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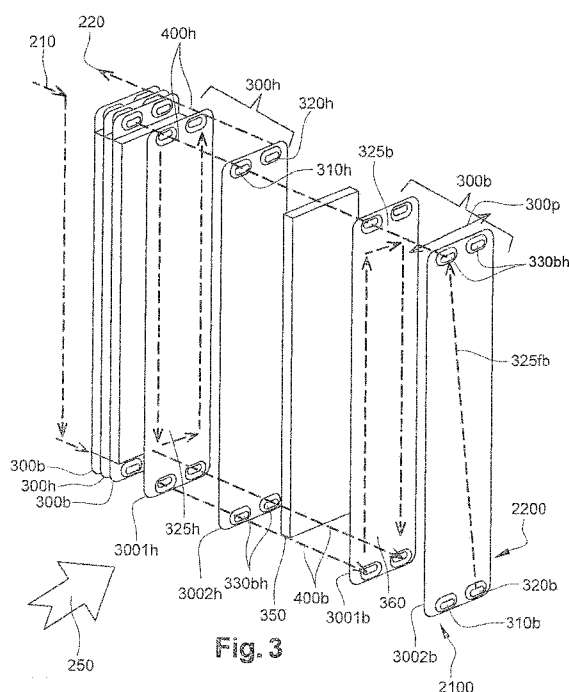
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(54) Title: EVAPORATOR, IN PARTICULAR FOR A MOTOR VEHICLE AIR-CONDITIONING CIRCUIT, AND COR-
RESPONDING AIR-CONDITIONING CIRCUIT



(57) Abstract: The invention relates to an evaporator comprising a stack of first (300b) and second (300h) tubes, each tube comprising a path (325h, 325b) for circulation of coolant fluid between an inlet orifice (310b, 310h) and an outlet orifice (320b, 320h), such that: · the inlet orifices (310b) of the first tubes (300b) are in fluid communication with a fluid inlet (210) of the evaporator via a first path (400b) for supply of the coolant fluid; · the outlet orifices (320h) of the second tubes (300h) are in fluid communication with a fluid outlet (220) of the evaporator via a second path (400h) for supply of the coolant fluid; and · the outlet orifices (320b) of the first tubes (300b) are in fluid communication with inlet orifices (310h) of the second tubes. In addition, the first (400b) and second (400h) paths for supply of the coolant fluid to the evaporator have a direction opposite the direction of stacking of the plates.

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Evaporator, in particular for a motor vehicle air-conditioning circuit, and corresponding air-conditioning circuit

5 **1 TECHNICAL FIELD**

The invention relates to evaporators, in particular those which are used in air-conditioning circuits of motor vehicles.

10 **2 TECHNOLOGICAL BACKGROUND**

Air-conditioning circuits are known which operate with a coolant fluid.

15 A circuit of this type typically comprises, in the direction of circulation of the coolant fluid, a compressor, a condenser, an evaporator, an expansion valve and an accumulator.

20 It is also known to provide an internal heat exchanger in the air-conditioning circuit in order to improve the performance of the evaporator. An internal exchanger is a device which allows the coolant fluid to exchange heat with this same fluid, but in a different temperature and pressure state.

25 The high-pressure coolant fluid coming from the compressor is condensed in the condenser and then passes into a first part of the internal exchanger. Then, the coolant fluid is expanded by the expansion valve. The low-pressure coolant fluid leaving the expansion valve then passes through the evaporator in order to be evaporated there, then through the accumulator, and into a second part of the internal heat exchanger, before returning to the compressor.

35 In the internal exchanger, the high-pressure hot fluid exchanges heat with the cold, low-pressure fluid. In other words, the internal exchanger ensures an exchange

of heat of the coolant fluid at two different points of the air-conditioning circuit.

5 The evaporator makes it possible to produce a flow of cold, or conditioned air, which can be conveyed for example to the passenger space of a motor vehicle.

Conventionally, the evaporators comprise firstly a core generally constituted by two layers of parallel ducts
10 for the circulation of coolant fluid, and, secondly, means for distribution of the coolant fluid arranged at the two ends of these layers, in order to ensure the distribution and collection of the coolant fluid in the different ducts of each of the layers.

15 According to the terminology used in the field, "layer" means a coolant fluid circuit which is situated on a single plane orthogonal to the flow of air to be cooled. The layers are conventionally constituted by
20 parallel ducts for circulation of the coolant fluid.

According to a known solution, the ducts are produced from pairs of attached plates forming a tube.

25 The pairs of plates or tubes can be arranged alternating with interposed upsetters through which a flow of air can circulate.

According to another known solution, the ducts are
30 produced from manifolds.

In the case of the evaporators with plates, the ducts are distributed between different areas which each form a passage for circulation of the coolant fluid.

35 In other words, a plurality of ducts defines a passage.

In the case of the evaporators with tubes, it is the internal partitions provided in the collector containers which define these passages.

5 The means for distribution (configuration of the plates or internal partitioning of the collector containers) are thus designed to permit circulation of the coolant fluid in a plurality of passages, with inversion of the direction of circulation of the coolant fluid from one
10 passage to the next.

Conventionally, each of the two layers of these evaporators has three or four passages.

15 A flow of air passes through the gaps between the coolant fluid ducts, and transfers heat to the coolant fluid, which changes from the liquid state to the gaseous state.

20 The flow of air thus cooled can then in particular be used for the air-conditioning of the passenger space of a motor vehicle.

Evaporators with two layers with a plurality of
25 different fluid trajectories, such as to define in parts of each layer, and/or from one layer to another, a fluid path according to circuits in the form of a "U", and/or with intersecting flows (i.e. in opposite directions), are well known to persons skilled in the
30 art, and are extensively described in the prior art.

The operation of these evaporators is satisfactory, but it is necessary to improve further the heat exchange between the coolant fluid and the air to be cooled.

35 This involves improved homogeneity of the temperature of the coolant fluid between these different regions (right/left, top/bottom) of the evaporator, and thus

better distribution of the losses of load within the different regions of the evaporator.

There is therefore a need for an evaporator with improved performance for the exchange of heat in comparison with the known devices.

3 SUMMARY

The objective of the present invention is to solve these problems of the prior art by proposing an evaporator, in particular for an air-conditioning circuit of a motor vehicle, comprising a stack of plates forming first tubes and second tubes, distinct from the first tubes, for circulation of a coolant fluid, delimiting air passages between one another, such as to cool a flow of air circulating via the passages through the evaporator.

According to the invention, each of the tubes from out of the first or second tubes comprises a path for circulation of the coolant fluid between an inlet orifice and an outlet orifice.

In addition:

- the inlet orifices of the first tubes are in fluid communication with one another, as well as with a fluid inlet of the evaporator, thus defining a first path for supply of coolant fluid to the evaporator;
- the outlet orifices of the second tubes are in fluid communication with one another, as well as with a fluid outlet of the evaporator, thus defining a second path for supply of coolant fluid to the evaporator;
- the outlet orifices of the first tubes are in fluid communication with one another, as well as with inlet orifices of the second tubes, the inlet

- 5 -

orifices of the second tubes being in fluid communication with one another.

5 In addition, the first and second paths for supply of the coolant fluid to the evaporator have a direction opposite the direction of stacking of the plates.

10 Thus, the invention proposes a novel and inventive solution for improving the performance of an evaporator, used for example in an air-conditioning circuit of a motor vehicle.

15 For this purpose, the invention proposes use of a stack of two types of tubes, with the inlets and outlets respectively of the tubes of each type being put into fluid communication with one another (i.e. these inlets and outlets are all supplied to, or collected from, in parallel).

20 Since the stack of tubes of a given type is moreover configured to delimit a direction of flow of the coolant fluid relative to the direction of the stack (i.e. the coolant fluid enters the stack on the side of a first tube of a given type, and exits from the stack on the side of a final tube of the same type of stack),
25 the length of the trajectory traveled by the coolant fluid when passing through a tube of a given type is identical, irrespective of the type of tube in question through which the fluid has passed.

30 Balancing of the paths through which the coolant fluid passes is thus obtained irrespective of the tube of the first type, and irrespective of the tube of the second time through which the fluid has passed.

35 This makes it possible to obtain balanced distribution of the fluid in the stack, and consequently improved efficiency of the evaporator.

In addition, the directions of flow are opposite for the two types of tubes used.

5 Since the two assemblies of tubes of different types are also connected in series in fluid communication with one another, the balancing effect of the length of the trajectory traveled by the coolant fluid is obtained when passing through the two assemblies of tubes of different types, even when the coolant fluid
10 enters and exits on the same side of the evaporator, i.e. on a single face corresponding to an end of the stack, by this means permitting better integration of the evaporator in a conventional air-conditioning system.

15 According to one embodiment, the circulation path in each of the first and second tubes comprises two coolant fluid circulation passages.

20 This therefore provides an evaporator with four passages, all of the paths of which are balanced.

According to one embodiment, the stack is constituted by alternation of first tubes and second tubes.

25 Thus, alternation between the tubes of each type is obtained, consequently improving the homogeneity of the temperature of the coolant fluid along the entire length of the evaporator, and consequently improving
30 the efficiency of the heat exchange with the flow of air overall.

According to one embodiment, the inlet and outlet orifices of the first tubes are arranged in the
35 vicinity of a first end of the first tubes, and the inlet and outlet orifices of the second tubes are arranged in the vicinity of a second end of the second tubes. In addition, the first end of the first tubes is

arranged opposite a first end of the second tubes which is opposite the second end of the second tubes.

Thus, alternation of the directions of circulation of the coolant fluid in the adjacent passages of a layer is obtained, consequently improving the homogeneity of the temperature at the surfaces of heat exchange of the evaporator with the flow of air.

According to one embodiment, each of the first and second tubes comprises two plates delimiting between one another the path of circulation of the coolant fluid, the circulation path including at least one passage in the form of a "U" in a direction parallel to the flow of air.

Thus, the technique described applies in particular to an evaporator with circulation of coolant fluid of the type in the form of a "U" with two passages per tube.

The passage in the form of a "U" is formed on a plane perpendicular to the direction of stacking of the tubes.

According to one embodiment, at least one of the two plates is a stamped plate which has at least one duct and is designed to cooperate with at least one face of another one of the two plates, such as to constitute at least one portion of the coolant fluid circulation path.

Thus, the production of the tubes is simple and economical.

According to one embodiment, the two plates are configured to delimit at least two coolant fluid supply sections, the two coolant fluid supply paths being

derived from the cooperation of supply sections obtained for each tube of the stack.

Thus, the joining in fluid communication of the inlets
5 and outlets of the tubes is simple and economical.

According to one embodiment, the evaporator has a depth of 38 mm.

10 Thus, the evaporator can easily be integrated within a standard HVAC (Heating, Ventilation and Air-Conditioning) housing.

The invention also relates to an air-conditioning
15 circuit comprising an evaporator as previously described, according to any one of the aforementioned embodiments.

4 LIST OF THE FIGURES

20 Other characteristics and advantages of the invention will become apparent from reading the following description, provided by way of non-limiting indication, and from the appended drawings, in which:

- figure 1 is a diagram representing an air-
25 conditioning circuit in which an evaporator according to the invention can be implemented;
- figure 2 illustrates an evaporator with plates, as well as a known example of circulation of coolant fluid within this evaporator;
- 30 - figure 3 is a schematic view of component elements of a stack of plates, forming tubes, of an evaporator according to the invention;
- figure 4 is a schematic view of coolant fluid supply paths of a stack of tubes of an evaporator
35 according to the invention.

5 DETAILED DESCRIPTION OF THE INVENTION

In all the figures appended to the present description, elements which are identical are designated by the same numerical reference.

5 The general principle of the invention consists of an evaporator of the type with plates comprising a stack of plates forming first tubes for circulation of a coolant fluid and second tubes for circulation of a coolant fluid, distinct from the said first tubes, the
10 first tubes and the second tubes delimiting air passages between one another such as to cool a flow of air circulating via the passages in question.

Each tube from out of the first or second tubes
15 comprises a coolant fluid circulation path between an inlet orifice and an outlet orifice, such that:

- the inlet orifices of the first tubes are in fluid communication with one another, as well as with a fluid inlet of the evaporator, thus defining a
20 first coolant fluid supply path in the evaporator;
- the outlet orifices of the second tubes are in fluid communication with one another, as well with as a fluid outlet of the evaporator, thus defining a second coolant fluid supply path in the
25 evaporator;
- the outlet orifices of the first tubes are in fluid communication with one another, as well as with outlet orifices of the second tubes, the inlet orifices of the second tubes being in fluid
30 communication with one another.

In addition, the first and second coolant fluid supply paths in the evaporator have directions opposite the direction of stacking of the plates.

35 Thus, the length of the trajectory traveled by the coolant fluid during its passage through a tube of a given type (which is either a first tube or second

tube) is identical, irrespective of the type of tube in question through which the fluid has passed.

In addition, the directions of flow are opposite for the two types of tubes used. Since the two assemblies of tubes of different types are also connected in series in fluid communication with one another, the balancing effect of the length of the trajectory traveled by the coolant fluid is obtained during the passage through the two assemblies of tubes of different types, even when the coolant fluid enters and exits on the same side of the evaporator.

A description is now provided, in relation with **figure 1**, of the component elements of a conventional air-conditioning circuit 100, in which an evaporator according to the invention can be implemented.

The air-conditioning circuit 100 comprises a compressor 103, a condenser 105, an internal heat exchanger 107, an expansion valve 109, an evaporator 111 and a drying cylinder 113, these different elements being connected to one another by joining parts, such as manifolds, pipes or the like, such as to ensure circulation of coolant fluid.

The coolant fluid is typically a chlorinated and fluorinated fluid operating in a subcritical regime, such as the fluid R-134a, a mixture of HFO-1234yf and CF31, or any other coolant fluid which can function in a subcritical regime.

In figure 1, arrows illustrate the circulation of the coolant fluid.

The coolant fluid, conveyed by the compressor 103, passes through the condenser 105, from which it exits in a high-pressure and high-temperature state. The

coolant fluid then passes through the internal heat exchanger 107, following an internal circulation circuit known as a high-pressure circuit, and is then expanded in the expansion valve 109.

5

The fluid thus expanded is then conveyed to the evaporator 111, before regaining in a low-pressure and low-temperature state the internal heat exchanger 107, which it passes through following an internal
10 circulation circuit known as a high-pressure circuit.

The drying cylinder 113 is interposed between the condenser 105 and the internal heat exchanger 107.

15 In the internal heat exchanger 107, the low-pressure coolant fluid coming from the evaporator 111 exchanges heat with this same high-pressure coolant fluid coming from the condenser 105.

20 At the outlet of the internal heat exchanger 107, the fluid returns to the compressor 103, and so on.

A description is now provided, in relation with **figure 2**, of the structure of an evaporator 111 with plates,
25 as well as a known example of circulation of coolant fluid within this evaporator.

The evaporator 111 comprises an evaporator core constituted by two adjacent layers 2100, 2200 extending
30 on parallel planes.

Each layer is formed by a plurality of parallel ducts produced from attached pairs of plates forming a tube.

35 A coolant fluid passes through a tube of this type such as to cool the flow of air 250 which passes in succession through the first 2100 and second 2200 layers.

In a known manner, the plates are configured such as to define fluid distribution means at the two ends (upper and lower) of the layers 2100, 2200 which ensure the distribution and collection of the coolant fluid in the different ducts of the layers 2100, 2200, whilst defining between the distribution means fluid circulation in a given direction for each duct.

The evaporator 111 has a fluid inlet 210 which makes it possible to convey the coolant fluid from the exterior of the evaporator 111 (for example from the expansion valve 109) to the core of the evaporator 111.

Similarly, a fluid outlet 220 makes it possible to convey the coolant fluid from the core of the evaporator 111 to the exterior of the evaporator 111 (for example to the internal heat exchanger 107).

The plates have orifices at the upper end, the orifices being bordered by collars such as to form an inlet collector space which is connected to the fluid inlet 210, and an outlet collector space which is connected to the fluid outlet 220 when the plates are stacked.

According to the known configuration represented, the coolant fluid follows in the core of the evaporator 111 a path constituted by two layers and a single passage per layer (in this case represented by the arrows 2251 for the first layer 2100, i.e. the one which is arranged on the side of the incoming flow of air 250 to be cooled, and by the arrows 2252 for the second layer 2200 situated on the side of the cooled flow of air).

In addition, for reasons of integration of the evaporator 111, the fluid inlet 210 and outlet 220 are arranged on the same side of the evaporator 111.

Thus, even when the manifolds of the first layer 2100 are associated one by one with a corresponding manifold of the second layer 2200 (such as to form circulation in the form of a "U" of the coolant fluid, as
5 illustrated by the arrows 225, thus forming an evaporator with two passages in the present case) in order to reduce the losses of load associated with the remixing in a collector container putting the two layers into fluid communication, it appears that the
10 length of the trajectory followed by the coolant fluid varies according to the circulation in the form of a "U" concerned.

More specifically, the more the coolant fluid follows
15 the manifolds which are distant from the fluid inlet 210 and outlet 220 of the evaporator, the more the length of the trajectory followed by the coolant fluid in the core of the evaporator 111 increases. This results in non-homogenous distribution of the flow of
20 coolant fluid along the evaporator.

An evaporator 111 according to the invention has the same structure as that described in relation with
figure 2.

25

Figure 3 illustrates part of an evaporator 111 according to the invention. The latter comprises a stack of plates forming first tubes 300b and second tubes 300h, distinct from the first tubes 300b, for
30 circulation of a coolant fluid, delimiting between them air passages such as to cool a flow of air 250 circulating via the passages through the evaporator 111.

35 According to this embodiment, each tube from out of the first 300b or second 300h tubes comprises a path 325b, 325h for circulation of the coolant fluid between an

inlet orifice 310b, 310h and an outlet orifice 320b, 320h.

More particularly:

- 5 • the inlet orifices 310b of the first tubes 300b are in fluid communication with one another, as well as with a fluid inlet 210 of the evaporator 111, defining a first supply path 400b of the coolant fluid in the evaporator 111;
- 10 • the outlet orifices 320h of the second tubes 300h are in fluid communication with one another, as well as with a fluid outlet 220 of the evaporator 111, defining a second supply path 400h of the coolant fluid in the evaporator 111;
- 15 • the outlet orifices 320b of the first tubes 300b are in fluid communication with one another, as well as with inlet orifices 310h of the second tubes 300h (the arrows 325fb illustrate the return circulation path of the coolant fluid between the
- 20 outlet orifices 320b of the first tubes 300b and the inlet orifices 310h of the second tubes 300h, for example via a dedicated manifold which puts into fluid communication the first 400b and second 400h supply paths), the inlet orifices 310h of the
- 25 second tubes 300h being in fluid communication with one another.

In addition, the first 400b and second 400h supply paths of the coolant fluid in the evaporator 111 have a direction opposite the direction of stacking of the plates.

Thus, two types of tubes 300b, 300h are used in the stacking according to the invention, the inlets 310b, 310h and respectively outlets 320b, 320h of the tubes 300b, 300h of each type being put into fluid communication with one another (i.e. they are all supplied to, or collected from, in parallel).

Since the stacking of the tubes 300b, 300h of a given type is also configured to delimit a direction of flow of the coolant fluid relative to the direction of stacking (i.e. the coolant fluid enters the stack from the side of a first tube 300b, 300h of a given type, and exits from the stack on the side of a final tube 300b, 300h of the same type of stack following the corresponding supply path 400b, 400h), the length of the trajectory followed by the coolant fluid during its passage through a tube 300b, 300h of a given type is identical irrespective of the type of tube 300b, 300h in question via which the fluid has passed.

Balancing of the paths traveled by the coolant fluid is thus obtained irrespective of the tube 300b, 300h of the first type, and irrespective of the tube 300b, 300h of the second type via which it has passed.

Balanced distribution of the coolant fluid in the stack is thus obtained, and therefore ultimately better efficiency of the evaporator.

In addition, the directions of flow in the second supply paths 400b, 400h are opposite for the two types of tube 300b, 300h used.

Since the two assemblies of tubes 300b, 300h of a different type are also put into fluid communication in series with one another (via the return circulation path 325fb), the balancing effect of the length of the trajectory traveled by the coolant fluid is obtained during its passage through the two assemblies of tubes 300b, 300h of a different type, even when the inlet 210 and outlet 220 of the coolant fluid into/from the evaporator 111 are arranged on the same side of the evaporator 111, i.e. on a single face corresponding to an end of the stack, thus permitting better integration

of the evaporator 111 in a conventional air-conditioning system for a motor vehicle.

Each of the first and second tubes 300b, 300h comprises
5 two plates 3001b, 3001h, 3002b, 3002h delimiting the circulation path 325b, 325h between one another.

This circulation path 325b, 325h formed by the plates
3001b, 3001h, 3002b, 3002h comprises two passages for
10 circulation of the coolant fluid, each passage being defined by a fluid circulation duct ("passage" in this case means the path of the coolant fluid in a duct of a layer 2100, 2200).

15 Since the coolant fluid passes in succession via a tube 300b of the first type, then via a tube 300h of the second type, an evaporator 111 with four passages is therefore obtained, all the circulation paths of which are balanced.

20 More particularly, the circulation path 325b, 325h for each tube 300b, 300h comprises two coolant fluid circulation passages, one passage out of the two passages belonging to the first layer 2100, and the
25 other passage out of the two passages belonging to the second layer 2200.

Thus, the four passages through which the coolant fluid ultimately passes are grouped in the two layers 2100,
30 2200.

A so-called "four passage" and "two layer" evaporator 111 is thus obtained by stacking tubes 300b, 200h of this type according to the technique described.

35 According to this embodiment, the stack is constituted by alternation of first 300b and second 300h tubes.

Thus, the homogeneity of the temperature of the cooling fluid along the entire evaporator 111 is improved, and therefore ultimately also is the efficiency of the exchange of heat with the flow of air 250.

5

In addition, in the embodiment described, the first 300b and second 300h tubes are stacked alternately with interposed fins 350 through which the flow of air 250 passes.

10

Thus, the exchange of heat is improved between the coolant fluid and the flow of air 250.

According to a particular characteristic:

15

- the inlet 310b and outlet 320b orifices of the first tubes 300b are arranged in the vicinity of a first end of the first tubes 300b;
- the inlet 310h and outlet 320h orifices of the second tubes 300h are arranged in the vicinity of
- the first end of the first tubes 300b is arranged opposite the first end of the second tubes 300h which is opposite the second end of the second tubes 300h.

20

25

Thus, alternation of the directions of circulation of the coolant fluid in adjacent passages of a layer is obtained, consequently improving the homogeneity of the temperature at the surfaces of exchange of heat of the evaporator 111 with the flow of air 250.

30

More particularly, the inlet orifice 310b and the outlet orifice 320b of the tube 300b are situated at the same lower end of the tube 300b.

35

For this purpose, the plates 3001b, 3002b are pierced at their lower end with two holes which put the first

supply path 400b into fluid communication with the circulation path 325b of the tube 300b itself.

5 In addition, at their upper ends, the plates 3001b, 3002b have two orifices 330bh dedicated to the passage of the second supply path 400h putting the fluid inlets 310h and outlets 320h of the second tubes 300h of the stack into fluid communication.

10 Reciprocally, the inlet orifice 310h and the outlet orifice 320h of the tube 300h are situated at the same upper end of the tube 300h.

15 For this purpose, the plates 3001h, 3002h are pierced at their upper end with two holes which put the second supply path 400h into fluid communication with the circulation path 325h of the tube 300h itself.

20 At their lower ends, the plates 3001h, 3002h have two orifices 330bh dedicated to the passage of the first supply path 400b putting the fluid inlets 310b and outlets 320b of the first tubes 300b of the stack into fluid communication.

25 In addition, the circulation path includes at least one passage in the form of a "U" 352b, 325h in a direction parallel to the flow of air 250.

30 Thus, the technique described applies to an evaporator 111 with circulation of coolant fluid of the type in the form of a "U" with two passages per tube 300b, 300h, the passage in the form of a "U" being formed on a plane perpendicular to the direction of stacking of the tubes 300b, 300h.

35 According to a variant, at least one of the two plates 3001b, 3001h, 3002b, 3002h is a stamped plate with at least one duct 360.

In addition, the stamped plate is designed to cooperate with at least one face of another one of the two plates 3001b, 3001h, 3002b, 3002h, such as to constitute at least one portion of the circulation path 352b, 325h of the coolant fluid.

Thus, the production of the tubes is simple and economical.

10 In the embodiment illustrated in figure 3, the tubes 300b, 300h of each type are all identical.

Thus, the evaporator 111 is obtained in a modular manner, and different lengths of the stack can be envisaged according to the number of tubes 300b, 300h of each type which are stacked.

Thus, a plurality of ranges of evaporators 111 can be produced on the basis of the same elementary tubes 20 300b, 300h, consequently simplifying the industrial production process of such evaporators 111 according to the invention.

In relation with **figure 4**, a description is now provided of two paths 400b, 400h for supply of coolant fluid to a stack of tubes 300b, 300h designed for an evaporator 111 according to an embodiment of the technique described.

30 According to this embodiment, the two plates 3001b, 3001h, 3002b, 3002h constituting each tube 330b, 300h are configured to delimit at least two sections 40b, 40h for supply of the first 300b and second 300h tubes with coolant fluid, for example via cylindrical cross-sections (i.e. flanges or lips) extending perpendicularly to the plane of the plates 3001b, 3001h, 3002b, 3002h from the inlet 310b, 310h and the outlet 320b, 320h of the tube 300b, 300h in question.

Thus, the two coolant fluid supply paths 400b, 400h are obtained via the cooperation (by means of fitting, crimping, or brazing for example) of the supply sections 40b, 40h obtained for each tube 300b, 300h of the stack.

More particularly, the supply path 400b thus obtained puts the inlet orifices 310b of the first tubes 300b of the stack into fluid communication with the fluid inlet 210 of the evaporator, and puts the outlet orifices 320b of the first tubes 300b of the stack into fluid communication with the return circulation path 325fb leading to the fluid inlets 310h of the second tubes 300h of the stack.

Similarly, the supply path 400h thus obtained puts the inlet orifices 310h of the second tubes 300h of the stack into fluid communication with the return circulation path 325fb conveying the fluid from the fluid outlets 320b of the first tubes 300b of the stack, and puts the outlet orifices 320h of the second tubes 300b of the stack into fluid communication with the fluid outlet 220 of the evaporator.

Thus, the joining in fluid communication of the inlets 310b, 310h and outlets 320b, 320h of the tubes 300b, 300h is simple and economical.

According to one embodiment, the evaporator 111 has a depth of 38 mm.

Thus, it is possible to incorporate an evaporator 111 of this type within a standard HVAC housing, without substantial modification of the latter.

The use of an evaporator 111 according to the technique described in an air-conditioning circuit 100 incorporated in a motor vehicle makes it possible to

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improve the efficiency of the air conditioning, and thus the comfort in the vehicle.

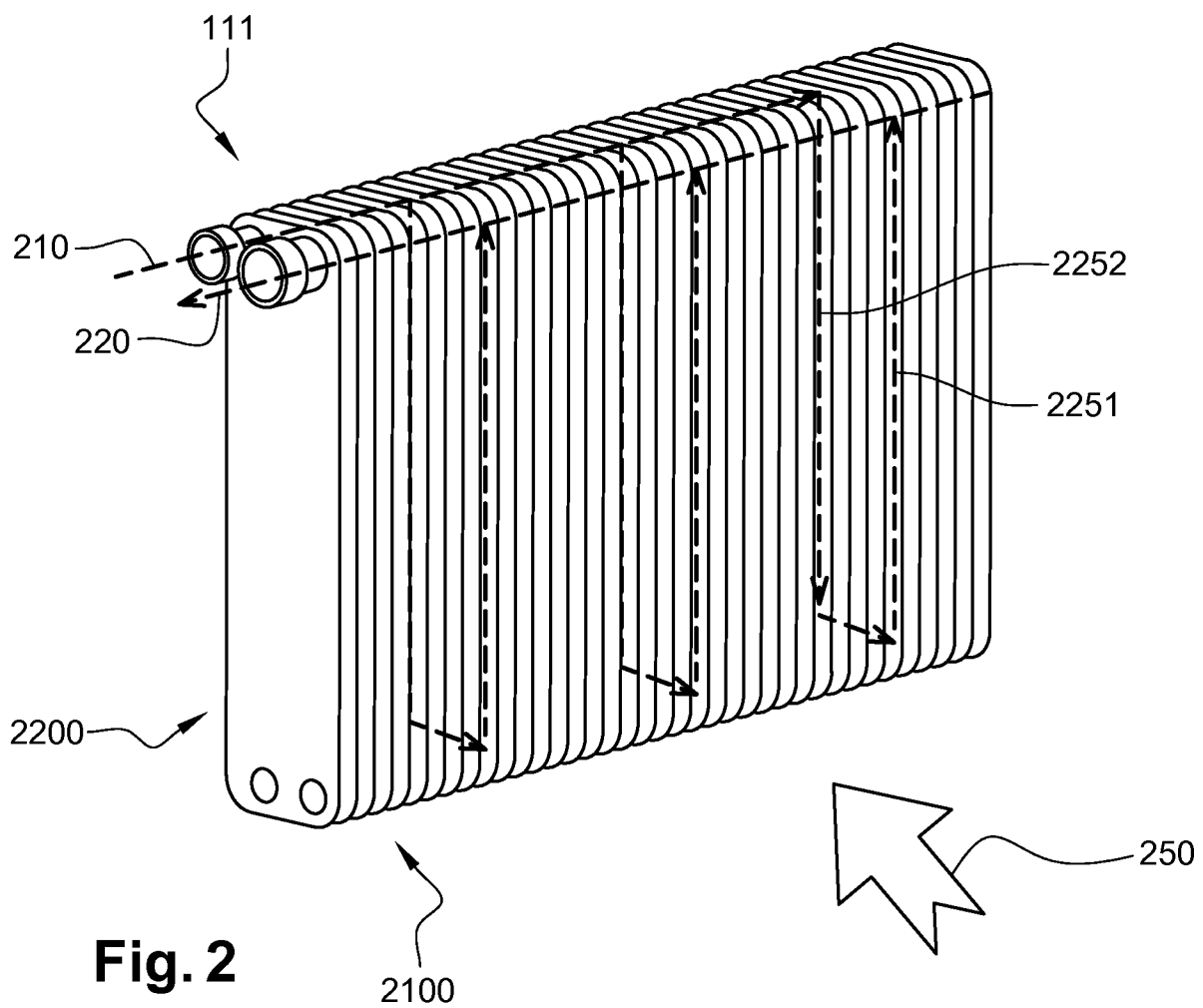
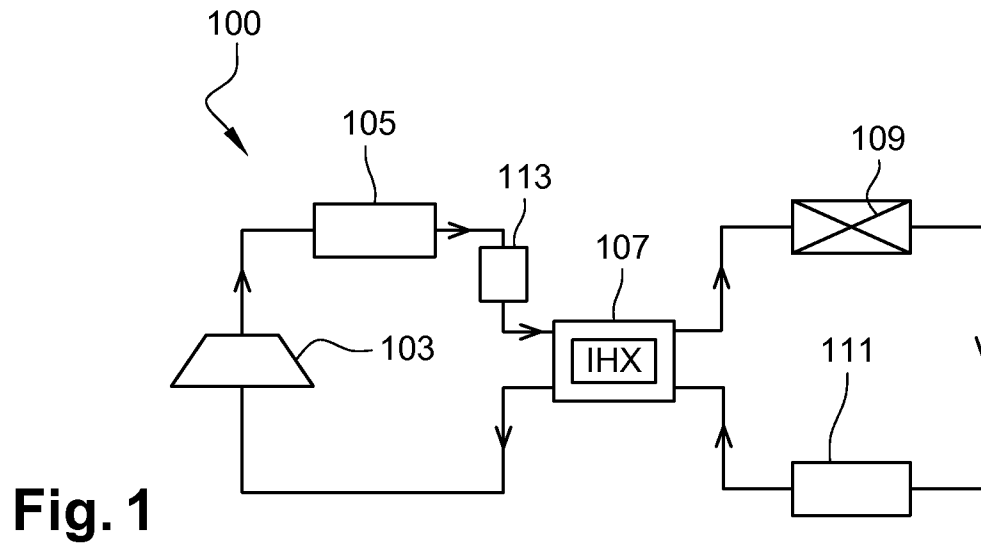
CLAIMS

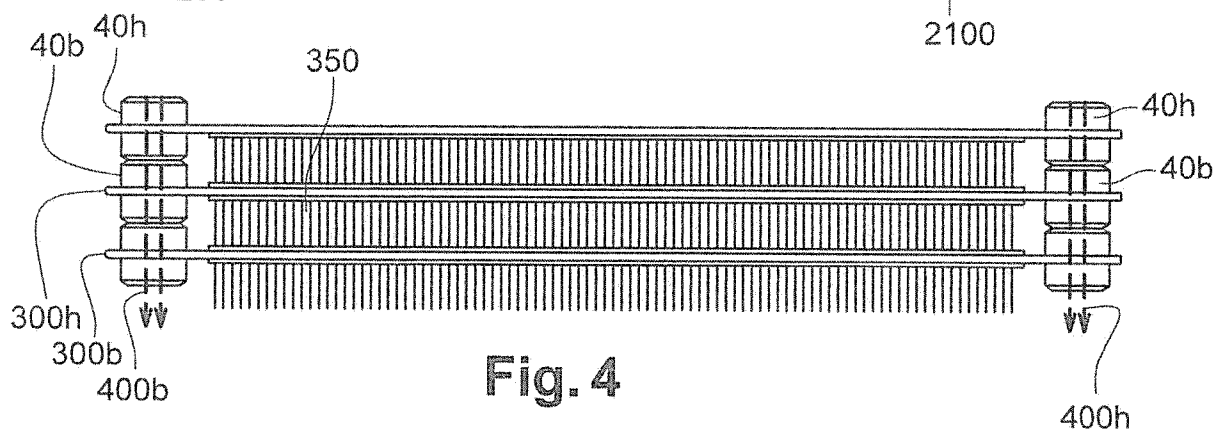
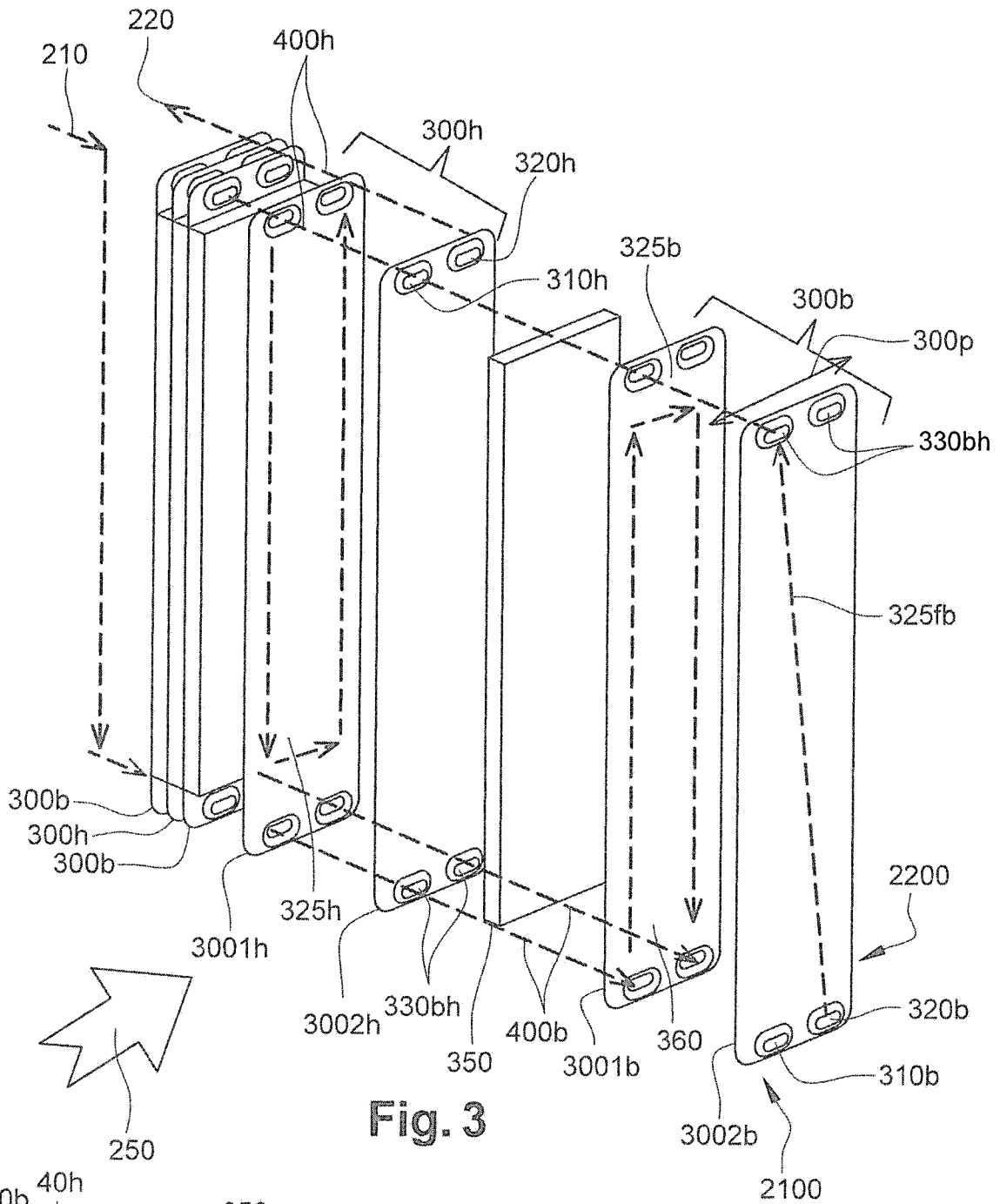
1. An evaporator (111), in particular for an air-conditioning circuit (100) of a motor vehicle,
5 comprising a stack of plates forming first tubes (300b) and second tubes (300h), distinct from the said first tubes (300b), for circulation of a coolant fluid, delimiting air passages between one another, such as to cool a flow of air (250)
10 circulating via the said passages through the evaporator (111),
each of the said tubes from out of the said first or second tubes (300b, 300h) comprising a path (325h, 325b) for circulation of the said coolant
15 fluid between an inlet orifice (310b, 310h) and an outlet orifice (320b, 320h),
the evaporator (111) being **characterized in that:**
- the inlet orifices (310b) of the said first tubes (300b) are in fluid communication with one
20 another, as well as with a fluid inlet (210) of the said evaporator (111), thus defining a first path (400b) for supply of the said coolant fluid to the evaporator (111);
 - the outlet orifices (320h) of the said second
25 tubes (300h) are in fluid communication with one another, as well as with a fluid outlet (220) of the said evaporator (111), thus defining a second path (400h) for supply of the said coolant fluid to the evaporator (111);
 - the outlet orifices (320b) of the said first tubes (300b) are in fluid communication with one
30 another, as well as with inlet orifices (310h) of the said second tubes (300h), the said inlet orifices (310h) of the said second tubes (300h)
35 being in fluid communication with one another,
and in that the said first and second paths (400b, 400h) for supply of the said coolant fluid to the

evaporator (111) have a direction opposite the direction of stacking of the plates.

2. The evaporator (111) as claimed in claim 1,
5 characterized in that the said circulation path (325h, 325b) in each of the first and second tubes (300b, 300h) comprises two passages for circulation of the said coolant fluid.
- 10 3. The evaporator (111) as claimed in claim 1 or 2, characterized in that the stack is constituted by alternation of first tubes (300b) and second tubes (300h).
- 15 4. The evaporator (111) as claimed in claim 3, characterized in that:
- the said inlet (310b) and outlet (320b) orifices of the said first tubes (300b) are arranged in the vicinity of a first end of the said first tubes
20 (300b);
 - the said inlet (310h) and outlet (320h) orifices of the said second tubes (300h) are arranged in the vicinity of a second end of the said second tubes (300h);
- 25 the said first end of the said first tubes (300b) being arranged opposite a first end of the said second tubes (300h) which is opposite the said second end of the said second tubes (300h).
- 30 5. The evaporator (111) as claimed in any one of claims 1 to 4, characterized in that each of the said first and second tubes (300b, 300h) comprises two plates (3001b, 3001h, 3002b, 3002h) delimiting between one another the said path of circulation
35 of the said coolant fluid, the said circulation path including at least one passage in the form of a "U" (325b, 325h) in a direction parallel to the said flow of air (250).

6. The evaporator (111) as claimed in claim 5, characterized in that at least one of the said two plates (3001b, 3001h, 3002b, 3002h) is a stamped plate which has at least one duct (360) and is designed to cooperate with at least one face of another one of the said two plates (3001b, 3001h, 3002b, 3002h), such as to constitute at least one portion of the said the circulation path (352b, 325h) of the said coolant fluid.
7. The evaporator (111) as claimed in claim 5 or 6, characterized in that the said two plates (3001b, 3001h, 3002b, 3002h) are configured to delimit at least two coolant fluid supply sections (40b, 40h), the said two supply paths (400b, 400h) of the said coolant fluid being derived from the cooperation of supply sections (40b, 40h) obtained for each tube of the said stack.
8. The evaporator (111) as claimed in any one of claims 1 to 7, characterized in that it has a depth (300p) of 38 mm.
9. An air-conditioning circuit, characterized in that it comprises an evaporator (111) as claimed in any one of claims 1 to 8.





INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2018/066585

A. CLASSIFICATION OF SUBJECT MATTER
 INV. F28D1/03
 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)
 F28D F28F

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	WO 02/063223 A1 (SHOWA DENKO KK [JP]; HORIUCHI HIROFUMI [JP]; HOSHINO RYOICHI [JP]; OGA) 15 August 2002 (2002-08-15) page 12, line 24 - page 25, line 24; figures 1,2,3,7,8	1,2,5-9
X	EP 2 187 157 A2 (BEHR GMBH & CO KG [DE]) 19 May 2010 (2010-05-19) paragraph [0020] - paragraph [0032]; figure 1	1,2,5-9
A	FR 2 272 362 A1 (BORG WARNER [US]) 19 December 1975 (1975-12-19) page 3, line 17 - page 6, line 20; figures	3,4



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"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

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"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

30 August 2018

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2018/066585

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