermal module 1 is charged the refrigerant fluid FR is made to pass through the thermal module 1 instead of through the evaporator 500, thus preventing a frosting of the walls of the evaporator 500, which could plug up the air passage.

According to one aspect of the present invention, the thermal module 1 could be used to supplement the evaporator 500. In this aspect, the refrigerant fluid FR then goes through both the evaporator 500 and through the thermal module 1, making it possible to boost the heating capacity of the air conditioning system 12.

As was specified above, the thermal module 1 is mounted in parallel with the evaporator 500 in the circuit of refrigerant fluid. In particular, one could accomplish this parallel routing of the thermal module 1 with the aid of at least one valve piloted to control the flow rate of refrigerant fluid FR passing through the thermal module 1.

This thermal module 1 and its functioning shall be described more broadly in the remainder of the description.

We shall now describe in further detail the various elements making up the thermal module 1 according to the present invention, namely, at least one heat exchanger comprising a plurality of ducts in which the refrigerant fluid FR of the circuit 100 described above can circulate.

Figures 2 and 3 show respectively a first longitudinal end 2 and a second longitudinal end 3 of a duct 4 according to the present invention. It will thus be understood that this first longitudinal end 2 of the duct 4 is situated opposite the second longitudinal end 3 of this same duct 4.

5 The duct 4 according to the present invention extends along a longitudinal axis X and comprises a first tube 5 and a second tube 6 lodged in the first tube 5. One can see in these figures 2 and 3 that these two tubes 5, 6 are concentric. This first tube 5 and this second tube 6 thus both extend along the longitudinal axis X.

10 As can be seen from figures 2 and 3, the first tube 5 has a wall 7 bounding off an internal volume 8 in which the second tube 6 extends. This wall 7 has a first major face 9 and a second major face 10, these two major faces 9, 10 being joined together by two lateral edges 11.

These lateral edges 11 have a rounded shape, that of a circular arc, between the first major face 9 and the second major face 10 of the first tube 5.

15 This first tube 5 likewise has a series of conduits 13 designed to enable the circulation of the refrigerant fluid FR. These ducts 13 are bounded off by the first major face 9 of the first tube 5, by the second major face 10 of the first tube 5 and by at least one intermediate wall 14 of this first tube 5. These intermediate walls 14 are rigid and extend in a direction perpendicular to the major faces 9, 10 of the first tube 5 from the first major face 9 of the first
20 tube 5 to the second major face 10 of this first tube 5 and thus bound off the conduits 13 in which the refrigerant fluid can circulate. It is likewise understood that these intermediate walls 14 extend, without interruption or opening, from a first longitudinal end of the first tube 5 to a second longitudinal end of the first tube 5, opposite the first longitudinal end of this first tube 5.

25 As is illustrated in figures 2 and 3, two of these ducts 13 situated the furthest on the outside of the first tube 5 are likewise bounded by the two lateral edges 11 joining the first major face 9 to the second major face 10 of the first tube 5.

The second tube 6 for its part has a general architecture similar to the first tube 5. As is illustrated in figures 2 and 3, one notices that, in a cross section, a width of this second tube 6

is less than a width of the first tube 5 and a thickness of the second tube 6 is less than a thickness of the first tube 5.

5 The second tube 6 comprises a wall 15 bounding off an internal volume 16. This wall 15 of the second tube 6 has, like the wall 7 of the first tube 5, a first major face 17 joined to a second major face 18 by lateral edges 19. These lateral edges 19 have a rounded shape, in a circular arc, between the first major face 17 and the second major face 18 of the second tube 6.

10 It will be understood that the duct 4 represented in figure 2 is shown in a direction opposite that of figure 3. Thus, figure 2 shows, in front view, the first major face 9 of the first tube 5 and the first major face 17 of the second tube 6, whereas figure 3 shows, in front view, the second major face 10 of the first tube 5 and the second major face 18 of the second tube 6.

As previously mentioned, the second tube 6 extends in the internal volume 8 of the first tube 5. As shall be described, especially with reference to figure 4, at least one electrical heating element 27 extends in the internal volume 16 of this second tube 6.

15 Connecting walls 20 are arranged between the major faces of each of the tubes. These connecting walls 20 in particular join the first major face 9 of the first tube 5 to the first major face 17 of the second tube 6. They may also join the second major face 10 of the first tube 5 to the second major face 18 of the second tube 6.

20 These connecting walls 20 thus extend in a direction perpendicular to the first major face 9 of the first tube 5 and to the second major face 10 of the first tube 5.

One may note that these connecting walls 20 can also extend in a direction perpendicular to the first major face 17 of the second tube 6 and to the second major face 18 of this second tube 6.

25 In these figures 2 and 3, one likewise notices that the first tube 5 has a length less than a length of the second tube 6, these two lengths being measured along the longitudinal axis X.

According to one aspect of the present invention, the second tube 6 extends beyond the first tube 5, along the longitudinal axis X, in the area of the first longitudinal end 2 of the duct 4 and in the area of the second longitudinal end 3 of the duct 4.

According to another aspect of the present invention, the second tube 6 extends beyond the first tube 5, along the longitudinal axis X, only in the area of one of the longitudinal ends 2, 3 of the duct 4.

This length difference will be explained at greater length in the rest of the description.

5 Figure 2 shows the first longitudinal end 2 of the duct 4 according to the present invention. This first longitudinal end 2 comprises a first longitudinal end edge 21 of the first tube 5 bounding off a first opening 22 and a first longitudinal end ridge 23 of the second tube 6, this first longitudinal end ridge 23 bounding off a mouth.

10 Figure 3 illustrates the second longitudinal end 3 of the duct 4 according to the present invention. This second longitudinal end 3 thus comprises a second longitudinal end edge 24 of the first tube 5 bounding off a second opening 25 and a second longitudinal end ridge 26 of the second tube 6, this latter being closed.

This second longitudinal end ridge 26 of the second tube 6 may be closed mechanically, for example, by a process of brazing, bending, or crushing.

15 It will thus be understood that the first longitudinal end edge 21 of the first tube 5 is situated opposite the second longitudinal end edge 24 of this first tube 5 and that the first longitudinal end ridge 23 of the second tube 6 is situated opposite the second longitudinal end ridge 26 of this second tube 6.

20 Figure 4 shows, schematically, a longitudinal section, along a plane passing through the longitudinal axis X and through the lateral edges 11 of the first tube 5, of the duct 4 according to one exemplary embodiment of the present invention. As previously described, one sees in this figure that the second longitudinal end ridge 26 of the second tube 6 is closed, for example, by brazing or by crushing.

25 This figure in particular reveals a plurality of electrical heating elements 27 situated in the internal volume of the second tube 6 as previously described. These electrical heating elements 27 are powered by at least one electrical connector 28.

According to the exemplary embodiment shown here, these electrical heating elements 27 are realized by positive temperature coefficient resistors 270. These positive temperature

coefficient resistors 270 take the form of blocks or stones arranged one after another in the internal volume of the second tube 6, along the longitudinal axis X.

In order to electrically energize these positive temperature coefficient resistors 270, the electrical connector 28 is connected to these positive temperature coefficient resistors 270 by at least one electrode 280 disposed between the wall 15 of the second tube 6 and these positive temperature coefficient resistors 270. Advantageously, two electrodes 280 may be disposed on either side of these positive temperature coefficient resistors 270, a first electrode 280 being then interposed between these positive temperature coefficient resistors 270 and the first major face 17 of the second tube 6 and a second electrode being interposed between these positive temperature coefficient resistors 270 and the second major face of the second tube 6. An electrically insulating, but thermally conductive material is interposed between these electrodes and the major faces of the second tube in order to prevent any short circuit.

When the electrical heating element 27 is electrically powered, it gives off heat which passes through a surface of the wall 15 of the second tube 6. Thanks to the connecting walls situated between this wall 15 of the second tube 6 and the wall 7 of the first tube 5, this heat is routed up to a surface of this wall 7 of the first tube 5. This surface of the wall 7 then forms a major surface of heat exchange by convection with a phase change material designed to capture this heat, as will be described below.

According to another exemplary embodiment of the present invention not represented here, the electrical heating element may likewise be realized by a resistor element such as a resistive film comprising a flexible plate of synthetic material on which are disposed one or more electrical resistance tracks or a resistive wire.

Whatever exemplary embodiment is chosen, at least one electrical connector 28 emerges from the first longitudinal end ridge 23 of the second tube 6, this electrical connector 28 making it possible to connect electrically the electrical heating element 27.

In the case of a single electrical connector 28, the ground connection is accomplished via the second tube 6 of the duct 4 according to the present invention.

In this figure 4, one may likewise notice the intermediate walls 14 joining the first major face 9 of the first tube 5 to the second major face of this first tube 5, these intermediate

walls 14 bounding off the ducts 13 in which the refrigerant fluid can circulate.

This figure also shows the difference in length along the longitudinal axis X between the first tube 5 and the second tube 6 as previously mentioned. As can be seen, the second tube 6 extends more beyond the first tube 5 in the area of the first longitudinal end 2 of the duct 4 than in the area of the second longitudinal end 3 of this duct 4.

Figure 5 illustrates schematically a heat exchanger 29 comprising a plurality of ducts 4 according to the present invention, seen from the lateral edges 11 of the first tubes 5 of these ducts 4.

According to one embodiment of the present invention as illustrated in this figure 5, the heat exchanger 29 comprises two rows of ducts 4, a first distribution box 30 of the refrigerant fluid FR and a second distribution box 31 of the refrigerant fluid FR. The first distribution box 30 and the second distribution box 31 are respectively arranged in the area of the first longitudinal ends 2 and the second longitudinal ends 3 of the ducts 4. The ducts 4 are thus interposed between the first distribution box 30 and the second distribution box 31.

Each of these ducts 4 is terminated by the first longitudinal end edge 21 of the first tube 5 and by the first longitudinal end ridge 23 of the second tube 6, as well as by the second longitudinal end edge 24 of the first tube 5 and by the second longitudinal end ridge 26 of the second tube 6.

As is illustrated, the first longitudinal end edge 21 of the first tube 5 emerges inside the first distribution box 30 and the second longitudinal end edge 24 of the first tube 5 emerges inside the second distribution box 31. As previously described, this first longitudinal end edge 21 and this second longitudinal end edge 24 respectively bound off a first opening and a second opening through which the refrigerant fluid can circulate in the ducts which are formed in the internal volume of the first tube 5, the first distribution box 30 and the second distribution box 31.

The first longitudinal end ridge 23 of the second tube 6 for its part extends beyond the first distribution box 30 while the second longitudinal end ridge 26 of the second tube 6 extends inside the second distribution box 31.

The first distribution box 30 thus has at least a first orifice 32 designed to be traversed

by the first longitudinal end edge 21 of the first tube 5 and by the first longitudinal end ridge 23 of the second tube 6 and a second orifice 321 designed to be traversed solely by the first longitudinal end ridge 23 of the second tube 6. The first orifice 32 being traversed simultaneously by the first tube 5 and by the second tube 6, it has a larger cross section than that of the second orifice 321, which is respectively only traversed by the second tube 6. This first orifice 32 and this second orifice 321 may have an oblong cross section.

Likewise, it will be understood that the second distribution box 31 has a hole 322 designed to be traversed by both the second longitudinal end edge 24 of the first tube 5 and by the second longitudinal end ridge 26 of the second tube 6. Unlike the first distribution box 30, the second distribution box 31 does not have a second orifice, since the second longitudinal end edge 24 of the first tube 5 and the second longitudinal end ridge 26 of the second tube 6 both emerge inside the second distribution box 31.

As previously mentioned, the second longitudinal end ridge 26 of the second tube 6 is closed, which ensures the tightness of this second tube 6 with respect to the refrigerant fluid circulating in the first distribution box 31. In fact, this second tube 6 comprising the electrical heating element should insulate against the refrigerant fluid in order to guarantee the proper functioning of this electrical heating element.

According to the embodiment of the present invention illustrated in figure 5, the first distribution box 30 comprises two return collectors 33a, 33b and the second distribution box 31 comprises an inlet collector 34 and an outlet collector 35.

Each of the return collectors 33a, 33b of the first distribution box 30 has a flat 41a, 41b. As illustrated in figure 5, these flats 41a, 41b are arranged in contact with one another. The inlet collector 34 and the outlet collector 35 of the second distribution box 31 likewise each have a flat, respectively denoted as 42 and 43. The flat 42 of the inlet collector 34 and the flat 43 of the outlet collector 35 are arranged one in contact with the other and each one has a cavity 44a, 44b, these cavities 44a, 44b being arranged next to each other and designed to enable the circulation of the refrigerant fluid.

In the context of an air conditioning system as represented in figure 1, the heat exchanger 29 is designed to be integrated in a thermal module 1. The inlet collector 34 of the second distribution box 31 of this heat exchanger 29 is thus designed to receive the refrigerant

fluid coming from the expansion device of this air conditioning system.

The refrigerant fluid then goes into the conduits of the first tube 5 of a duct 4 of a first row of ducts 4 before rejoining the return collector 33 of the first distribution box 30. After this return collector 33, the refrigerant fluid is routed, via the conduits of the first tube 5 of the duct 4 of a second row of ducts 4, to the outlet collector 35 of the second distribution box 31.

This return collector 35 thus allows the refrigerant fluid to leave the heat exchanger 29 and return to the compressor of the air conditioning system.

Thus, the heat exchanger 29 has a U-shaped circulation of refrigerant fluid, each duct 4 forming the arms of this U shape, and the first distribution box 30 forming the base of this U. Thus, the first tube 5 and the second tube 6 of a duct 4 according to the present invention jointly form one arm of the U shape.

It is understood that, according to another embodiment, the first distribution box might comprise the inlet collector and the outlet collector while the second distribution box would comprise the return collector.

Optionally, heat dissipation elements, especially fins or inserts, may be arranged between the ducts of the heat exchanger.

Figures 6 and 7 respectively represent two exemplary embodiments of a thermal module 1 according to the present invention in which there is shown a housing 36 containing at least one heat exchanger 29 according to the present invention, the housing 36 being covered by a closure lid 37 represented here as being separate from the rest of the thermal module 1.

According to a first exemplary embodiment as shown in figure 6, the ducts 4 of the heat exchanger 29 are arranged in a first row 45 and a second row 46 parallel to each other. The previously mentioned heat dissipation elements are thus arranged between the ducts 4 of the first row 45 and the ducts 4 of the second row 46.

It will also be understood that, in particular according to this exemplary embodiment, the collectors 33, 34, 35 of the first distribution box 30 and of the second distribution box 31 of the heat exchanger 29 form zones where the refrigerant fluid may be collected or distributed to or from the ducts 4 of the first row 45, or to or from the ducts 4 of the second

row 46, depending on the direction of circulation of the refrigerant fluid in the heat exchanger 29.

According to a second exemplary embodiment as shown in figure 7, the ducts 4 are stacked along a stacking axis Y. According to this second exemplary embodiment, the heat dissipation elements are arranged between pairs of ducts 4 stacked along this stacking axis Y.

According to these two exemplary embodiments, the thermal module 1 comprises a housing 36 whose walls bound off an internal volume 39 in which are arranged at least one heat exchanger 29 according to the present invention and a phase change material 40. This housing 36 is substantially rectangular, as seen from above, that is, looking at its opening. It has a first major wall 36a and a second major wall 36b joined together by a first small wall 36c and a second small wall 36d. It will be understood that in these figures the housing is represented in two different and opposite views. In figure 6, one faces the first major wall 36a of the housing 36, while in figure 7 one faces the second major wall 36b of this housing 36.

The heat exchanger 29 according to the present invention may comprise, according to one of the arrangements illustrated in figures 6 and 7, various types of ducts 4, provided that at least one of these ducts 4 is realized according to the present invention. In other words, at least one duct 4 of the heat exchanger 29 of the thermal module 1 has at least one heating element. Advantageously, a heat exchanger 29 may comprise several ducts 4 according to the present invention.

These ducts 4 according to the present invention may be devised with other types of ducts, known as “plain” ducts, which do not comprise an electrical heating element.

By a “plain” duct is meant any duct having at least one conduit for circulation of a refrigerant fluid, but lacking an electrical heating element.

For example, and this is what is represented in figures 6 and 7, one could provide a heat exchanger 29 in which three “plain” ducts are arranged for a duct 4 comprising an electrical heating element. The shape and the disposition of the various tubes and conduits inside these “plain” ducts may vary without the particular heat exchanger 29 leaving the scope of the present invention.

As non-exhaustive examples, a “plain” duct might comprise two concentric tubes with

no heating element, two non-concentric tubes with no heating element, or a single solitary tube with no heating element, in which at least one of the tubes comprises at least one conduit for circulation of the refrigerant fluid.

The housing 36 likewise comprises a phase change material 40 which fills, according to the present invention, a portion of the available space between the heat exchanger 29 and the walls bounding the internal volume of this housing 36. It will thus be understood that the heat exchanger 29 is immersed in the phase change material which is then in direct contact with the ducts 4 of this heat exchanger 29, and more particularly with the walls of the first tubes 5 of these ducts 4.

Advantageously, the phase change material 40 occupies approximately 90 percent of the internal volume 39 of the housing 36. This percentage of filling of the housing 36 makes it possible to avoid the risks of bulging of the housing 36 during changes in phase of the phase change material 40.

There is illustrated in figure 7 a degree N of filling corresponding schematically to the degree of filling of the phase change material 40 to occupy 90 percent of the internal volume 39 of the housing 36. As illustrated in this figure, the ducts 4 of the heat exchanger 29 pass beyond the level N of filling. When the heat exchanger 29 is immersed in the phase change material 40, it will be understood that the housing 36 illustrated in figures 6 and 7 may be dimensioned to conform to this latter filling characteristic while still allowing the ducts 4 of this heat exchanger 29 to be immersed in the phase change material 40.

According to the first exemplary embodiment of the thermal module 1 as illustrated in figure 6, the ducts 4 of the heat exchanger 29 are arranged one behind another between the first major wall 36a and the second major wall 36b of the housing 36. In other words, and as previously noted, the heat exchanger 29 has a first row 45 of ducts 4 disposed next to the first major wall 36a of the housing and a second row 46 of ducts 4 disposed next to the second major wall 36b of the housing 36, the major faces of the first tubes of these ducts 4 being thus arranged next to the major walls 36a, 36b of the housing 36.

According to the second exemplary embodiment of the thermal module 1 as illustrated in figure 7, the ducts 4 of the heat exchanger 29 are arranged one behind another between the first small wall 36c and the second small wall 36d of the housing 36. In other words, the ducts

4 are stacked along the stacking axis Y, this latter being perpendicular to at least one of the small walls 36c or 36d.

One may thus consider that the ducts 4 of the first exemplary embodiment of the thermal module 1 as illustrated in figure 6 extend in a plane parallel, or substantially parallel, to the plane of extension of one or the other of the major faces 36a, 36b of the housing 36, while the ducts 4 of the second exemplary embodiment of the thermal module 1 as illustrated in figure 7 extend in a plane perpendicular, or substantially perpendicular, to the plane of extension of one or the other of the major faces 36a, 36b of the housing 36.

According to one variant of the first exemplary embodiment of the thermal module, not represented here, the ducts are inscribed in a plane perpendicular to the plane of extension of one or the other of the major faces of the housing.

According to one variant of the second exemplary embodiment of the thermal module, not represented here, the ducts may be rotated by 90°. In other words, according to this variant of the present invention, the ducts are inscribed in a plane parallel, or substantially parallel, to the plane of extension of one or the other of the major faces of the housing.

It will likewise be understood that, according to the exemplary embodiment illustrated in figures 6 or 7, the ducts 4 are extruded.

According to one or the other of these arrangements, the housing 36 of the thermal module 1 may be closed by a lid 37 having cavities 38 through which pass through the electrical connectors 28 making possible the powering of the electrical heating element(s).

This housing 36 likewise has, in the area of one of the second small walls 36d, two mouths from which emerge the inlet collector 34 and the outlet collector 35 of the second distribution box 31 of the heat exchanger 29.

The thermal module 1 according to the present invention is designed in particular to be integrated in an electric vehicle. When this electric vehicle is in the charging phase, for example at night, the electrical heating elements extending in the second tubes of the ducts 4 of the heat exchanger 29, being then energized, heat and give off heat. As previously described, this heat is routed from the surface of the wall of the second tube 6 to the surface of the wall of the first tube 5 via the connecting walls disposed between the major faces of this

first tube and the major faces of this second tube.

Once reaching the surface of the wall of the first tube 5, this heat is captured by the phase change material in which the heat exchanger 29 is immersed. This phase change material is then able to surrender this heat to its surroundings, and thus to the refrigerant fluid 5 which will circulate in the conduits of the first tubes of the ducts 4.

This functioning thus makes it possible to store progressively, with the help of the phase change material, the heat dissipated by the electrical heating elements. It will thus be understood that the thermal module 1 according to the present invention is utilized as a thermal heat storage.

10 Once the phase change material has been charged with heat, and during the starting of the vehicle, this phase change material progressively releases the stored-up heat. This heat is then absorbed by the refrigerant fluid FR circulating in the ducts 4 of the heat exchanger 29 contained in the thermal module 1.

15 This functioning enables a progressive releasing of the heat of the phase change material while reducing the electrical consumption of the circuit of refrigerant fluid illustrated in figure 1 and/or increasing the heating capacity of the air conditioning system. The compressor of this system thus consumes less electrical energy, since the refrigerant fluid FR has a higher temperature thanks to the restitution of the heat brought about by the thermal module 1.

20 This phase change material may be present, for example, in the housing 36 of the thermal module 1 in a liquid or solid state, or in the form of beads.

One may introduce the phase change material into the housing 36 of the thermal module 1 either in liquid form or in solid form, and particularly in the latter case in the form of a polymerized composite material, such as in the form of a sheet.

25 The use of the thermal module 1 thus makes it possible to delay the use of the evaporator 500, or limit its power. When the latter is used, the power consumed at the front surface to condition the refrigerant fluid FR is diminished, so that the risk of frosting by a decrease in the condensation on the walls of the evaporator 500 is limited.

It will be understood from a reading of the above that the invention makes possible, especially when the electric vehicle is being recharged, a storing up of the heat given off by one or more electrical heating elements in a thermal module 1 so that this stored heat can be used later on, particularly during the starting of the vehicle and when the temperature is very low, for example, less than -10°C . This use is primarily of interest in reducing the power of the evaporator which may become frosted in such conditions. Thanks to the present invention, the heating capacity of the system at very low temperature may thus be boosted without degrading the power drawn by the evaporator.

Moreover, the present invention makes it possible to boost the heating capacity of the system at very low temperature (less than -10°C) without reducing the power drawn by the evaporator.

However, the invention should not be seen as limited to the means and configurations as described and illustrated here, but rather it likewise applies to all equivalent means or configurations and to every technical combination using such means. In particular, the shape and the disposition of the heating elements, the tubes, and the ducts may be modified without detracting from the invention, as long as they fulfil the same functionalities as the ones described in this document.

CLAIMS

1. A duct (4) for a heat exchanger (29), comprising at least a first tube (5) bounding off at
5 least one conduit (13) able to receive a flow of refrigerant fluid (FR), and a second tube
(6) lodged in the first tube (5), characterized in that at least one electric heating element
(27) extends in the second tube (6).
2. The duct (4) as claimed in the preceding claim, wherein the first tube (5) and the second
tube (6) are concentric.
- 10 3. The duct (4) as claimed in any one of the preceding claims, wherein at least one
connecting wall (20) joins the first tube (5) and the second tube (6).
4. The duct (4) as claimed in any one of the preceding claims, wherein the first tube (5)
has a length measured along a longitudinal axis (X) of extension of the duct (4) which is
less than a length of the second tube (6), measured along this longitudinal axis (X).
- 15 5. The duct (4) as claimed in any one of the preceding claims, wherein the first tube (5)
comprises a series of conduits (13) configured to allow the circulation of a refrigerant
fluid (FR).
6. The duct (4) as claimed in any one of the preceding claims, wherein the second tube (6)
has a first open longitudinal end edge (23) from which emerges at least one electrical
20 connector (28) able to electrically power the electrical heating element (27), and a second
closed longitudinal end ridge (26), opposite the first longitudinal end ridge (23).
7. A heat exchanger (29) comprising at least a first distribution box (30), a second
distribution box (31) and a plurality of ducts (4) as claimed in any one of the preceding
claims, each of the distribution boxes (30, 31) being disposed at the longitudinal ends (2,
25 3) of the plurality of ducts (4).
8. The heat exchanger (29) as claimed in the preceding claim, wherein at least a first
longitudinal end edge (21) of the first tube (5) of a duct (4) extends inside the first
distribution box (30) of this heat exchanger (29), and wherein at least a first longitudinal

end ridge (23) of the second tube (6) of this duct (4) extends outside the first distribution box (30).

5 9. Heat exchanger (29) as claimed in claim 7, wherein at least one second longitudinal end edge (24) of the first tube (5) of the duct (4) and at least one second longitudinal end ridge (26) of the second tube (6) of this duct (4) extend inside the second distribution box (31) of the heat exchanger (29).

10 10. A thermal module (1) for an automobile comprising a housing (36) bounding off a volume in which is disposed at least one heat exchanger (29) as claimed in any one of claims 10 to 12 and a phase change material (40), this phase change material (40) being placed in direct contact with the plurality of ducts of the at least one heat exchanger (29).

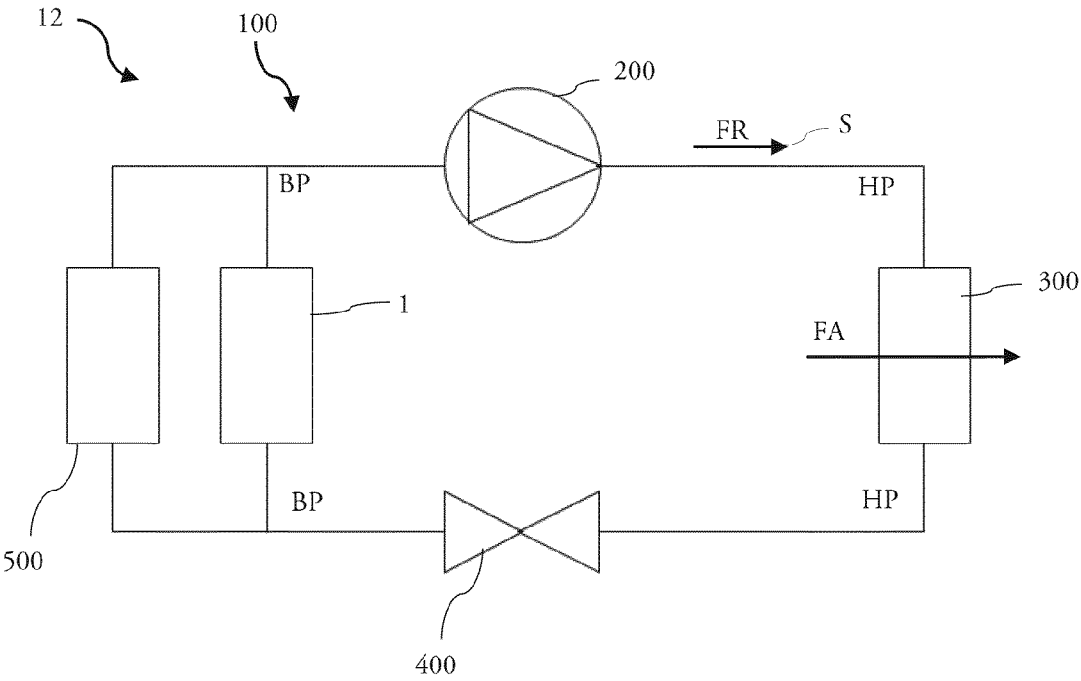


Fig. 1

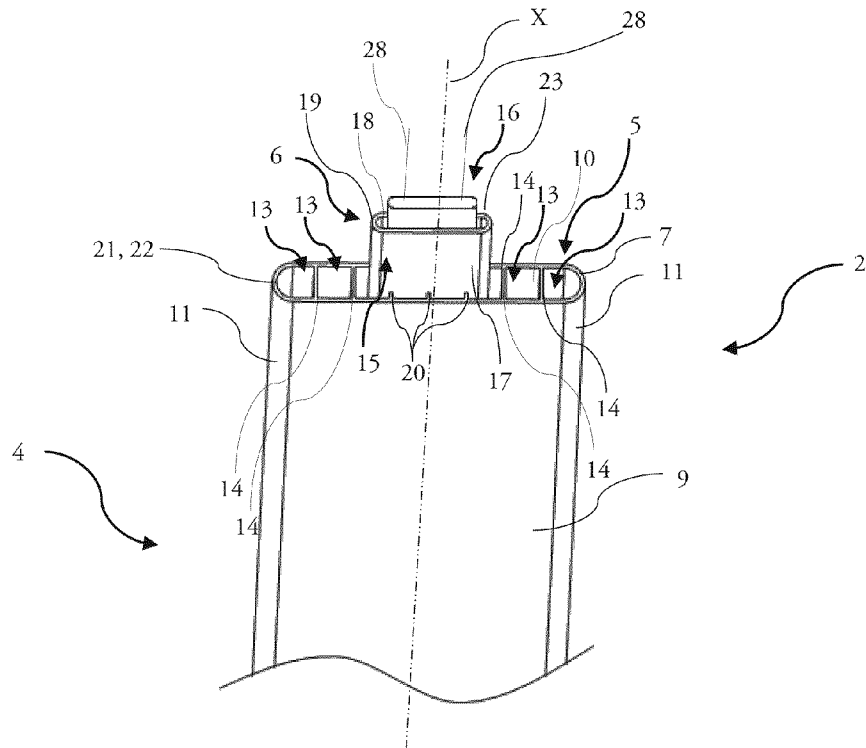


Fig. 2

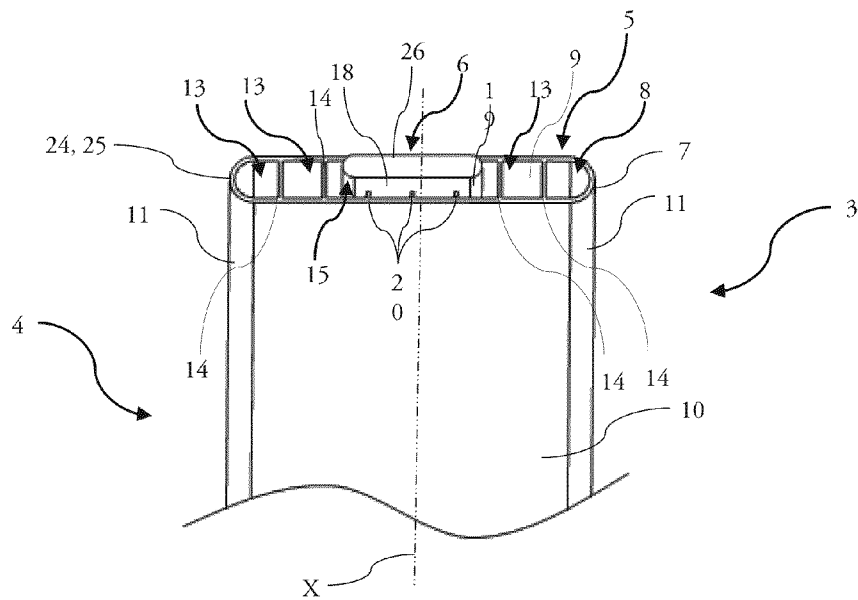
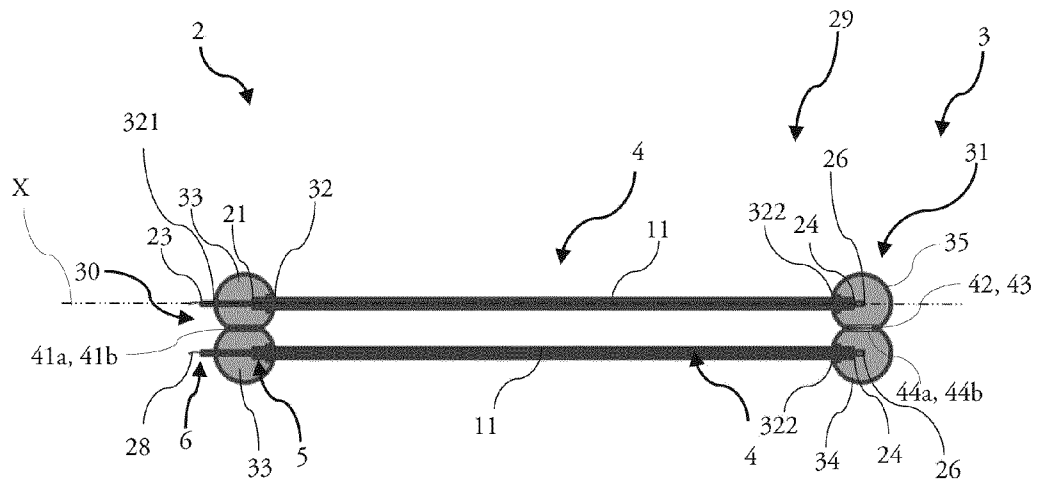
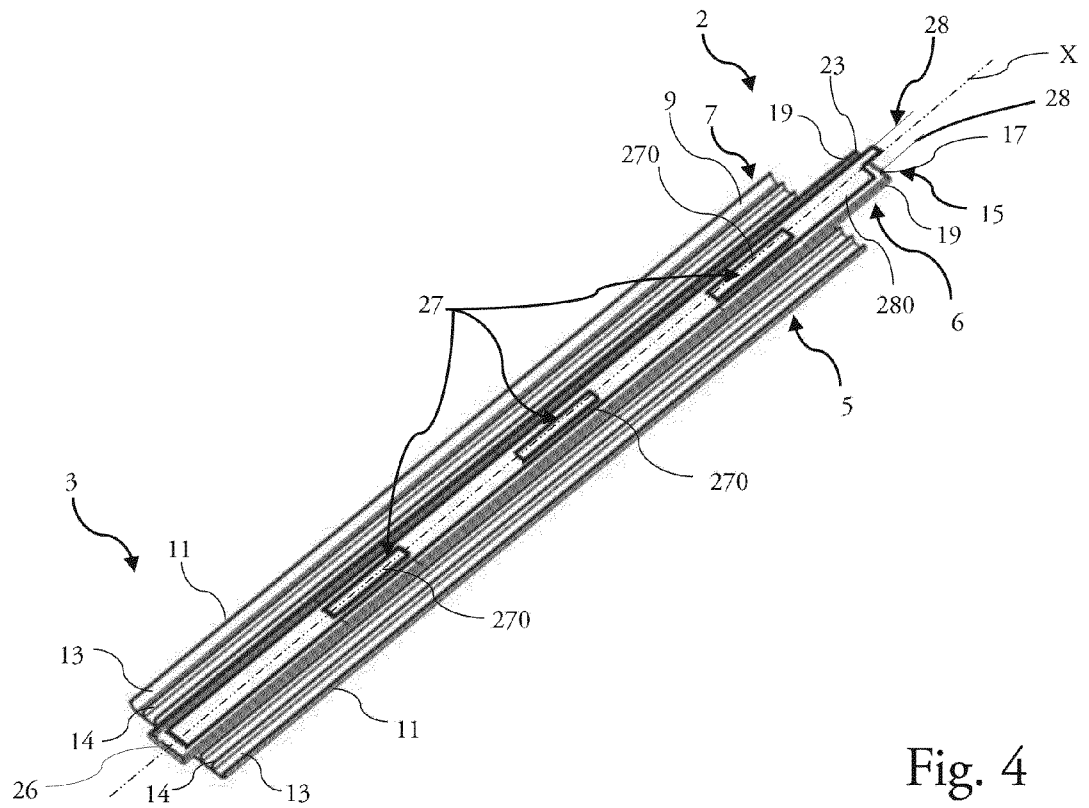
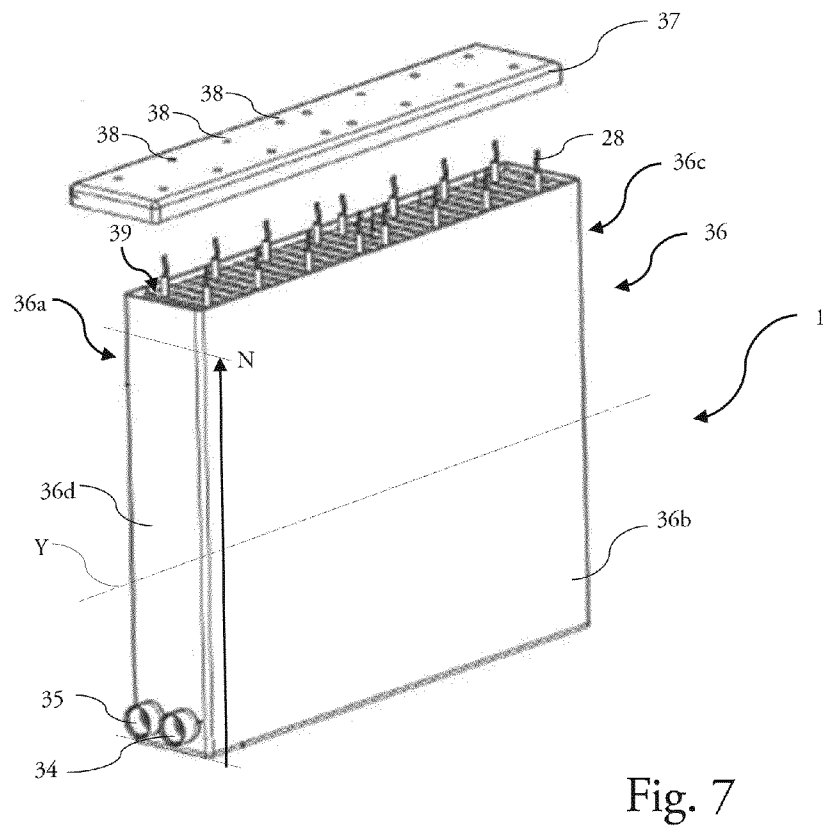
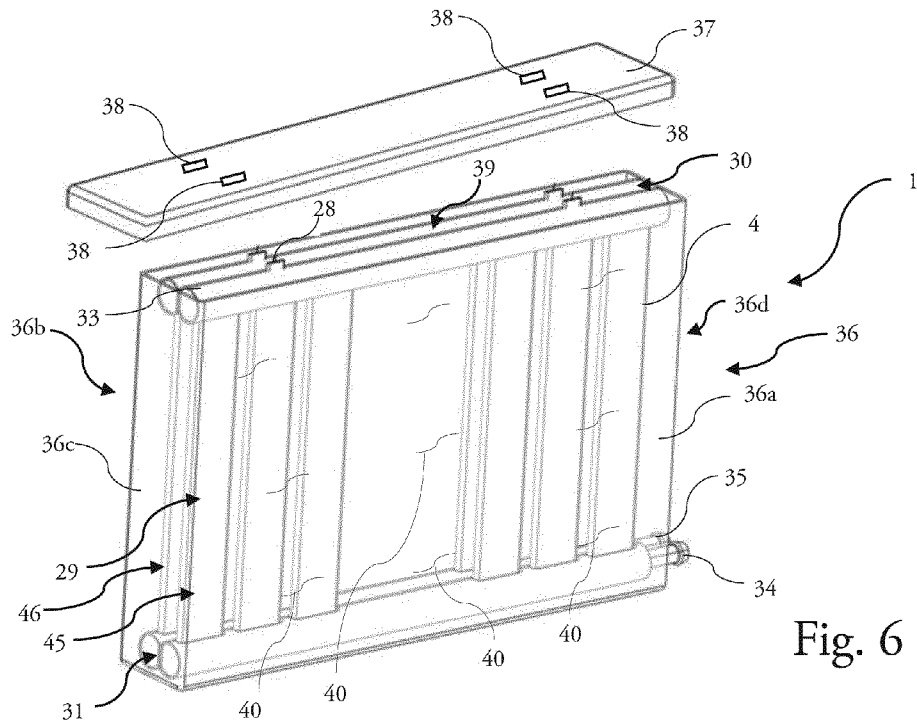


Fig. 3





INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/061046

A. CLASSIFICATION OF SUBJECT MATTER

INV. F24H1/00 B60H1/32 F24H1/12 F24H1/14 F24H7/02
F24H7/04 F25D21/08 F28D20/02 F24H4/02 F28D7/10

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24H B60H F25D F28D F24D F25B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/223825 A1 (JANG KIL SANG [KR]) 29 August 2013 (2013-08-29) paragraphs [0013], [0037], [0038] - [0042]; figures 3-5,13 -----	1-3,5
X	DE 20 04 759 A1 (TURBOTEC INC.) 14 October 1971 (1971-10-14) page 3 - page 5; figures 1,2 -----	1,2,6
X	US 2014/287374 A1 (LEE JUNG HO [KR] ET AL) 25 September 2014 (2014-09-25) page 2; figures 2-6 -----	1-6
X	DE 24 40 426 A1 (CZEPEK & CO) 4 March 1976 (1976-03-04) figure 1 -----	1-6
	-/-	

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

13 July 2018

Date of mailing of the international search report

25/07/2018

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

García Moncayo, O

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2018/061046

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 410 813 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 25 January 2012 (2012-01-25) figures 1-3 -----	1-3,5,6
X	US 1 684 963 A (D.M. LUEHRS) 18 September 1928 (1928-09-18)	1,2,4, 6-9
Y	page 1; figures 1,2 -----	10
X	FR 3 026 171 A1 (VALEO SYSTEMES THERMIQUES [FR]) 25 March 2016 (2016-03-25)	1-9
Y	figures 1,2a,2b -----	10
Y	WO 2016/016428 A1 (COMMISSARIAT ENERGIE ATOMIQUE [FR]) 4 February 2016 (2016-02-04) figures 1-7 -----	10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2018/061046

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013223825 A1	29-08-2013	CN 104144806 A KR 20130099462 A US 2013223825 A1 WO 2013129815 A1	12-11-2014 06-09-2013 29-08-2013 06-09-2013
DE 2004759 A1	14-10-1971	NONE	
US 2014287374 A1	25-09-2014	KR 101137528 B1 US 2014287374 A1 WO 2013073905 A1	20-04-2012 25-09-2014 23-05-2013
DE 2440426 A1	04-03-1976	NONE	
EP 2410813 A1	25-01-2012	DE 102010031520 A1 EP 2410813 A1	19-01-2012 25-01-2012
US 1684963 A	18-09-1928	NONE	
FR 3026171 A1	25-03-2016	NONE	
WO 2016016428 A1	04-02-2016	EP 3175196 A1 FR 3024534 A1 WO 2016016428 A1	07-06-2017 05-02-2016 04-02-2016