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(54) Title: MULTI-PASS HEAT EXCHANGER THAT FORMS PART OF A REFRIGERANT CIRCUIT

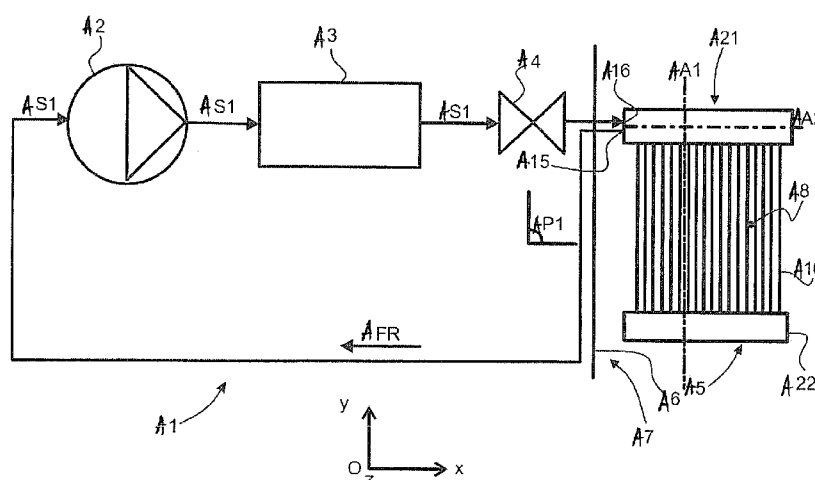


Figure 1

(57) Abstract: The subject of the invention is a heat exchanger (A5, B5, C5) through which a refrigerant (AFR, BFR, CFR) is intended to pass, the heat exchanger (A5, B5, C5) comprising a first layer (A9, B15, C9) of first tubes (A10, B14, C10) and a second layer (A11, B17, C11) of second tubes (A12, B16, C12), the first layer (A9, B15, C9) comprising a first header (A21, B8, C21) which comprises a plurality of top compartments (A41, A42, A43, B41, B42, B43, C41, C42, C43) including a first compartment (A41, B41, C41) interposed between a second compartment (A42, B42, C42) and a third compartment (A43, B42, C42) so that they are produced in succession one after the other along an axis of overall extension (AA2, BA1, CA2), the heat exchanger (A5, B5, C5) further comprising an intake opening (A16, B9, C16) admitting refrigerant (AFR, BFR, CFR), wherein the heat exchanger (A5, B5, C5) is configured to convey the refrigerant (AFR, BFR, CFR) directly from the intake opening (A5, B5, C5) to the first compartment (A41, B41, C41), the



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intake opening (A5, B5, C5) being shifted along the axis of overall extension (AA2, BA1, CA2) with respect to the first compartment (A41, B41, C41) so that it is located on the side of the second compartment (A42, B42, C42) substantially opposite the side of the second compartment (A42, B42, C42) which faces the first compartment (A41, B41, C41).

Multi-pass heat exchanger that forms part of a refrigerant circuit

The field of the present invention is that of multi-pass heat exchangers that form part of a refrigerant circuit with which a motor vehicle is equipped. The subject of the invention is such a heat exchanger.

5 A motor vehicle is commonly equipped with a heating, ventilation and/or air conditioning installation for thermally treating the air present in or sent into the motor vehicle interior. In order to do this, such an installation is associated with a closed circuit inside which a refrigerant flows. The refrigerant circuit comprises, in succession, a compressor, a gas condenser or cooler, an expansion member, possibly an internal heat
10 exchanger and an air/fluid heat exchanger. The heat exchanger is housed inside the heating, ventilation and/or air conditioning installation to allow an exchange of heat between the refrigerant and an air flow circulating inside the said installation, prior to the air flow being delivered to the vehicle interior.

According to one mode of operation of the refrigerant circuit, the heat exchanger is
15 used as an evaporator to cool the air flow. In that case, the refrigerant is compressed in the compressor, then the refrigerant is cooled inside the gas condenser or cooler, then the refrigerant undergoes expansion in the expansion member and finally the refrigerant picks up heat energy from the air flow inside the heat exchanger.

According to another mode of operation of the refrigerant circuit, the air/fluid heat
20 exchanger is used as an evaporator to cool the air flow. In that case, the refrigerant is compressed in the compressor, then the refrigerant is cooled inside the gas condenser or cooler, then the refrigerant undergoes expansion in the expansion member, and then, inside the internal heat exchanger, the refrigerant leaving the expansion member exchanges heat energy with the refrigerant leaving the air/fluid heat exchanger, and finally the refrigerant
25 picks up heat energy from the air flow inside the air/fluid heat exchanger.

Document WO2010073938A1 describes an evaporator comprising two layers of tubes which are arranged parallel to one another between two longitudinal ends of the evaporator. A first layer of tubes is arranged between a header tank and a first return tank whereas a second layer of tubes is arranged between an outlet tank and a second return

tank. The header tank is provided with a refrigerant intake opening whereas the outlet tank is provided with a refrigerant discharge opening. A passage is created between the first return tank and the second return tank so as to allow the refrigerant to circulate from the first layer of tubes to the second layer of tubes.

5 The evaporator is a multi-pass heat exchanger in which the refrigerant circulates alternately from the header tank to the first return tank, then from the first return tank to the header tank, and alternately from the second return tank to the outlet tank, then from the outlet tank to the second return tank. In order to do this, shutters are housed inside the header tank, the outlet tank and inside the first and second return tanks. The shutter housed
10 inside the header tank is provided with an orifice to allow the refrigerant to flow through it inside the header tank.

Inside the heating, ventilation and/or air conditioning installation, the air flow passes in succession through the second layer, then the first layer of the multi-pass evaporator.

15 A first disadvantage with the arrangement of such an evaporator lies in the fact that the air flow passes first of all through the second layer, which means to say the layer which is hottest, and then the first layer, which means to say the layer which is coldest.

20 A second disadvantage of the arrangement of such an evaporator lies in the fact that a central zone of the evaporator, which can extend between the header tank and the first return tank and which can be situated equal distances from the longitudinal ends of the header tank and equal distances from the longitudinal ends of the first return tank, is not
supplied with enough coldest refrigerant to cool as effectively as possible an air flow passing through the central zone.

25 In general, such an organization is not optimal from the viewpoint of homogenizing the distribution of refrigerant inside the evaporator. The result of this is heterogeneity in a temperature at various points on the surface of the evaporator, which leads to heterogeneity in a temperature of the air flow leaving the evaporator, and this is unsatisfactory.

30 One objective of the invention is to perfect the homogeneity of the distribution of refrigerant within the heat exchanger and notably within the first tubes in order ultimately to improve the efficiency and output thereof, with a view to delivering to the vehicle interior an air flow at the desired temperature.

Another objective of the invention is to optimize an exchange of heat energy between the refrigerant circulating inside the first tubes, notably in a central zone of the heat exchanger, and an air flow circulating inside the heating, ventilation and/or air conditioning installation.

5 An object of the invention is a heat exchanger through which a refrigerant is intended to pass, the heat exchanger comprising a first layer of first tubes and a second layer of second tubes, the first layer comprising a first header which comprises a plurality of top compartments including a first compartment interposed between a second compartment and a third compartment so that they are produced in succession one after the other along
10 an axis of overall extension, the heat exchanger further comprising an intake opening admitting refrigerant, wherein the heat exchanger is configured to convey the refrigerant directly from the intake opening to the first compartment, the intake opening being shifted along the axis of overall extension with respect to the first compartment so that it is located on the side of the second compartment substantially opposite the side of the second
15 compartment which faces the first compartment.

The effect of such a combination lies in the possibility of conveying the refrigerant to a central pass of the heat exchanger while maintaining conventional coupling to the rest of the refrigerant circuit, which means to say couplings in which the refrigerant inlet pipe and the refrigerant discharge pipe are side-by-side.

20 Preferably, the first layer comprises a first header which may be provided with a refrigerant discharge opening and which comprises a plurality of top compartments including a first compartment interposed between a second compartment and a third compartment. The second layer may be provided with a refrigerant intake opening.

25 According to the present invention, the heat exchanger is equipped with a means of conveying the refrigerant, which means is interposed between the intake opening and the first top compartment.

The heat exchanger advantageously comprises at least any one of the following features, on their own or in combination:

30 - the conveying means comprises at least one canal which is interposed between the intake opening and the first top compartment,

- the conveying means comprises a first chamber interposed between the canal and the intake opening,

- the conveying means comprises a second chamber interposed between the canal and the first top compartment,

5 - the canal extends inside a longitudinal midplane of the heat exchanger,

- the longitudinal midplane delimits the first layer and the second layer,

- the longitudinal midplane is parallel to an inlet face via which an air flow enters the heat exchanger,

10 - the first chamber extends inside a plane parallel to a lateral plane of the heat exchanger, which plane is orthogonal, or substantially orthogonal, to a longitudinal plane of the heat exchanger,

- the second chamber extends inside a plane parallel to the lateral plane,

- the canal is housed inside a groove formed between the first header and the third header,

15 - the intake opening and the discharge opening are formed inside a transverse plane which is orthogonal, or substantially orthogonal, to the longitudinal plane and to the lateral plane,

- the intake opening and the discharge opening are formed inside distinct respective planes which are parallel to the longitudinal plane,

20 - the intake opening and the discharge opening are formed through a first flange of the heat exchanger,

- the first top compartment is a central compartment of the heat exchanger situated equal distances from the first flange and from a second flange of the heat exchanger. Alternatively, the first top compartment may be closer to a first flange or to a second
25 flange of the heat exchanger.

- the heat exchanger is a plate-type heat exchanger comprising a stack of first plates

and of second plates which are assembled in pairs via their respective edges,

- the heat exchanger comprises an end plate comprising a first dishing which, together with the first flange, delimits the first chamber,

- the heat exchanger comprises a dividing plate comprising a second dishing which, together with a plate, delimits the second chamber,

- the canal comprises a first mouth in fluidic communication with the first chamber,

- the canal comprises a second mouth in fluidic communication with the second chamber.

The invention also relates to a refrigerant circuit comprising at least one such heat exchanger.

The invention also relates to a use of such a heat exchanger as an evaporator housed within a housing of a heating, ventilation and/or air conditioning installation with which a motor vehicle is equipped.

The invention also relates to a motor vehicle heating, ventilation and/or air conditioning installation comprising at least one such heat exchanger and through which there passes an air flow circulating inside the heating, ventilation and/or air conditioning installation, in which the heat exchanger is arranged in the heating, ventilation and/or air conditioning installation in such a way that the air flow enters the heat exchanger first of all via the first layer which comprises the first top compartment.

20

The air/fluid heat exchanger of the present invention may be also an air/fluid heat exchanger through which a refrigerant is intended to pass. The air/fluid heat exchanger comprises a first layer of first tubes and a second layer of second tubes. The first layer comprises a first top tank which comprises a plurality of top compartments including at least one first top compartment interposed between a second top compartment and a third top compartment. An intake opening admitting refrigerant into the heat exchanger can be inscribed within a thickness of the first layer.

Preferably, an intake tube extends into the second top compartment between the intake opening and the first top compartment. It will be appreciated here that the intake tube extends in the volume of the second top compartment, along the length thereof.

5 The air/fluid heat exchanger advantageously comprises at least any one of the following features, on their own or in combination:

- the air/fluid heat exchanger is provided with a discharge opening which can be inscribed within the thickness of the first layer,

- the intake tube comprises a first longitudinal end delimiting the intake opening admitting the refrigerant into the air/fluid heat exchanger,

10 – the second top compartment is delimited at least by a first flange which longitudinally borders the air/fluid heat exchanger and a first top partition which is interposed between the first top compartment and the second top compartment,

- the first longitudinal end of the intake tube is formed through the first flange of the air/fluid heat exchanger,

15 – the first longitudinal end of the intake tube is formed through an end plate of the air/fluid heat exchanger, which end plate is interposed between the first flange and the second top compartment,

- the intake tube comprises a second longitudinal end which is formed through the first top partition,

20 – the first longitudinal end of the intake tube is supported by retaining means which may just as well be assigned to the first flange as to the end plate,

- the second top compartment being delimited by a top wall, a bottom wall, a middle wall and a lateral wall, the first longitudinal end of the intake tube is placed a first distance away from the top wall, a second distance away from the bottom wall, a third distance
25 away from the middle wall, and a fourth distance away from the lateral wall,

- the first distance is equal to the second distance and the third distance is equal to the fourth distance,

- the first distance is less than the second distance,
- the first distance is greater than the second distance,
- the third distance is equal to the fourth distance,
- the third distance is less than the fourth distance,
- 5 – the third distance is greater than the fourth distance,
- the intake tube is cylindrical.

The present invention also relates to a heat exchange module comprising an internal heat exchanger and such an air/fluid heat exchanger, the internal heat exchanger and the air/fluid heat exchanger being associated with one another by means of assembly means.

10 The heat exchange module advantageously comprises at least any one of the following features, on their own or in combination:

- the internal heat exchanger comprises a peripheral wall which is connected to a ring delimiting the discharge opening,
- the internal heat exchanger comprises a central canal which is in fluidic
15 communication with the first longitudinal end of the intake tube,
- the internal heat exchanger comprises a peripheral canal which is in fluidic communication with the first longitudinal end of the intake tube.

The present invention also relates to a refrigerant circuit comprising at least one such heat exchanger.

20 The present invention also relates to a refrigerant circuit comprising at least one such heat exchange module.

The present invention also relates to a use of such an air/fluid heat exchanger as an evaporator housed within a housing of a heating, ventilation and/or air conditioning installation with which a motor vehicle is equipped.

25 The present invention also relates to a motor vehicle heating, ventilation and/or air

conditioning installation comprising at least one such air/fluid heat exchanger and through which there passes an airflow circulating inside the heating, ventilation and/or air conditioning installation, in which the air/fluid heat exchanger is arranged in the heating, ventilation and/or air conditioning installation in such a way that the airflow enters the
5 air/fluid heat exchanger first of all via the first layer which comprises the first top compartment.

A heat exchanger of the present invention may also be a heat exchanger through which a refrigerant is intended to pass. The heat exchanger comprises a first layer of first tubes and a second layer of second tubes. The first layer comprises a first header which is
10 provided with a refrigerant discharge opening and which comprises a plurality of top compartments including at least one first top compartment interposed between a second top compartment and a third top compartment. The second layer is provided with a refrigerant intake opening.

Preferably, the heat exchanger is equipped with a means of conveying the refrigerant,
15 which means is interposed between the intake opening and the first top compartment, the conveying means extending at least partially inside the second top compartment.

The effect of such a combination lies in the possibility of conveying the refrigerant to a central pass of the heat exchanger while maintaining conventional coupling to the rest of the refrigerant circuit, which means to say couplings in which the refrigerant inlet pipe and
20 the refrigerant discharge pipe are side-by-side.

According to one aspect of the invention, the conveying means comprises at least one canal which is housed inside the second top compartment. It will be appreciated here that at least part of the canal, and advantageously its entirety, encroaches upon a volume delimited by the second top compartment. The position of this canal may be coaxial with
25 the second top compartment but it may also be offset transversely or laterally in the second top compartment. Such measures make it possible to position the canal in such a way that it has the least possible impact on the circulation of refrigerant within the second top compartment.

The conveying means may comprise at least one chamber interposed between the
30 canal and the intake opening. Such a chamber transfers the refrigerant, which enters the

heat exchanger via a plane that can be inscribed in the second layer, towards the first layer so that it can circulate along the canal.

According to one exemplary embodiment, the chamber comprises a groove connected directly to a cavity, the intake opening opening directly into the cavity while the
5 canal opens directly into the groove. The cavity has a cross section identical or substantially identical to the intake opening. By contrast, the groove has a volume smaller than the volume of the cavity. The cavity is, for example, cylindrical, notably circular, whereas the groove is predominantly rectilinear.

According to one example, the chamber extends along a straight line which can be
10 inscribed inside a plane parallel to a lateral plane of the heat exchanger, the latter being orthogonal to a longitudinal plane defining a face via which an air flow enters the heat exchanger. The straight line in question may advantageously be perpendicular to the longitudinal plane in which the inlet face via which the air flow enters the heat exchanger can be inscribed.

The heat exchanger may comprise an intermediate component in the thickness of
15 which the chamber is formed. The groove and the cavity are spaced-apart zones created in the intermediate component, such spaces being intended to be followed by the refrigerant. The intermediate component thus forms an interface between the pipes of the refrigerant circuit and the heat exchanger, such an interface being configured to duct the refrigerant
20 entering the heat exchanger via the second layer and conduct it into the first layer, notably into the first top compartment of the first header.

According to one example, the intermediate component comprises a first orifice and a second orifice which each open through a first face and a second face of the intermediate component. The first orifice is contained in a cross section of the second orifice. The first
25 orifice has a cross section equivalent to a cross section of the canal, whereas the cross section of the second orifice is substantially equal to a cross section of the discharge opening.

According to this example, the first orifice is in fluidic communication with the groove. For its part, the second orifice is in fluidic communication with the discharge
30 opening of the heat exchanger. The groove opens onto the second face and is closed in the

region of the first face by a first wall. The latter thus forms a bottom for the groove and for the cavity.

According to one aspect of the invention, the intermediate component bears the canal, at least at one of its ends.

5 Advantageously, the first orifice and the second orifice are separated from one another by a flange which accepts a first end of the canal housed inside the first orifice. The flange also bears the end of the canal and allows the internal volume of the canal to be coupled to the volume inside the groove.

10 The intake opening and the discharge opening are formed both on the one same side of the heat exchanger and, for example, at the one same corner.

The heat exchanger may comprise a closure plate which closes the chamber and bears sleeves delimiting the intake opening and the discharge opening. The closure plate allows the chamber to be sealed so that the refrigerant can be conveyed from the second layer to the first layer.

15 According to one exemplary embodiment, the first top compartment is a central compartment of the heat exchanger situated equal distances from a first longitudinal end and from a second longitudinal end of the heat exchanger. A width of these three compartments is identical, or near identical, measured along a straight line which is inscribed in the face via which the air flow enters the exchanger.

20 The invention also relates to a use of such a heat exchanger as an evaporator, notably when it is housed within a housing of a heating, ventilation and/or air conditioning installation with which a motor vehicle is equipped.

The invention also relates to a refrigerant circuit comprising at least one such heat exchanger, for example a motor-vehicle refrigerant circuit.

25 The invention also relates to a motor vehicle heating, ventilation and/or air conditioning installation comprising at least one such heat exchanger and through which there passes an air flow circulating inside the heating, ventilation and/or air conditioning installation, in which the heat exchanger is arranged in the heating, ventilation and/or air

conditioning installation in such a way that the air flow enters the heat exchanger first of all via the first layer which comprises the first top compartment.

Further features, details and advantages of the invention will become apparent from
5 reading the detailed description given hereinbelow by way of illustration and with reference to the drawings of the attached plates, in which:

- Figure 1 is a schematic depiction of a refrigerant circuit comprising a heat exchanger of the present invention,

- Figure 2 is a perspective illustration of the heat exchanger illustrated in Figure 1,

- 10 - Figure 3 is a schematic illustrative cross section through the top of the heat exchanger illustrated in Figure 2,

- Figure 4 is a schematic illustrative cross section through the middle of the heat exchanger illustrated in Figure 2,

- 15 - Figure 5 is a schematic illustrative cross section through the bottom of the heat exchanger illustrated in Figure 2,

- Figure 6 is a schematic illustration of a path followed by the refrigerant circulating inside the heat exchanger illustrated in Figure 2,

- Figure 7 is a three-quarters perspective view of the heat exchanger illustrated in Figure 2,

- 20 - Figure 8 is a view from the side and from above of the heat exchanger illustrated in Figure 2,

- Figure 9 is a perspective view of a plate that makes up the heat exchanger illustrated in Figure 2,

- 25 - Figures 10 and 11 are perspective and partial views of the heat exchanger illustrated in Figure 2.

- Figure 12 is a schematic depiction of an alternative form of embodiment of a refrigerant circuit comprising an air/fluid heat exchanger according to the present invention,

5 - Figure 13 is a perspective illustration of the air/fluid heat exchanger illustrated in Figure 12,

- Figure 14 is a schematic illustration of a cross section of the top of the air/fluid heat exchanger illustrated in Figure 13,

- Figure 15 is a schematic illustration of a cross section of the middle of the air/fluid heat exchanger illustrated in Figure 13,

10 - Figure 16 is a schematic illustration of a cross section of the bottom of the air/fluid heat exchanger illustrated in Figure 13,

- Figure 17 is a schematic illustration of a path followed by the refrigerant circulating inside the air/fluid heat exchanger illustrated in Figure 13,

- Figure 18 is partial side view of the air/fluid heat exchanger illustrated in Figure 13,

15 - Figure 19 is a partial schematic illustration of a first alternative form of embodiment of an end plate that the air/fluid heat exchanger illustrated in Figure 13 comprises,

20 - Figure 20 is a schematic partial illustration of a second alternative form of embodiment of an end plate that the air/fluid heat exchanger illustrated in Figure 13 comprises,

- Figure 21 is a schematic partial illustration of a third alternative form of embodiment of an end plate that the air/fluid heat exchanger illustrated in Figure 13 comprises,

25 - Figure 22 is a schematic perspective illustration of a heat exchange module comprising an internal heat exchanger and an air/fluid heat exchanger according to the present invention,

- Figure 23 is a schematic illustration of a second alternative form of embodiment of

a refrigerant circuit comprising the heat exchange module illustrated in Figure 22,

- Figure 24 is a schematic perspective illustration of a first form of embodiment of an internal heat exchanger forming part of the refrigerant circuit illustrated in Figure 23,

5 - Figure 25 is a schematic perspective illustration of a second form of embodiment of an internal heat exchanger forming part of the refrigerant circuit illustrated in Figure 23.

- Figure 26 is a schematic depiction of a refrigerant circuit comprising an embodiment of a heat exchanger of the present invention,

- Figure 27 is a perspective illustration of the heat exchanger illustrated in Figure 26,

10 - Figure 28 is a schematic illustrative cross section of the top of the heat exchanger illustrated in Figure 27,

- Figure 29 is a schematic illustrative cross section of the middle of the heat exchanger illustrated in Figure 27,

- Figure 30 is a schematic illustrative cross section of the bottom of the heat exchanger illustrated in Figure 27,

15 - Figure 31 is a schematic illustration of a path followed by the refrigerant circulating inside the heat exchanger illustrated in Figure 27,

- Figure 32 is a partial illustration in three-quarters perspective of the heat exchanger illustrated in Figure 27,

20 - Figure 33 is a view from the side and from above of the heat exchanger illustrated in Figure 27,

- Figure 34 is a perspective view of a plate that makes up the heat exchanger illustrated in Figure 27,

- Figure 35 is partial perspective view of the heat exchanger illustrated in Figure 27,

25 - Figures 36 and 37 are a front view and a rear view of an intermediate component that makes up the heat exchanger illustrated in Figure 27.

The figures and the description thereof set out the invention in detail and according to particular ways of implementing same. They may serve the better to define the invention, where appropriate.

5 Figure 1 depicts a closed circuit A1 in which a refrigerant AFR circulates. In the exemplary embodiment illustrated, the refrigerant circuit A1 comprises, in succession, in a direction AS1 in which the refrigerant AFR circulates within the refrigerant circuit A1, a compressor A2 for compressing the refrigerant AFR, a gas condenser or cooler A3 for cooling the refrigerant AFR, an expansion member A4 in which the refrigerant AFR
10 undergoes an expansion and a heat exchanger A5 according to the invention. The heat exchanger A5 is housed within a housing A6 of a heating, ventilation and/or air conditioning installation A7 within which an air flow circulates. The heat exchanger A5 allows heat transfer between the refrigerant AFR and the air flow AFA coming into contact with it and/or passing through it, as illustrated in Figure 2. According to the mode of
15 operation of the refrigerant circuit A1 described hereinabove, the heat exchanger A5 is used as an evaporator to cool the air flow AFA, as the air flow AFA comes into contact with and/or passes through the heat exchanger A5.

 In Figure 2, the heat exchanger A5 is depicted inside an orthonormal frame of reference Oxyz. The heat exchanger A5 comprises an inlet face A8 for the air flow AFA
20 which extends along a longitudinal plane AP1 parallel to the plane Oxy. The inlet face A8 is that face of the heat exchanger A5 through which the air flow AFA enters the inside of the heat exchanger A5. The inlet face A8 is notably the face with the largest dimensions of the heat exchanger A5. The air flow AFA flows through the heat exchanger A5 substantially orthogonally to the longitudinal plane AP1.

25 The heat exchanger A5 comprises two layers A9, A11 of tubes A10, A12, these being a first layer A9 of first tubes A10 and a second layer A11 of second tubes A12. The first layer A9 comprises the inlet face A8 such that the first layer A9 is the first layer that the air flow AFA passes through as it circulates through the heat exchanger A5. In other words, the air flow AFA passes in succession through the inlet face A8 then the first layer
30 A9 then the second layer A11. The first layer A9 and the second layer A11 are parallel to one another and parallel to the longitudinal plane AP1. The first tubes A10 and the second

tubes A12 are parallel to one another and extend along a first axis of overall extension AA1 which is parallel to the longitudinal plane AP1.

The first tubes A10 are interposed between a first header A21 for the refrigerant AFR and a second header A22 for the refrigerant AFR. The first header A21 and the second header A22 extend parallel to a second axis of overall extension AA2 which is orthogonal, or substantially orthogonal, to the first axis of overall extension AA1. The first header A21 and the second header A22 are separated from one another and are connected to one another by the first tubes A10. The first header A21 and the second header A22 are contained within a plane parallel to a transverse plane AP2 of the heat exchanger A5, which is itself parallel to the plane Oyz. The first header A21 is provided with a discharge opening A15 through which the refrigerant AFR is discharged from the heat exchanger A5.

The second tubes A12 are interposed between a third header A23 for the refrigerant AFR and a fourth header A24 for the refrigerant AFR. The third header A23 and the fourth header A24 extend parallel to the second axis of overall extension AA2. The third header A23 and the fourth header A24 are separated from one another and are connected to one another by the second tubes A12. The third header A23 and the fourth header A24 are contained within a plane which is parallel to the transverse plane AP2 of the heat exchanger A5. The third header A23 is provided with an intake opening A16 through which the refrigerant AFR is admitted into the heat exchanger A5.

Each of the first tubes A10 and of the second tubes A12 are associated in pairs, being aligned inside the one same lateral plane AP3 which is parallel to the plane Oyz.

The first header A21 and the third header A23 are contiguous with one another in a plane parallel to the plane AP2 of the heat exchanger A5. The second header A22 and the fourth header A24 are contiguous with one another in another plane parallel to the plane AP2 of the heat exchanger A5.

The intake opening A16 and the discharge opening A15 are arranged inside a plane parallel to the transverse plane AP2 and are produced through a first longitudinal end A17 of the heat exchanger A5. In other words, the intake opening A16 and the discharge opening A15 are produced side-by-side next to one another. It will be appreciated here that the first header A21 and the third header A23 extend in the transverse plane AP2 between

the first longitudinal end A17 and a second longitudinal end A18 of the heat exchanger A5. Furthermore, the layers A9, A11 of the heat exchanger A5 extend longitudinally along the second longitudinal axis AA2 between a first flange A19 and a second flange A20 which respectively border the heat exchanger A5 over its entire height parallel to the transverse plane AP2.

In Figure 3, which illustrates a cross section through the top of the heat exchanger A5 on a plane which passes through the first header A21 and the third header A23 and is parallel to the transverse plane AP2, the first header A21 and the third header A23 are compartmentalized. The first header A21 and the third header A23 comprise a plurality of top compartments A41, A42, A43, A44, A45.

Throughout the description, any element of the heat exchanger A5 situated above a plane which is parallel to the transverse plane AP2 and which is interposed between the first header A21 and the third header A23, on the one hand, and the tubes A10, A12, on the other hand, is qualified as “top”, and any element of the heat exchanger A5 situated below the plane which is parallel to the transverse plane AP2 and which is interposed between the first header A21 and the third header A23, on the one hand, and the tubes A10, A12, on the other hand, is qualified as “bottom”.

The first header A21 comprises at least one first top compartment A41 which is interposed between a second top compartment A42 and a third top compartment A43. According to the alternative form illustrated in Figure 3, the first top compartment A41 is a single compartment which means that the first header A21 comprises three compartments A41, A42, A43, and that the first top compartment A41 is a central compartment of the heat exchanger A5. In other words, and by way of nonlimiting example, a first distance between a centre of mass of the first compartment A41 and the first flange A19 is equal to a second distance between the centre of mass of the first compartment and the second flange A20. The first top compartment A41, the second top compartment A42 and the third top compartment A43 are sealed with respect to one another. For this purpose, the first top compartment A41 and the second top compartment A42 are separated from one another by at least a first top partition A51. For this purpose also, the first top compartment A41 and the third top compartment A43 are separated from one another by at least one second top partition A52. The second top compartment A42, the first top compartment A41 and the

third top compartment A43 are produced in succession one after the other along an axis parallel to the second axis of overall extension AA2. The second top compartment A42 is partially delimited by the first flange A19 and the third top compartment A43 is partially delimited by the second flange A20.

5 The third header A23 comprises a fourth top compartment A44 and a fifth top compartment A45. The fourth top compartment A44 and the fifth top compartment A45 are sealed relative to one another. For this purpose, the fourth top compartment A44 and the fifth top compartment A45 are separated from one another by a third top partition A53. The fourth top compartment A44 and the fifth top compartment A45 are produced in
10 succession one after the other along an axis parallel to the second axis of overall extension AA2. The fourth top compartment A44 is partially delimited by the second flange A20 and the fifth top compartment A45 is partially delimited by the first flange A19.

 According to one aspect of the present invention, the heat exchanger A5 is equipped with a means A80 of conveying the refrigerant AFR from the intake opening A16 towards
15 the first top compartment A41 so that the refrigerant AFR entering the heat exchanger A5 circulates from the intake opening A16 towards the first layer A9, and more particularly towards the first top compartment A41, which is a central compartment of the heat exchanger A5.

 These measures are such that the refrigerant AFR admitted into the heat exchanger
20 A5 is directed towards the first layer A9, namely that which is first to receive the air flow AFA even though the intake opening A16 can be inscribed within a plane of the second layer A11.

 The means A80 for conveying the refrigerant AFR places the intake opening A16 in fluidic communication with the first top compartment A41. The conveying means A80
25 comprises a first chamber A81 which is in opening communication with the intake opening A16 via a first opening A80a. The first chamber A81 is in fluidic communication with a canal A83 via a first mouth A80b of the canal A83. The canal A83 is interposed between the first chamber A81 and a second chamber A82. The canal A83 is in fluidic communication with the second chamber A82 via a second mouth A80c. The second
30 chamber A82 is in fluidic communication with the first top compartment A41 via a fourth opening A80d produced through a second wall A82a.

The conveying means A80 is for example arranged at least in part along the axis Oz. To that end, the first chamber A81 is produced parallel to the lateral plane AP3, the canal A83 is produced along the second axis of overall extension AA2, and the second chamber A82 is produced parallel to the lateral plane AP3.

5 The canal A83 is preferably produced inside a longitudinal midplane AP4 which delimits the first layer A9 and the second layer A11. The first mouth A80b and the second mouth A80c are preferably aligned along the second axis of overall extension AA2. The first mouth A80b and the second mouth A80c are preferably produced inside the longitudinal midplane AP4.

10 The first chamber A81 extends chiefly inside the second layer A11. However, the first chamber A81 is capable of extending partially inside the first layer A9, straddling the longitudinal midplane AP4.

15 The first chamber A81 is delimited by the first flange A19 and a first wall A81a which extends substantially parallel to the lateral plane AP3. The first flange A19 is provided with the first opening A80a which is in fluidic communication with the intake opening A16. According to one example, the first wall A81a is housed inside the fifth top compartment A45.

20 The second chamber A82 extends chiefly inside the first layer A9. However, the second chamber A82 is capable of extending partially inside the second layer A11, straddling the longitudinal midplane AP4.

25 The second chamber A82 is delimited by the first top partition A51 and the second wall A82a which extends substantially parallel to the lateral plane AP3. The second wall A82a is provided with the fourth opening A80d which is in fluidic communication with the first top compartment A41. The second wall A82a is interposed between the first top partition A51 and the second top partition A52. The second wall A82a is notably housed inside the first top compartment A41.

30 In Figure 4, which illustrates a cross section through the middle of the heat exchanger A5 on a plane which is parallel to the transverse plane AP2 and equal distances from the first header A21 and the third header A23, on the one hand, and from the second header A22 and the fourth header A24, on the other hand, the heat exchanger A5 is a

multi-pass heat exchanger in which the first layer A9 comprises a plurality of passes A31, A32, A33, and in which the second layer A11 likewise comprises a plurality of passes A34, A35, A36. The passes A31, A32, A33 of the first layer A9 are each formed of a plurality of first tubes A14 in which the refrigerant AFR circulates in the one same direction. Two adjacent passes A31, A32, A33 of the first layer A9 comprise first tubes A10 in which the refrigerant AFR circulates in opposite directions from one pass to the other, and is also apparent from Figure 6. Likewise, the passes A34, A35, A36 of the second layer A11 are each formed of a plurality of second tubes A12 in which the refrigerant AFR circulates in the one same direction. Two adjacent passes A34, A35, A36 of the second layer A11 comprise second tubes A12 in which the refrigerant AFR circulates in opposite directions from one pass to the other, and is also illustrated in Figure 6.

A study of Figure 4 shows that each pass A31, A32, A33 of the first layer A9 is positioned facing a respective second pass A34, A35, A36 of the second layer A11. The refrigerant AFR circulating in the first tubes A10 of any one of the passes A31, A32, A33 of the first layer A9 circulates in an opposite direction to that of the refrigerant AFR circulating in second tubes A12 of the pass of the adjacent second layer A11 situated in the one same plane parallel to the lateral plane AP3.

Thus, the first layer A9 comprises at least one first pass A31 which is interposed between a second pass A32 and a third pass A33. The second pass A32 is delimited at least in part by the first flange A19 and the third pass A33 is delimited at least in part by the second flange A20. According to the alternative form illustrated in Figure 3, the first pass A31 is a single pass, which means that the first layer A9 comprises three passes A31, A32, A33, and that the first pass A31 is a central first pass of the heat exchanger A5. According to another alternative form of embodiment, there are a plurality of first passes A31, which means that the first layer A9 comprises more than three passes, and notably four passes.

Likewise, the second layer A11 comprises at least one fourth pass A34 which is interposed between a fifth pass A35 and a sixth pass A36. The fifth pass A35 is delimited at least in part by the first flange A19 and the sixth pass A36 is delimited at least in part by the second flange A20. According to the alternative form illustrated in Figure 3, the fourth pass A34 is a single pass, which means that the second layer A11 comprises three passes

A34, A35, A36, and that the fourth pass A34 is a central pass of the heat exchanger A5. According to another alternative form of embodiment, there are a plurality of fourth passes A34, which means that the second layer A11 comprises more than three passes, and notably four passes.

5 The top compartments A41, A42, A43 of the first layer A9 are in fluidic relationship with the passes A31, A32, A33 of the first layer A9. More specifically, the first top compartment A41 is in fluidic communication with the top ends of the first tubes A10 of the first pass A31. The second top compartment A42 is in fluidic communication with the top ends of the first tubes A10 of the second pass A32. The third top compartment A43 is
10 in fluidic communication with the top ends of the first tubes A10 of the third pass A33.

 The top compartments A44, A45 of the second layer A11 are in fluidic relationship with the passes A34, A35, A36 of the second layer A11. More specifically, the fourth top compartment A44 is in fluidic communication with the top ends of the second tubes A12 of the fifth pass A35. The fifth top compartment A45 is in fluidic communication with the
15 top ends of the second tubes A12 of the fourth pass A34 and with the top ends of the first tubes A12 of the sixth pass A36.

 Finally, the third top compartment A43 and the fourth top compartment A44 are in fluidic communication with one another via at least one top passage A54.

 In Figure 5, which illustrates a cross section through the bottom of the heat
20 exchanger A5 on a plane which passes through the second header A22 and the fourth header A24 and is parallel to the transverse plane AP2, the second header A22 and the fourth header A24 are compartmentalized. The second header A22 and the fourth header A24 comprise a plurality of bottom compartments A61, A62, A63, A64.

 The second header A22 comprises a first bottom compartment A61 and a second
25 bottom compartment A62. The first bottom compartment A61 and the second bottom compartment A62 are sealed relative to one another. For this purpose, the first bottom compartment A61 and the second bottom compartment A62 are separated from one another by a first bottom partition A71. The first bottom compartment A61 and the second bottom compartment A62 are produced in succession one after the other along an axis
30 parallel to the second axis of overall extension AA2. The first bottom compartment A61 is

partially delimited by the second flange A20 and the second bottom compartment A62 is partially delimited by the first flange A19.

The bottom compartments A61, A62 are in fluidic relationship with the passes A31, A32, A33 of the first layer A9. More specifically, the first bottom compartment A61 is in fluidic communication with the bottom ends of the first tubes A10 of the first pass A31 and with the bottom ends of the first tubes A10 of the third pass A33. The second bottom compartment A62 is in fluidic communication with the bottom ends of the first tubes A10 of the second pass A32.

The fourth header A24 comprises a third bottom compartment A63 and a fourth bottom compartment A64. The third bottom compartment A63 and the fourth bottom compartment A64 are sealed relative to one another. For this purpose, the third bottom compartment A63 and the fourth bottom compartment A64 are separated from one another by a second bottom partition A72. The third bottom compartment A63 and the fourth bottom compartment A64 are produced in succession one after the other along an axis parallel to the second axis of overall extension AA2. The third bottom compartment A63 is delimited in part by the second flange A20 and the fourth bottom compartment A64 is delimited in part by the first flange A19.

The bottom compartments A63, A64 of the second layer A11 are in fluidic relationship with the passes A34, A35, A36 of the second layer A11. More specifically, the third bottom compartment A63 is in fluidic communication with the bottom ends of the second tubes A12 of the fourth pass A34 and with the bottom ends of the second tubes A12 of the fifth pass A35. The fourth bottom compartment A64 is in fluidic communication with the bottom ends of the second tubes A12 of the sixth pass A36.

Finally, the second bottom compartment A62 and the fourth bottom compartment A64 are in fluidic communication with one another via at least one bottom passage A73.

More specifically, and with reference to Figures 3 to 6, the refrigerant AFR entering the heat exchanger A5 is admitted via the intake opening A16, into the first chamber A81, then circulates via the canal A83 as far as the second chamber A82. The refrigerant AFR circulates from the second chamber A82 towards the first top compartment A41, via the fourth opening A80d. Next, the refrigerant AFR circulates from the first top compartment

A41 to the first bottom compartment A61, following the first tubes A10 of the first pass A31. The refrigerant AFR then flows inside the first bottom compartment A61 to reach the first tubes A10 of the third pass A33 and join up with the third top compartment A43. The refrigerant AFR then circulates from the third top compartment A43 to the fourth top compartment A44, following the top passage A54. The refrigerant AFR then circulates from the fourth top compartment A44 towards the third bottom compartment A63, following the second tubes A12 of the fifth pass A35. The refrigerant AFR then flows inside the third bottom compartment A63 to reach the second tubes A12 of the fourth pass A34 and join up with the fifth top compartment A45. The refrigerant AFR then circulates inside the fifth top compartment A45 to reach the second tubes A12 of the sixth pass A36 and join up with the fourth bottom compartment A64. The refrigerant AFR then flows from the fourth bottom compartment A64 to the second bottom compartment A62, following the bottom passage A73. The refrigerant AFR then circulates from the second bottom compartment A62 to the second top compartment A42, following the first tubes A10 of the second pass A32. Finally, the refrigerant AFR is discharged from the heat exchanger A5 through the discharge opening A15 which is in fluidic communication with the second top compartment A42.

With reference to Figures 7 and 8, the heat exchanger A5 is a plate-type heat exchanger which comprises a plurality of first plates A91 and of second plates A92 butted together via their respective rims A91a, A92a to form a first tube A10 and a second tube A12 as well as the first header A21, the second header A22, the third header A23 and the fourth header A24. More specifically, a first plate A91 and a second plate A92 are butted together by their respective rims A91a, A92a so that they jointly form a first tube A10 and a second tube A12, a plurality of pairs of first plates A91 and of second plates A92 being stacked on top of one another so that they form the plurality of tubes A10, A12, and therefore the heat exchanger A5. A dissipation member is also interposed between two pairs of plates A91, A92, so as to exchange with the air flow AFA that passes through the heat exchanger A5. Such a member for example adopts the form of an insert.

The canal A83 is housed inside a groove A93 formed between the first header A21 and the third header A23 and which is parallel to the second axis of overall extension AA2. Such a groove A93 adopts the shape of a U-shaped cutout open towards the outside of the heat exchanger A5. Such a cutout is thus made in each of the plates A91, A92 that make up

the tubes A10, A12 that form the second pass A32 and the sixth pass A36.

According to another alternative form of embodiment, the canal A83 is the result of eyelets formed by deformation of the first plates A91 and of the second plates A92 which are juxtaposed with one another in such a way that the eyelets face one another and are in contact with one another so that together they form the canal of the conveying means A80.

In Figure 9, each first plate A91 and/or each second plate A92 that makes up the one same compartment comprises four orifices A94, of which two orifices A94 are produced in a top zone A95 of the first plate A91 and/or of the second plate A92 and two orifices A94 are produced in a bottom zone A96 of the first plate A91 and/or of the second plate A92, on each side of the longitudinal midplane AP4 and which respectively, when the first and second plates A91, A92 are butted together, form the headers A21, A22, A23, A24. Each first plate A91 and/or each second plate A92 that divides two adjacent compartments from one another is free of any orifice in the top zone A95 and/or bottom zone A96. It will be noted at this stage in the description that the first top partition A51, the second top partition A52, the third top partition A53, the first bottom partition A71 and the second bottom partition A72 are advantageously common with the first plates A91 or the second plates A92 that have no orifice.

With reference to Figure 10, the heat exchanger A5 comprises an end plate A97 which is applied against a top zone A95 of the first flange A19 and against an internal face A98 of the first flange A19.

The end plate A97 comprises a first dishing A99 which forms the first wall A81a to delimit the first chamber A81. The first dishing A99 advantageously forms a shutter closing the orifice A94 of the adjacent plate A91, A92 so as to prevent the refrigerant AFR from flowing from the first chamber A81 towards the fifth compartment A45. The first flange A19 comprises an internal rim A100 against which a bottom edge A101 of the end plate A97 comes to bear.

In other words, the first chamber A81 is bordered by the first flange A19 and the end plate A97, the first dishing A99 of which delimits and defines an internal volume of the first chamber A81. The first dishing A99 is provided with the first mouth A80b of the canal A83.

With reference to Figure 11, the heat exchanger A5 comprises a dividing plate A102 which is intended to form the first partition A51. To this end, the dividing plate A102 comprises a second dishing A103 which delimits and defines an internal volume of the second chamber A82.

5 The dividing plate A102 comprises an orifice A94 which contributes towards delimiting the fifth compartment A45. The dishing A99 advantageously forms a shutter closing the orifice A94 of the adjacent plate A91, A92 so as to prevent the refrigerant AFR from flowing from the first compartment A41 and the second compartment A42.

10 It will also be noted that the top passage A54 and the bottom passage A73 are advantageously formed of a plurality of spaces each produced between a first plate A91 and a second plate A92.

Figure 12 depicts a first alternative form of embodiment of a closed circuit B1 in which a refrigerant BFR circulates. In the exemplary embodiment illustrated, the refrigerant circuit B1 comprises, in succession, in a direction BS1 in which the refrigerant
15 BFR circulates within the refrigerant circuit B1, a compressor B2 for compressing the refrigerant BFR, a gas condenser or cooler B3 for cooling the refrigerant BFR, an expansion member B4 in which the refrigerant BFR experiences an expansion and an air/fluid heat exchanger B5. The air/fluid heat exchanger B5 is housed within a housing B6 of a heating, ventilation and/or air conditioning installation B7 within which an airflow
20 circulates. The air/fluid heat exchanger B5 allows heat transfer between the refrigerant BFR and the air flow BFA coming into contact with it and/or passing through it, as illustrated in Figure 13. According to the mode of operation of the refrigerant circuit B1 described hereinabove, the air/fluid heat exchanger B5 is used as an evaporator to cool the air flow BFA, as the airflow BFA comes into contact with and/or passes across the air/fluid
25 heat exchanger B5.

In Figure 13 the air/fluid heat exchanger B5 is depicted inside an orthonormal frame of reference Oxyz. The air/fluid heat exchanger B5 comprises an inlet face B30 for the air flow BFA which extends along a longitudinal plane BP1 parallel to the plane Oxy. The inlet face B30 is that face of the air/fluid heat exchanger B5 through which the air flow
30 BFA first enters the inside of the heat air/fluid heat exchanger B5. The inlet face B30 is notably the face with largest dimensions of the air/fluid heat exchanger B5. The air flow

BFA flows through the air/fluid heat exchanger B5 substantially orthogonally to the longitudinal plane BP1.

The air/fluid heat exchanger B5 comprises a first top tank B8 which is provided with an intake opening B9 through which the refrigerant BFR is admitted into the air/fluid heat exchanger B5. The first top tank B8 is also provided with a discharge opening B11 through which the refrigerant BFR is discharged from the air/fluid heat exchanger B5. More specifically, the discharge opening B11 houses the intake opening B9, as described in great detail later on. The first top tank B8 extends parallel to a first axis of overall extension BA1 of the air/fluid heat exchanger B5 which axis is parallel to the longitudinal plane BP1 of the air/fluid heat exchanger B5.

The air/fluid heat exchanger B5 comprises a second top tank B10 which is contiguous with the first top tank B8. The second top tank B10 extends parallel to the first axis of overall extension BA1.

The air/fluid heat exchanger B5 comprises a first bottom tank B12 and a second bottom tank B13 which extend parallel to the first axis of overall extension BA1. The first bottom tank B12 and the second bottom tank B13 are contiguous with one another and opposite the top tanks B8, B10 in relation to a core bundle of tubes B14, B16.

First tubes B14 extend between the first top tank B8 and the first bottom tank B12, parallel to a second axis of overall extension BA2 which is orthogonal to the first axis of overall extension BA1. The first tubes B14 together form a first layer B15 for the circulation of the refrigerant BFR between the first top tank B8 and the first bottom tank B12.

Second tubes B16 extend between the second top tank B10 and the second bottom tank B13, parallel to the second axis of overall extension BA2. The second tubes B14 together form a second layer B17 for the circulation of the refrigerant BFR between the second circulation tank B12 and the second top tank B10.

The first tubes B14 and the second tubes B16 are associated in pairs being aligned inside a plane parallel to a lateral plane BP3 which is parallel to the plane Oyz. The invention covers an instance in which the number of tubes per pass is identical from one pass to the other, or from one layer to the other. Alternatively, the invention also covers the

instance in which the number of tubes per pass is different from one pass to the other, or from one layer to the other.

Throughout the description, any element of the air/fluid heat exchanger B5 which is situated above a plane parallel to the transverse plane BP2 and which is interposed between the top tanks B8, B10 on the one hand and the tubes B14, B16 on the other hand, is qualified as “top”, and any element of the air/fluid heat exchanger B5 which is situated below the plane parallel to the transverse plane BP2 and which is interposed between the top tanks B8, B10 on the one hand, and the tubes B14, B16 on the other hand, is qualified as “bottom”.

The intake opening B9 can be inscribed within a thickness of the first layer B15. Such a thickness is measured in a direction perpendicular to a plane defining an inlet face via which the airflow enters the air/fluid heat exchanger. It will therefore be appreciated that the intake opening B9 extends in a direction that passes between two planes which delimit the first layer B15. The intake opening may occupy the entire thickness of the first layer, but it may occupy just part of this thickness, as is the case in the embodiments set out here.

The discharge opening B11 can be inscribed within a thickness of the first layer B15. As explained hereinabove, such a thickness is measured in a direction perpendicular to a plane defining an inlet face via which the airflow enters the air/fluid heat exchanger. It will therefore be appreciated that the discharge opening B11 extends in a direction that passes between two planes which delimit the first layer B15. The discharge opening may occupy the entire thickness of the first layer, but it may occupy just part of this thickness.

The first top tank B8 and the second top tank B10 extend parallel to the first axis of overall extension BA1 between a first longitudinal edge B18a, which is provided with the intake opening B9 and with the discharge opening B11, and a second longitudinal edge B18b. The heat exchanger B5 extends longitudinally between a first flange B19a through which the intake opening B9 and the discharge opening B11 pass, and a second flange B19b.

In Figure 14, which illustrates a cross section through the top of the air/fluid heat exchanger B5 on a plane which is parallel to the transverse plane BP2 and which passes

through the first top tank B8 and the second top tank B10, the first top tank B8 and the second top tank B10 are compartmentalized. The first top tank B8 and the second top tank B10 comprise a plurality of top compartments referenced B41, B42, B43, B44, B45.

5 The first top tank B8 comprises at least a first top compartment B41 which is interposed between a second top compartment B42 and a third top compartment B43, along the first axis of overall extension BA1 of the air/fluid heat exchanger B5.

According to the alternative form illustrated in Figure 14, the first top compartment B41 is a single compartment which means that the first top tank B8 comprises three first compartments B41, B42, B43, and that the first top compartment B41 is a central first
10 compartment of the air/fluid heat exchanger B5. In this case, the first top compartment B41 comprises a centre of mass which is situated at equal distances from the first flange B19a and the second flange B19b. The second top compartment B42, the first top compartment B41 and the third top compartment B43 are sealed with respect to one another. For this purpose, the second top compartment B42 and the first top compartment B41 are separated
15 from one another by at least a first top partition B51. For this purpose also, the first top compartment B41 and the third top compartment B43 are separated from one another by at least one second top partition B52. The second top compartment B42, the first top compartment B41 and the third top compartment B43 are formed in succession one after the other along an axis parallel to the first axis of overall extension BA1. The second top
20 compartment B42 is delimited in part by the first flange B19a and the third top compartment B43 is delimited in part by the second flange B19b.

The second top tank B10 comprises a fourth compartment B44 and a fifth compartment B45. The fourth compartment B44 and the fifth compartment B45 are sealed relative to one another. For this purpose, the fourth compartment B44 and the fifth
25 compartment B45 are separated from one another by a third top partition B53. The fourth compartment B44 and the fifth compartment B45 are formed in succession one after the other along an axis parallel to the first axis of overall extension BA1. The fifth compartment B45 is delimited in part by the first flange B19a and the fourth compartment B44 is delimited in part by the second flange B19b.

30 The third top compartment B43 and the fourth compartment B44 are in fluidic communication with one another via at least one top passage B54.

According to the present invention, the second top compartment B42 houses an intake tube B21 which extends between the intake opening B9 and the first top compartment B41. The intake tube B21 is provided with a first longitudinal end B21a which delimits the intake opening B9, and with a second longitudinal end B21b which equips the first top partition B51. These arrangements are such that the first longitudinal end B21a of the intake tube B21 borders the intake opening B9 of the air/fluid heat exchanger B5.

For preference, the intake tube B21 is cylindrical and is formed parallel to the first axis of overall extension BA1.

The result of these arrangements is that the refrigerant BFR admitted into the air/fluid heat exchanger B5 is admitted directly into the first top compartment B41 without beforehand circulating through the second top compartment B42, and accessing the first top compartment B41 directly. The result of that is that the refrigerant BFR admitted into the air/fluid heat exchanger B5 is admitted directly into a central zone of the air/fluid heat exchanger B5, notably situated equal distances away from the first flange B19a and the second flange B19b. These arrangements are such that the refrigerant BFR entering the air/fluid heat exchanger B5 is conveyed by the intake tube B21 from the intake opening B9 towards the first top compartment B41 which makes up the first layer B15 and which is interposed between the second top compartment B42 and the third top compartment B43, the first top compartment B41 occupying within the longitudinal plane BP1 a central position of the air/fluid heat exchanger B5 with respect to the second top compartment B42 and to the third top compartment B43.

In Figure 15, which illustrates a cross section through the middle of the air/fluid heat exchanger B5 on a plane which is parallel to the transverse plane BP2 and equal distances from the first top tank B8 and the second top tank B10 on the one hand, and from the first bottom tank B12 and the second bottom tank B13 on the other hand, the air/fluid heat exchanger B5 is a multi-pass heat exchanger of which the first layer B15 and the second layer B17 comprise a plurality of passes B31, B32, B33, B34, B35, B36. The passes B31, B32, B33 of the first layer B15 are each formed of a plurality of first tubes B14 in which the refrigerant BFR circulates in the one same direction. Two adjacent passes B31, B32, B33 of the first layer B15 comprise first tubes B14 in which the refrigerant BFR circulates

in opposite directions. Likewise, the passes B34, B35, B36 of the second layer B17 are each formed of a plurality of second tubes B16 in which the refrigerant BFR circulates in the one same direction. Two passes B34, B35, B36 of the second layer B17 comprise second tubes B16 in which the refrigerant BFR circulates in opposite directions.

5 For preference, each pass B31, B32, B33 of the first layer B15 is positioned facing a respective pass B34, B35, B36 of the second layer B17 with respect to the longitudinal plane BP1. For preference, the refrigerant BFR circulating in the first tubes B14 of any one of the passes B31, B32, B33 of the first layer B15 circulates in an opposite direction to that of the refrigerant BFR circulating in the second tubes B16 of the adjacent pass B34, B35, 10 B36 of the second layer B17 situated in the one same plane parallel to the lateral plane BP3.

The first layer B15 comprises at least one first pass B31 which is interposed between a second pass B32 and a third pass B33. According to the alternative form illustrated in Figure 15, the first pass B31 is a single pass, which means that the first layer B15 15 comprises three passes, referenced B31, B32, B33, and that the first pass B31 is a central first pass of the air/fluid heat exchanger B5. According to another alternative form of embodiment, there are a plurality of first passes B31 so that the first layer B15 comprises more than three passes, and notably four passes.

The second layer B17 comprises at least one fourth pass B34 which is interposed 20 between a fifth pass B35 and a sixth pass B36. The fifth pass B35 is delimited in part by the first flange B19a and the sixth pass B36 is delimited in part by the second flange B19b. According to the alternative form illustrated in Figure 15, the fourth pass B34 is a single pass, which means that the second layer B17 comprises three passes, B34, B35, B36, and that the fourth pass B34 is a central pass of the air/fluid heat exchanger B5. According to 25 another alternative form of embodiment, there are a plurality of fourth passes B34 so that the second layer B17 comprises more than three passes, and notably four passes.

In Figure 16, which illustrates a cross section through the bottom of the air/fluid heat exchanger B5 on a plane which is parallel to the transverse plane BP2 and on a plane which passes through the first bottom tank B12 and the second bottom tank B13, the first 30 bottom tank B12 and the second bottom tank B13 are compartmentalized. The first bottom tank B12 and the second bottom tank B13 comprise a plurality of bottom compartments

referenced B61, B62, B63, B64.

The first bottom tank B12 comprises a first bottom compartment B61 and a second bottom compartment B62. The first bottom compartment B61 and the second bottom compartment B62 are sealed relative to one another. For this purpose, the first bottom compartment B61 and the second bottom compartment B62 are separated from one another by a first bottom partition B71. The first bottom compartment B61 and the second bottom compartment B62 are formed in succession one after the other along an axis parallel to the first axis of overall extension BA1. The second bottom compartment B62 is delimited in part by the first flange B19a and the first bottom compartment B61 is delimited in part by the second flange B19b.

The second bottom tank B13 comprises a third compartment B63 and a fourth compartment B64. The third compartment B63 and the fourth compartment B64 are sealed relative to one another. For this purpose, the third compartment B63 and the fourth compartment B64 are separated from one another by a second bottom partition B72. The third compartment B63 and the fourth compartment B64 are formed in succession one after the other along an axis parallel to the first axis of overall extension BA1. The fourth compartment B64 is delimited in part by the first flange B19a and the third compartment B63 is delimited in part by the second flange B19b.

The second bottom compartment B62 and the fourth compartment B64 are in fluidic communication with one another via at least one bottom passage B73.

With reference to Figures 14 to 17, the top compartments B41, B42, B43 of the first layer B15 are in fluidic relationship with the first passes B31, B32, B33 of the first layer B15. More specifically, the first top compartment B41 is in fluidic communication with the top ends of the first tubes B14 of the first pass B31. The second top compartment B42 is in fluidic communication with the top ends of the first tubes B14 of the second pass B32. The third top compartment B43 is in fluidic communication with the top ends of the first tubes B14 of the third pass B33.

The top compartments B44, B45 of the second layer B17 are in fluidic relationship with the passes B34, B35, B36 of the second layer B17. More specifically, the fifth compartment B45 is in fluidic communication with the top ends of the second tubes B16 of

the fifth pass B35 and with the top ends of the second tubes B16 of the fourth pass B34. The fourth compartment B44 is in fluidic communication with the top ends of the second tubes B16 of the sixth pass B36.

The bottom compartments B61, B62 of the first layer B15 are in fluidic relationship with the passes B31, B32, B33 of the first layer B15. More specifically, the second bottom compartment B62 is in fluidic communication with the bottom ends of the first tubes B14 of the second pass B32. The first bottom compartment B61 is in fluidic communication with the bottom ends of the first tubes B14 of the first pass B31 and with the bottom ends of the first tubes B14 of the third pass B33.

The bottom compartments B63, B64 of the second pass B17 are in fluidic relationship with the second passes B34, B35, B36 of the second pass B17. More specifically, the fourth compartment B64 is in fluidic communication with the bottom ends of the second tubes B16 of the fifth pass B35. The third compartment B63 is in fluidic communication with the bottom ends of the second tubes B16 of the sixth pass B36 and with the bottom ends of the second tubes B16 of the fourth pass B34.

With reference to Figures 14 to 17, the refrigerant BFR entering the heat exchanger B5 is admitted via the first longitudinal end B21a of the intake tube B21, to flow into the intake tube B21 and reach the first upper compartment B41 via the second longitudinal end B21b of the intake tube B21. Next, the refrigerant BFR circulates from the first top compartment B41 to the first bottom compartment B61, following the first tubes B14 of the first pass B31. The refrigerant BFR then flows inside the first bottom compartment B61 to reach the first tubes B14 of the third pass B33 and join up with the third top compartment B43. The refrigerant BFR then circulates from the third top compartment B43 to the fourth top compartment B44, following the top passage B54. The refrigerant BFR then flows from the fourth top compartment B44 towards the third bottom compartment B63, following the second tubes B16 of the sixth pass B36. The refrigerant BFR then flows inside the third bottom compartment B63 to reach the second tubes B16 of the fourth pass B34 and join up with the fifth top compartment B45. The refrigerant BFR then circulates inside the fifth top compartment B45 to reach the second tubes B16 of the fifth pass B35 and join up with the fourth bottom compartment B64. The refrigerant BFR then flows from the fourth bottom compartment B64 to the second bottom compartment

B62, following the bottom passage B73. The refrigerant BFR then circulates from the second bottom compartment B62 to the second top compartment B42, following the first tubes B14 of the second pass B32. Finally, the refrigerant BFR is discharged from the air/fluid heat exchanger B5 through the discharge opening B11 with which the second top compartment B42 is equipped.

Figures 18 to 21 describe retaining means B20 for holding the first longitudinal end B21a of the intake tube B21. More particularly in Figure 18, the retaining means B20 for holding the first longitudinal end B21a of the intake tube B21 are attached to the first flange B19a. More specifically in Figures 19 to 21, the retaining means B20 that hold the first longitudinal end B21a of the intake tube B21 are attached to an end plate B85 which is interposed between the first flange B19a and the second top compartment B42, an internal face of the end plate B85 being the one that delimits the second top compartment B42.

In Figures 18 to 21, the retaining means B20 comprise a sleeve B20a, for example a cylindrical sleeve with an axis of elongation parallel to the first overall axis of extension BA1, which envelops the first longitudinal end B21a of the intake tube B21. The sleeve B20a is borne by at least one arm B20b which connects the sleeve B20a to a rim B20c of an orifice B19', B85'. According to the alternative forms of embodiment illustrated in Figures 18 and 19, there are a plurality of the arms B20b, for example three of them. For preference, the arms B20b are symmetrically distributed about the sleeve B20a, for example at an angle equal to 120°. According to the alternative forms of embodiment illustrated in Figures 20 and 21, the arm B20b is a single arm. According to other alternative forms of embodiment, there are multiple arms B20b, for example four or five of them.

In Figure 18, the rim B20c delimits an orifice B19' formed through the first flange B19a. It will be appreciated here that the retaining means B20 are borne by the first flange B19a. According to one preferred embodiment, the retaining means B20 are derived from the first flange B19a and are formed in the same material thereas.

In Figures 19 to 21, the rim B20c delimits an orifice B85' formed through the end plate B85. It will be appreciated here that the retaining means B20 are borne by the end plate B85. According to one preferred embodiment, the retaining means B20 are derived from the end plate B85 and are formed from the same material thereas. In that case, the

first flange B19a is, for example, equipped with means for supporting the end plate B85, such as a transverse groove against which a lower rim of the end plate B85 comes to bear.

In Figures 19 to 21, the intake tube B21 is housed inside the second top compartment B42. The second top compartment B42 is delimited by a top wall B81, a bottom wall B82 which is opposite the top wall B81 and which adjoins the second pass B32, a middle wall B83 which is interposed between the second top compartment B42 and the fifth top compartment B45, and a lateral wall B84 opposite the middle wall B83. The intake tube B21 is placed a first distance BD1 away from the top wall B81, a second distance BD2 away from the bottom wall B82, a third distance BD3 away from the middle wall B83, and a fourth distance BD4 away from the lateral wall B84. The distances BD1, BD2, BD3 and BD4 are measured between a centre BC of the intake tube B21 and the relevant wall delimiting the second top compartment B42 which lies facing the intake tube B21.

In Figure 19, the first distance BD1 is equal to the second distance BD2 and the third distance BD3 is equal to the fourth distance BD4. In other words, the intake tube B21 is centred inside the second top compartment B42. According to this alternative form of embodiment, the intake tube B21 is, for example, borne by a plurality of arms B20b.

In Figure 20, the first distance BD1 is greater than the second distance BD2 and the third distance BD3 is less than the fourth distance BD4. In other words, the intake tube B21 is off-centred laterally and longitudinally inside the second top compartment B42. According to this alternative form of embodiment, the intake tube B21 is, for example, borne by a single arm B20b that the end plate B84 comprises.

In Figure 21, the first distance BD1 is equal to the second distance BD2 and the third distance BD3 is less than the fourth distance BD4. In other words, the intake tube B21 is off-centred laterally inside the second top compartment B42. According to this alternative form of embodiment, the intake tube B21 is, for example, borne by a single arm B20b that the end plate B854 comprises.

Although this has not been depicted, the invention also covers instances in which the first distance BD1 is greater than the second distance BD2 and in which the third distance BD3 is equal to the fourth distance BD4. In other words, the intake tube B21 is off-centred longitudinally inside the second top compartment B42.

The invention thus covers any arrangement of the intake tube B21 around a straight line passing through the centre of the second top compartment B42 and extending parallel to the first axis of overall extension BA1.

The distances BD1 to BD4 set out hereinabove apply mutatis mutandis to the alternative form in Figure 18 in which the retaining means B20 for the intake tube B21 are derived from the first flange B19a.

In Figure 22 the air/fluid heat exchanger B5 is combined with an internal heat exchanger B22 with which the discharge opening B11 is equipped. In other words, the internal heat exchanger B22 is combined with the air/fluid heat exchanger B5 at the discharge opening B11 of the latter. The air/fluid heat exchanger B5 and the internal heat exchanger B22 are connected to one another by means of assembly, such as means of assembly by welding, by fitting-together or by any other equivalent means of lasting assembly. It will be noted, for example, at this stage in the description that there is a ring B29, also illustrated in Figure 18, fitted to the discharge opening B11 of the air/fluid heat exchanger B5 in order to hold the internal heat exchanger B22 on the air/fluid heat exchanger B5. The ring B29 may just as well be a crimping ring as a welding ring. The result of this is that the air/fluid heat exchanger B5 and the internal heat exchanger B22 are in direct contact with one another. In that case, the air/fluid heat exchanger B5 and the internal heat exchanger B22 together form a heat exchange module B23 which is a one-piece module that can be handled in one piece.

Figure 23 depicts a second alternative form of the closed circuit B1 in which a refrigerant BFR circulates. In the exemplary embodiment illustrated, the refrigerant circuit B1 comprises, in succession, in the direction BS1 in which the refrigerant BFR circulates within the refrigerant circuit B1, the compressor B2 for compressing the refrigerant BFR, the condenser or a gas cooler B3 for cooling the refrigerant BFR, the expansion member B4 in which the refrigerant BFR experiences an expansion. The refrigerant circuit B1 also comprises the internal heat exchanger B22 which comprises a first leg B22a and a second leg B22b which are designed to allow an exchange of heat between the refrigerant BFR coming from the expansion member B4 and the refrigerant BFR coming from the air/fluid heat exchanger B5.

The internal heat exchanger B22 performs superheating of the refrigerant which

leaves the air/fluid heat exchanger B5.

The air/fluid heat exchanger B5 of the heat exchange module B23 is housed within the housing B6 of the heating, ventilation and/or air conditioning installation B7 within which the airflow BFA circulates. The internal heat exchanger B22 of the heat exchange module B23 is housed outside the housing B6. The heat exchange module B23 allows heat transfer between the refrigerant BFR and the air flow BFA coming into contact with it and/or passing through it. According to the mode of operation of the refrigerant circuit B1 described hereinabove, the air/fluid heat exchanger B5 of the heat exchange module B23 is used as an evaporator to cool the airflow BFA, as the airflow BFA comes into contact with and/or passes across through the air/fluid heat exchanger B5.

In Figures 24 and 25, the internal heat exchanger B22 is an exchanger of which the first leg B22a and the second leg B22b are formed parallel to one another. The internal heat exchanger B22 comprises a peripheral wall B22c which delimits the second leg B22b. In other words, the peripheral wall B22c surrounds the second leg B22b. For preference, the peripheral wall B22c is cylindrical and is formed along all axis of symmetry BA3 of the internal heat exchanger B22.

In Figure 24, the internal heat exchanger B22 is a coaxial exchanger of which the first leg B22a and the second leg B22b are formed coaxially about the axis of symmetry BA3. The internal heat exchanger B22 comprises a central channel B22d which delimits the first leg B22a. In other words, the central canal B22d surrounds the first leg B22a. For preference, the central canal B22d is cylindrical. At least one radial wall B22e extends between the central canal B22d and the peripheral wall B22c in order to maintain the central canal B22d. This radial wall B22e also delimits two sub-legs which make up the second leg B22b. In the alternative form illustrated, there are a plurality of the radial walls B22e, namely three of them, which partition the second leg into that same number of sub-legs. Such an internal heat exchanger B22 is particularly well suited to being combined with an air/fluid heat exchanger B5 as partially illustrated in Figures 18 and 19 because of the central canal B22d being centred inside the peripheral wall B22c. An exchange of heat takes place between the refrigerant BFR circulating in the first leg B22a, and the refrigerant circulating in the second leg B22b, countercurrentwise with respect to one another.

In Figure 25, the internal heat exchanger B22 comprises a peripheral canal B22f which delimits the first leg B22a. In other words, the peripheral canal B22f surrounds the first leg B22a. The peripheral canal B22f is formed around a peripheral axis BA4 distinct from the axis of symmetry BA3 of the internal heat exchanger B22. The peripheral axis BA4 and the axis of symmetry BA3 are parallel to each other. According to an alternative form of embodiment, the peripheral canal B22f and the peripheral wall B22c are made from a metallic material by extrusion in particular. Such an internal heat exchanger B22 is particularly well suited to being combined with an air/fluid heat exchanger B5 as partially illustrated in Figures 20 and 21 because of the peripheral canal B22f being off-centred inside the peripheral wall B22c.

The peripheral wall B22c is designed to come into contact with the ring B29 with which the discharge opening B11 is equipped, the dimensions and shapes of the peripheral wall B22c and of the ring B29 being adapted so as to allow perfect fluidic communication between the internal heat exchanger B22 and the air/fluid heat exchanger B5. These arrangements allow perfect circulation of the refrigerant BFR from the first leg B22a delimited by the central canal B22d or indeed the peripheral canal B22f to the intake tube B21 as refrigerant BFR passes from the internal heat exchanger B22 to the air/fluid heat exchanger B5. These arrangements also allow perfect circulation of the refrigerant BFR from the discharge opening B11 to the second leg B22b delimited by the peripheral wall B22c as refrigerant BFR passes from the air/fluid heat exchanger B5 to the internal heat exchanger B22.

With reference once again to Figures 13 and 22, the heat exchanger B5 is a plate-type heat exchanger which comprises a plurality of first plates B24 and of second plates B25 butted together via their respective rims to form the first tubes B14 and the second tubes B16 as well as the first top tank B8, the second top tank B10, the first bottom tank B12 and the second bottom tank B13. More specifically, a first plate B24 and a second plate B25 are butted together by their respective rims so that they jointly form a first tube B14 and a second tube B16, a plurality of pairs of first plates B24 and of second plates B25 being stacked on top of one another so that, with inserts, they together form a core bundle of the heat exchanger B5.

Each first plate B24 and each second plate B25 forming a bottom compartment

comprise a pair of bottom orifices formed in a bottom zone of the first plate B24 and the second plate B25, right across the longitudinal plane BP1 to form, when the first plate B24 and second plate B25 are butted together, the first bottom tank B12 and the second bottom tank B13 .

- 5 Each first plate B24 and each second plate B25 forming a top compartment comprise a pair of top orifices formed in a top zone of the first plate B24 and the second plate B25, right across the longitudinal plane BP1 to form, when the first plate B24 and second plate B25 are butted together, the first top tank B8 and the second top tank B10 respectively.

10 Each first plate B24 and/or each second plate B25 that divides two adjacent compartments from one another is free of any orifice.

It will be noted at this stage in the description that the first top partition B51, the second top partition B52, the third top partition B53, the first bottom partition B71 and the second bottom partition B72 are advantageously derived from the first plates B24 and/or the second plates B25, being, for example, formed of a plate having no orifices.

- 15 It will also be noted that the top passage B54 and the bottom passage B73 are advantageously formed of a plurality of spaces each left between a first plate B23 and a second plate B24.

Figure 26 depicts a closed circuit C1 in which a refrigerant CFR circulates. In the exemplary embodiment illustrated, the refrigerant circuit C1 comprises, in succession, in a direction CS1 in which the refrigerant CFR circulates within the refrigerant circuit C1, a compressor C2 for compressing the refrigerant CFR, a gas condenser or cooler C3 for cooling the refrigerant CFR, an expansion member C4 in which the refrigerant CFR experiences an expansion and a heat exchanger C5 according to the invention. The heat exchanger C5 is housed within a housing C6 of a heating, ventilation and/or air conditioning installation C7 within which an air flow circulates. The heat exchanger C5 allows heat transfer between the refrigerant CFR and the air flow CFA coming into contact with it and/or passing through it, as illustrated in Figure 27. According to the mode of operation of the refrigerant circuit C1 described hereinabove, the heat exchanger C5 is used as an evaporator to cool the air flow CFA, as the air flow CFA comes into contact with and/or passes through the heat exchanger C5.

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In Figure 27, the heat exchanger C5 is depicted inside an orthonormal frame of reference Oxyz. The heat exchanger C5 comprises an inlet face C8 for the air flow CFA and an outlet face C25 for this air flow CFA which faces extend along a longitudinal plane CP1 parallel to the plane Oxy. The inlet face C8 is that face of the heat exchanger C5 through which the air flow CFA first enters the inside of the heat exchanger C5, whereas the outlet face C25 is that face of the heat exchanger C5 via which the air flow CFA leaves the heat exchanger after having been heat treated. The inlet face C8 and the outlet face C25 are notably the faces with largest dimensions of the heat exchanger C5. The air flow CFA flows through the heat exchanger C5 substantially orthogonally to the longitudinal plane CP1.

The heat exchanger C5 comprises two layers C9, C11 of tubes C10, C12, these being a first layer C9 of first tubes C10 and a second layer C11 of second tubes C12. The first layer C9 is delimited by the inlet face C8 such that the first layer C9 is the first layer that the air flow CFA passes through as it circulates through the heat exchanger C5. In other words, the air flow CFA passes in succession through the inlet face C8, then the first layer C9 and then the second layer C11 and leaves the heat exchanger via the outlet face C25 thereof. The first layer C9 and the second layer C11 are parallel to one another and parallel to the longitudinal plane CP1. The first tubes C10 and the second tubes C12 are parallel to one another and extend along a first axis of overall extension CA1 which is parallel to the longitudinal plane CP1 and parallel to the direction Oy of the orthonormal frame of reference Oxyz. Each of the first tubes C10 and of the second tubes C12 are associated in pairs being aligned inside the one same lateral plane CP3 which is parallel to the plane Oyz.

The first tubes C10 are interposed between a first header C21 for the refrigerant CFR and a second header C22 for the refrigerant CFR. The first header C21 and the second header C22 extend parallel to a second axis of overall extension CA2 which is orthogonal, or substantially orthogonal, to the first axis of overall extension CA1. The first header C21 and the second header C22 are contained inside a plane parallel to the longitudinal plane CP1 of the heat exchanger C5. The first header C21 is provided with a discharge opening C15 through which the refrigerant CFR is discharged from the heat exchanger C5. It will be appreciated here that this discharge opening C15 is contained, partially or in its entirety, in the first layer C9 of the heat exchanger C5.

The second tubes C12 are interposed between a third header C23 for the refrigerant CFR and a fourth header C24 for the refrigerant CFR. The third header C23 and the fourth header C24 extend parallel to the second axis of overall extension CA2. The third header C23 and the fourth header C24 are contained within a plane which is parallel to the longitudinal plane CP1 of the heat exchanger C5. The third header C23 is provided with an intake opening C16 through which the refrigerant CFR is admitted into the heat exchanger C5. This intake opening C16 is contained, partially or in its entirety, in the second layer C11 of the heat exchanger C5.

The first header C21 and the third header C23 are contiguous with one another in a plane parallel to the transverse plane CP2 of the heat exchanger C5, the latter plane being itself parallel to the plane Oxz. The second header C22 and the fourth header C24 are contiguous with one another in a plane parallel to the transverse plane CP2 of the heat exchanger C5

The intake opening C16 and the discharge opening C15 are arranged inside a plane parallel to the transverse plane CP2 and are formed through a first longitudinal end C17 of the heat exchanger C5. In other words, the intake opening C16 and the discharge opening C15 are produced side-by-side next to one another. It will be appreciated here that the first header C21 and the third header C23 extend in the transverse plane CP2 between the first longitudinal end C17 and a second longitudinal end C18 of the heat exchanger C5. Furthermore, the layers C9, C11 of the heat exchanger C5 extend longitudinally along the second longitudinal axis CA2 between a first flange C19 and a second flange C20 which respectively border the heat exchanger C5 over its entire height parallel to the transverse plane CP2 and which form the longitudinal ends C17, C18.

In Figure 28, which illustrates a cross section through the top of the heat exchanger C5 on a plane which passes through the first header C21 and the third header C23 and is parallel to the transverse plane CP2, the first header C21 and the third header C23 are compartmentalized. The first header C21 and the third header C23 comprise a plurality of top compartments referenced C41, C42, C43, C44 and C45.

Throughout the description, any element of the heat exchanger C5 which is situated above a plane parallel to the transverse plane CP2 and which is equal distances from the first header C21 and from the second header C22, is qualified as “top”, and any element of

the heat exchanger C5 which is situated below this same plane parallel to the transverse plane CP2, is qualified as “bottom”.

The first collector C21 comprises at least one first top compartment C41 which is interposed between a second top compartment C42 and a third top compartment C43. According to the alternative form illustrated in Figure 28, the first top compartment C41 is a single compartment which means that the first header C21 comprises three compartments C41, C42, C43, and that the first top compartment C41 is a central compartment of the heat exchanger C5. In other words, a first distance between the centre of mass of the first compartment C41 and the first longitudinal end C17 is equal to a second distance between the centre of mass of the first compartment C41 and the second longitudinal end C18.

The first top compartment C41, the second top compartment C42 and the third top compartment C43 are sealed with respect to one another. For this purpose, the first top compartment C41 and the second top compartment C42 are separated from one another by at least a first top partition C51. For this purpose also, the first top compartment C41 and the third top compartment C43 are separated from one another by at least one second top partition C52. The second top compartment C42, the first top compartment C41 and the third top compartment C43 are formed in succession one after the other along an axis parallel to the second axis of overall extension CA2.

The third header C23 comprises a fourth top compartment C44 and a fifth top compartment C45. The fourth top compartment C44 and the fifth top compartment C45 are sealed relative to one another. For this purpose, the fourth top compartment C44 and the fifth top compartment C45 are separated from one another by a third top partition C53. The fourth top compartment C44 and the fifth top compartment C45 are formed in succession one after the other along an axis parallel to second axis of overall extension CA2.

According to the present invention, the heat exchanger C5 is equipped with a means C80 of conveying the refrigerant CFR from the intake opening C16 towards the first top compartment C41 so that the refrigerant CFR entering the heat exchanger C5 circulates from the intake opening C16 towards the first layer C9, and more particularly towards the first top compartment C41, which is a central compartment of the heat exchanger C5. In other words, the conveying means C80 places the intake opening C16 in fluidic

communication with the first top compartment C41, the latter being interposed between two other compartments of the first header C21.

These measures are such that the refrigerant CFR admitted into the heat exchanger C5 is directed towards the first layer C9, namely that it is first to receive the air flow CFA even though the intake opening C16 is fitted to the second layer C11. More specifically, the conveying means C80 allows the supply of refrigerant CFR to the heat exchanger C5 to be first of all to the central compartment of the first header C21 of the first layer C9.

The conveying means C80 comprises a chamber C81 which is in fluidic communication with the intake opening C16 via a first aperture C80a. The chamber C81 may encroach upon the second top compartment C42 and/or on the fifth top compartment C45. Alternatively, the chamber C81 may be formed at the end of the first header C21, for example outside of the second top compartment C42 and/or on the fifth top compartment C45. The largest dimension of the chamber C81 is formed within a plane which is parallel to the lateral plane CP3. In other words, the chamber C81 allows the refrigerant CFR entering the heat exchanger C5 via the intake opening C16 to circulate immediately from the second layer C11 to the first layer C9. According to one exemplary embodiment, the chamber C81 adopts the shape of a cavity and of a groove which may notably extend along a straight line parallel to the axis Oz of the orthonormal frame of reference.

The conveying means C80 also comprises a canal C83 which extends inside the second compartment C42 and which fluidically connects the chamber C81 to the first top compartment C41. In other words, the canal C83 allows the refrigerant CFR to pass longitudinally through the second top compartment C42 from the chamber C81 toward the first top compartment C41. The canal C83 extends between the first chamber C81 and the first top partition C51, crossing the latter.

The conveying means C80 may therefore also be considered to comprise the canal C83 which is housed inside the second top compartment C42, and the chamber C81 which extends in part at the level of the second top compartment C42 and of the fifth top compartment C45.

The first chamber C81 is in fluidic communication with the canal C83 via a first mouth C80b of the canal C83. The canal C83 is also in fluidic communication with the

first top compartment C41 via a second mouth C80c which places an internal volume of the canal C83 in fluidic communication with an internal volume of the first top compartment C41. The first mouth C80b of the canal C83 is created at a first end C83a of the canal C83, whereas the second mouth C80c of the canal C83 is produced at a second longitudinal end C83b of the canal C83.

It will be noted that the first plate C101 and/or the second plate C102 delimiting the first top compartment C41 and the second top compartment C42 comprises a hole made in the first top partition C51 that makes up one or other of these plates. Such a hole forms a bearing to accept the second end C83b of the canal C83 so that the second mouth C80c opens into the first top compartment C41.

The conveying means C80 is for example arranged as an L-shaped bracket. To this end, the first chamber C81 forms the base of the L and the canal C83 the branch of the L which is elongated along the second axis of overall extension CA2.

As visible in Figure 29, the canal C83 is formed for example inside a longitudinal median plane CP4 of the first layer C9 which transversely divides the first layer C9 into two equal parts. The first mouth C80b and the second mouth C80c are for example formed perpendicularly to the second axis of overall extension CA2. The first mouth C80b and the second mouth C80c are formed here inside the longitudinal midplane CP4, but the invention also covers instances in which these mouths C80b, C80c and also the canal C83 are offset in the second top compartment C42, being for example closer to the inlet face C8 or closer to the outlet face C25 of the heat exchanger C5.

According to one embodiment, the first chamber C81 is formed in an intermediate component. This first chamber C81 is delimited by a first wall C81a of the intermediate component and by a closure plate C27 which extends substantially parallel to the lateral plane CP3. The intermediate component is provided with the first opening C80a which is in fluidic communication with the intake opening C16. According to this embodiment, the first wall C81a extends in a plane which is comprised inside the second top compartment C42 and the fifth top compartment C45.

In Figure 29, which illustrates a cross section through the middle of the heat exchanger C5 on a plane which is parallel to the transverse plane CP2 and equal distances

from the first header C21 and the second header C22 on the one hand, and from the third header C23 and the fourth header C24 on the other hand, the heat exchanger C5 is a multi-pass heat exchanger in which the first layer C9 comprises a plurality of passes C31, C32, C33, and in which the second layer C11 likewise comprises a plurality of passes C34, C35, C36. The passes C31, C32, C33 of the first layer C9 are each formed of a plurality of first tubes C10 in which the refrigerant CFR circulates in the one same directional sense. Two adjacent passes C31, C32, C33 of the first layer C9 comprise these first tubes C10 in which the refrigerant CFR circulates in opposite directions from one pass to the other. Likewise, the passes C34, C35, C36 of the second layer C11 are each formed of a plurality of second tubes C12 in which the refrigerant CFR circulates in the one same direction. Two adjacent passes C34, C35, C36 of the second layer C11 comprise these second tubes C12 in which the refrigerant CFR circulates in opposite directions from one pass to the other.

According to one exemplary embodiment, each pass C31, C32, C33 of the first layer C9 is positioned facing a respective second pass C34, C35, C36 of the second layer C11. The refrigerant CFR circulating in the first tubes C10 of any one of the passes C31, C32, C33 of the first layer C11 circulates in an opposite direction to that of the refrigerant CFR circulating in second tubes C12 of the pass C34, C35, C36 of the adjacent second layer C11 situated in the one same plane parallel to the lateral plane CP3.

The first layer C9 comprises at least one first pass C31 which is interposed between a second pass C32 and a third pass C33. The second pass C32 can be delimited at least in part by the first flange C19 and the sixth pass C33 is delimited at least in part by the second flange C20. According to the alternative form illustrated in Figure 29, the first pass C31 is a single pass, which means that the first layer C9 comprises three first passes, C31, C32, C33, and that the first pass C31 is a central first pass of the heat exchanger C5. According to another alternative form of embodiment, there are a plurality of first passes C31 so that the first layer C9 comprises more than three passes, and notably four passes.

Likewise, the second layer C11 comprises at least one fourth pass C34 which is interposed between a fifth pass C35 and a sixth pass C36. The fifth pass C35 may be delimited at least in part by the first flange C19 and the sixth pass C36 may be delimited at least in part by the second flange C20. According to the alternative form illustrated in Figure 29, the fourth pass C34 is a single pass, which means that the second layer C11

comprises three passes, C34, C35, C36, and that the fourth pass C34 is a central pass of the heat exchanger C5. According to another alternative form of embodiment, there are a plurality of fourth passes C34 so that the second layer C11 comprises more than three passes, and notably four passes.

5 Viewed in planes parallel to the lateral plane CP3, the first pass C31 faces the fourth pass C34, whereas the third pass C33 faces the fifth pass C35. Finally, the second pass C32 faces the sixth pass C36.

10 The top compartments C41, C42, C43 of the first layer C9 are in fluidic relationship with the passes C31, C32, C33 of the first layer C9. More specifically, the first top compartment C41 is in fluidic communication with the top ends of the first tubes C10 of the first pass C31. The second top compartment C42 is in fluidic communication with the top ends of the first tubes C10 of the second pass C32. The third top compartment C43 is in fluidic communication with the top ends of the first tubes C10 of the third pass C33.

15 The top compartments C44, C45 of the first layer C11 are in fluidic relationship with the passes C34, C35, C36 of the second layer C11. More specifically, the fourth top compartment C44 is in fluidic communication with the top ends of the second tubes C12 of the fifth pass C35. The fifth top compartment C45 is in fluidic communication with the top ends of the second tubes C12 of the fourth pass C34 and with the top ends of the first tubes C12 of the sixth pass C36.

20 Finally, the third top compartment C43 and the fourth top compartment C44 are in fluidic communication with one another via at least one top passage C54.

25 In Figure 30, which illustrates a cross section through the bottom of the heat exchanger C5 on a plane which passes through the second header C22 and the fourth header C24 and is parallel to the transverse plane CP2, the second header C22 and the fourth header C24 are compartmentalized. The second header C22 and the fourth header C24 comprise a plurality of bottom compartments C61, C62, C63.

30 The second header C22 comprises a first bottom compartment C61 and a second bottom compartment C62. The first bottom compartment C61 and the second bottom compartment C62 are sealed with respect to one another. For this purpose, the first bottom compartment C61 and the second bottom compartment C62 are separated from one another

by a first bottom partition C71. The first bottom compartment C61 and the second bottom compartment C62 are formed in succession one after the other along an axis parallel to the second axis of overall extension CA2.

The bottom compartments C61, C62 are in fluidic relationship with the passes C31, C32, C33 of the first layer C9. More specifically, the first bottom compartment C61 is in fluidic communication with the bottom ends of the first tubes C10 of the first pass C31 and with the bottom ends of the first tubes C10 of the third pass C33. The second bottom compartment C62 is in fluidic communication with the bottom ends of the first tubes C10 of the second pass C32.

The fourth header C24 comprises a third bottom compartment C63 and a fourth bottom compartment C64. The third bottom compartment C63 and the fourth bottom compartment C64 are sealed with respect to one another. For this purpose, the third bottom compartment C63 and the fourth bottom compartment C64 are separated from one another by a second bottom partition C72, the latter being able to be formed in the one same plane, and advantageously by the same plate, as the first bottom partition C71. The third bottom compartment C63 and the fourth bottom compartment C64 are formed in succession one after the other along an axis parallel to the second axis of overall extension CA2.

The bottom compartments C63, C64 of the fourth header C24 are in fluidic relationship with the passes C34, C35, C36 of the second layer C11. More specifically, the third bottom compartment C63 is in fluidic communication with the top ends of the second tubes C12 of the fourth pass C34 and with the bottom ends of the second tubes C12 of the fifth pass C35. The fourth bottom compartment C64 is in fluidic communication with the bottom ends of the second tubes C12 of the sixth pass C36.

Finally, the second bottom compartment C62 and the fourth bottom compartment C64 are in fluidic communication with one another via at least one bottom passage C73.

The circulation of refrigerant within the heat exchanger C5 will now be detailed with reference to Figures 28 to 31. The refrigerant CFR entering the heat exchanger C5 is admitted therein via the intake opening C16, then circulates from the second layer C11 to the first layer C9 via the chamber C81, then circulates via the canal C83 as far as the first top compartment C41. The intake opening C16 is thus in fluidic communication

directly via the fluid conveying means C80. Next, the refrigerant CFR circulates from the first top compartment C41 to the first bottom compartment C61, following the first tubes C10 of the first pass C31. The refrigerant CFR then flows inside the first bottom compartment C61 to reach the first tubes C10 of the third pass C33 and join up with the third top compartment C43. The refrigerant CFR then circulates from the third top compartment C43 to the fourth top compartment C44, following the top passage C54. The refrigerant CFR then flows from the fourth top compartment C44 towards the third bottom compartment C63, following the second tubes C12 of the fifth pass C35. The refrigerant CFR then flows inside the third bottom compartment C63 to reach the second tubes C12 of the fourth pass C34 and join up with the fifth top compartment C45. The refrigerant CFR then circulates inside the fifth top compartment C45 to reach the second tubes C12 of the sixth pass C36 and arrive at the fourth bottom compartment C64. The refrigerant CFR then flows from the fourth bottom compartment C64 to the second bottom compartment C62, following the bottom passage C73. The refrigerant CFR then circulates from the second bottom compartment C62 to the second top compartment C42, following the first tubes C10 of the second pass C32. Finally, the refrigerant CFR is discharged from the heat exchanger C5 through the discharge opening C15 which is in direct fluidic communication with the second top compartment C42.

With reference to Figures 32 and 33, the heat exchanger C5 is a plate-type heat exchanger which comprises a plurality of first plates C101 and of second plates C102 butted together via their respective rims C101a, C102a to form a first tube C10 and a second tube C12 as well as one cell of the first header C21, one cell of the second header C22, one cell of the third header C23 and one cell of the fourth header C24. More specifically, a first plate C101 and a second plate C102 are butted together by their respective rims C101a, C102a so that they jointly form a first tube C10 and a second tube C12, a plurality of pairs of first plates C101 and of second plates C102 being stacked on top of one another so that they together form the plurality of tubes C10, C12, and therefore the heat exchanger C5. The stack of cells also forms the headers listed hereinabove. A dissipation member C26 is also interposed between two pairs of plates C101, C102, so as to encourage exchange of heat between this air flow CFA and the walls of the plates C101, C102. Such a member for example adopts the form of an insert.

Figure 33 also shows an example of the lateral positioning of the canal C83 inside

the second top compartment C42. In this particular instance, the canal C83 is not centred on a central longitudinal axis of the first header C21. It is thus laterally offset with respect to this central longitudinal axis of the first header C21. According to the example visible in Figure 33, the canal C83 is closer to a midplane passing through the first header C21 and the second header C22 and between the third header C23 and the fourth header C24, than to the inlet face C8 via which the air flow CFA enters the heat exchanger C5. Stated differently, such a midplane passes between the first layer C9 and the second layer C11.

The invention also covers instances in which the canal is offset so that it is closer to the inlet face than to the abovementioned midplane.

Such an offset in the direction Oy of the orthonormal frame of reference of Figure 27 is also conceivable. The canal may thus be closer to a top of the first header than first tubes. Alternatively, the canal may be closer to the first tubes C10 than to this top of the first header.

Finally, the invention covers instances in which the canal C83 is centred in the second compartment with respect to the axis Oy and the axis Oz of the orthonormal frame of reference. In such instances, a central axis of extension of the canal is coincident with a central axis of extension of the second compartment.

In Figure 34, each first plate C101 and/or each second plate C102 that makes up the one same compartment comprises four holes C104, of which two holes C104 are formed in a top zone C105 of the first plate C101 and/or of the second plate C102 and two holes C104 are formed in a bottom zone C106 of the first plate C101 and/or of the second plate C102, on each side of the abovementioned midplane. The butting-together of a first plate C101 with a second plate C102 forms, in the region of its top zone C105, and in the region of its bottom zone C106, cells which, when the first plates C101 and second plates C102 are stacked together, form the first, second, third and fourth headers referenced C21, C22, C23 and C24 respectively. Each first plate C101 and/or each second plate C102 that divides two adjacent compartments from one another, is free of any hole in the top zone C105 and/or bottom zone C106. It will be noted at this stage in the description that the first top partition C51, the second top partition C52, the third top partition C53, the first bottom partition C71 and the second bottom partition C72 are advantageously derived from the first plate C101 or the second plate C102 that has no hole.

With reference to Figure 35, the heat exchanger C5 comprises an intermediate component C90 which is interposed between a core bundle of tubes C10, C12 and of dissipation members C26 of the heat exchanger C5 and the intake C16 and discharge C15 openings. According to this example, the intermediate component C90 is arranged between these intake C16 and discharge C15 openings and the first flange C19 which longitudinally terminates the core bundle of the heat exchanger C5. According to this exemplary embodiment, the closure plate C27 covers the intermediate component C90 in such a way as to seal the chamber C81, notably its cavity and its groove that make up this chamber C81. It will be noted that this closure plate C27 may bear sleeves C28, C29 which respectively delimit the intake opening C16 and the discharge opening C15.

The intermediate component C90 is intended to house the chamber C81 within its thickness and to bear a first end C83a of the canal C83. The intermediate component C90 is arranged in the continuation along the axis Ox of the first header C21 and of the second header C22. The thickness of this intermediate plate C90 is measured along a straight line parallel to the axis Ox of the orthonormal frame of reference depicted in Figure 27

In Figures 36 and 37, the intermediate component C90 comprises two parallel faces, these being a first face C91 intended to face the first flange C19 and a second face C92 which is intended to face the closure plate C27. The intermediate component comprises a groove C93 which opens through the second face C92 and which does not open through the first face C91. The groove C93 delimits the chamber C81 of the conveying means C80, particularly the groove thereof, the first wall C81a being made up of the first face C91 closing off the groove C93 on the first face C91. The intermediate component C90 further comprises the first opening C80a which opens onto the cavity C82, the latter being of a cross section substantially equivalent to the cross section of the intake opening C16. The cavity C82 is fluidically connected to the groove C93 and thus forms the chamber C81. The first opening C80a is designed to be placed facing the intake opening C16, so that the refrigerant enters the chamber C81, the first wall C81a preventing refrigerant from circulating towards the fifth top compartment C45. The first wall C81a forms an end wall of the intermediate component C90.

The intermediate component C90 comprises a first orifice C94 which passes through from the first face C91 as far as the second face C92, the first orifice C94 being formed at

the edge of the groove C93. The first orifice C94 is designed to be in fluidic communication with the first mouth C80b of the canal C83. Thus, the refrigerant present inside the chamber C81 uses the first orifice C94 to reach the first mouth C80b and then circulate inside the canal C83.

- 5 The first orifice C94 is partially delimited by a flange C95 inside which the first end C83a of the canal C83 is fitted, with a view to securing same. For this purpose, the first end C83a of the canal C83 comprises a restriction in diameter so that it can fit into the flange C95 inside the first orifice C94.

- 10 The flange C95 forms a dividing wall separating the groove C93 from a second orifice C96 which passes right through the intermediate component C90, namely passes from the first face C91 as far as the second face C92. The second orifice C96 is designed to be placed in fluidic communication with the discharge opening C15, the second orifice C96 allowing refrigerant CFR to be discharged from the second top compartment C42 towards the discharge opening C15.

CLAIMS

1. Heat exchanger (A5, B5, C5) through which a refrigerant (AFR, BFR, CFR) is intended to pass, the heat exchanger (A5, B5, C5) comprising a first layer (A9, B15, C9) of first tubes (A10, B14, C10) and a second layer (A11, B17, C11) of second tubes (A12, B16, C12), the first layer (A9, B15, C9) comprising a first header (A21, B8, C21) which comprises a plurality of top compartments (A41, A42, A43, B41, B42, B43, C41, C42, C43) including a first compartment (A41, B41, C41) interposed between a second compartment (A42, B42, C42) and a third compartment (A43, B42, C42) so that they are produced in succession one after the other along an axis of overall extension (AA2, BA1, CA2), the heat exchanger (A5, B5, C5) further comprising an intake opening (A16, B9, C16) admitting refrigerant (AFR, BFR, CFR), wherein the heat exchanger (A5, B5, C5) is configured to convey the refrigerant (AFR, BFR, CFR) directly from the intake opening (A5, B5, C5) to the first compartment (A41, B41, C41), the intake opening (A5, B5, C5) being shifted along the axis of overall extension (AA2, BA1, CA2) with respect to the first compartment (A41, B41, C41) so that it is located on the side of the second compartment (A42, B42, C42) substantially opposite the side of the second compartment (A42, B42, C42) which faces the first compartment (A41, B41, C41).

2. Heat exchanger (A5) according to claim 1, wherein a first header (A21) is provided with a discharge opening (A15) for discharging the refrigerant (AFR), wherein the second layer (A11) is provided with an intake opening (A16) for admitting the refrigerant (AFR), wherein the heat exchanger (A5) is equipped with a means (A80) of conveying the refrigerant (AFR), which means is interposed between the intake opening (A16) and the first top compartment (A41).

3. Heat exchanger (A5) according to Claim 2, in which the conveying means (A80) comprises at least one canal (A83) which is interposed between the intake opening (A16) and the first top compartment (A41).

4. Heat exchanger (A5) according to Claim 3, in which the conveying means (A80) comprises a first chamber (A81) interposed between the canal (A83) and the intake opening (A16).

5. Heat exchanger (A5) according to either one of Claims 3 and 4, in which the conveying means (A80) comprises a second chamber (A82) interposed between the canal (A83) and the first top compartment (A41).

6. Heat exchanger (A5) according to any one of Claims 3 to 5, in which the canal (A83) extends inside a longitudinal midplane (AP4) of the heat exchanger (A5).

7. Heat exchanger (A5) according to Claim 6, in which the longitudinal midplane (AP4) delimits the first layer (A9) and the second layer (A11).

8. Heat exchanger (A5) according to either one of Claims 6 and 7, in which the longitudinal midplane (AP4) is parallel to an inlet face (A8) via which an air flow (AFA) enters the heat exchanger (A5).

9. Heat exchanger (A5) according to Claims 4 and 6, in which the first chamber (A81) extends inside a plane parallel to a lateral plane (AP3) of the heat exchanger (A5), which plane is orthogonal to a longitudinal plane (AP1) of the heat exchanger (A5).

10. Heat exchanger (A5) according to Claims 5 and 9, in which the second chamber (A82) extends inside a plane parallel to the lateral plane (AP3).

11. Heat exchanger (A5) according to any one of Claims 3 to 8, in which the canal (A83) is housed inside a groove (A93) formed between the first header (A21) and the third header (A23).

12. Air/fluid heat exchanger (B5) according to claim 1, the first layer (B15) comprising a first top tank (B8) which comprises a plurality of top compartments (B41, B42, B43) including at least one first top compartment (B41) interposed between a second top compartment (B42) and a third top compartment (B43), an intake opening (B9) admitting refrigerant (BFR) being able to be inscribed within a thickness of the first layer (B15), wherein an intake tube (B21) extends into the second top compartment (B42) between the intake opening (B9) and the first top compartment (B41).

13. Air/fluid heat exchanger (B5) according to Claim 12, in which the intake tube (B21) comprises a first longitudinal end (B21a) delimiting the intake opening (B9) admitting the refrigerant (BFR) into the air/fluid heat exchanger (B5).

14. Air/fluid heat exchanger (B5) according to either one of claims 12-13, in which the the second top compartment (B42) is delimited at least by a first flange (B19a) which longitudinally borders the air/fluid heat exchanger (B5) and a first top partition (B51) which is interposed between the first top compartment (B41) and the second top compartment (B42).

15. Air/fluid heat exchanger (B5) according to Claims 13 and 14, in which the first longitudinal end (B21a) of the intake tube (B21) is formed through the first flange (B19a) of the air/fluid heat exchanger (B5).

16. Air/fluid heat exchanger (B5) according to Claims 13 and 14, in which the first longitudinal end (B21a) of the intake tube (B21) is formed through an end plate (B85) of the air/fluid heat exchanger (B5), which end plate is interposed between the first flange (B19a) and the second top compartment (B42).

17. Air/fluid heat exchanger (B5) according to any one of Claims 14 to 16, in which the intake tube (B21) comprises a second longitudinal end (B21b) which is formed through the first top partition (B51).

18. Air/fluid heat exchanger (B5) according to Claims 14 and 16, in which the first longitudinal end (B21a) of the intake tube (B21) is supported by retaining means (B20) which may just as well be assigned to the first flange (B19a) as to the end plate (B85).

19. Air/fluid heat exchanger (B5) according to any one of claims 12-18, in which the second top compartment (B42) being delimited by a top wall (B81), a bottom wall (B82), a middle wall (B83) and a lateral wall (B84), the first longitudinal end (B21a) of the intake tube (B21) is placed a first distance (BD1) away from the top wall (B81), a second distance (BD2) away from the bottom wall (B82), a third distance (BD3) away from the middle wall (B83), and a fourth distance (BD4) away from the lateral wall (B84).

20. Air/fluid heat exchanger (B5) according to Claim 19, in which the first distance (BD1) is equal to the second distance (BD2) and the third distance (BD3) is equal to the fourth distance (BD4).

21. Heat exchange module (B23) comprising an internal heat exchanger (B22) and

an air/fluid heat exchanger (B5) according to any one of claims 12-20, the internal heat exchanger (B22) and the air/fluid heat exchanger (B5) being associated with one another by means of assembly means.

5 **22.** Heat exchange module (B23) according to Claim 21, in which the internal heat exchanger (B22) comprises a peripheral wall (B22c) which is connected to a ring (B29) delimiting the discharge opening (B11).

23. Heat exchange module (B23) according to any one of Claims 21 and 22, in which the internal heat exchanger (B22) comprises a central canal (B22d) which is in fluidic communication with the first longitudinal end (B21a) of the intake tube (B21).

10 **24.** Heat exchange module (B23) according to any one of Claims 21 and 22, in which the internal heat exchanger (B22) comprises a peripheral canal (B22f) which is in fluidic communication with the first longitudinal end (21a) of the intake tube (B21).

25. Use of an air/fluid heat exchanger (B5) according to any one of Claims 12 to 20 as an evaporator housed within a housing (B6) of a heating, ventilation and/or air
15 conditioning installation (B7) with which a motor vehicle is equipped.

26. Motor vehicle heating, ventilation and/or air conditioning installation (B7), comprising at least one air/fluid heat exchanger (B5) according to any one of Claims 12 to 20 and through which there passes an airflow (BFA) circulating inside the heating, ventilation and/or air conditioning installation (B7), in which the air/fluid heat exchanger
20 (B5) is arranged in the heating, ventilation and/or air conditioning installation (B7) in such a way that the airflow (BFA) enters the air/fluid heat exchanger (B5) first of all via the first layer (B9) which comprises the first top compartment (B41).

27. Heat exchanger (C5) according to claim 1, wherein the second layer (C11) is provided with an intake opening (C16) admitting refrigerant (CFR), wherein the heat
25 exchanger (5) is equipped with a means (C80) of conveying the refrigerant (CFR) which means is interposed between the intake opening (C16) and the first top compartment (C41), the conveying means (C80) extending at least partially inside the second top compartment (C42).

28. Heat exchanger (C5) according to Claims 27, in which the conveying means

(C21) comprises at least one canal (C83) which is housed inside the second top compartment (C42).

5 **29.** Heat exchanger (C5) according to Claim 28, in which the conveying means (C80) comprises at least one chamber (C81) interposed between the canal (C83) and the intake opening. (C16).

30. Heat exchanger (C5) according to Claim 29, in which the chamber (C81) comprises a groove (C93) connected directly to a cavity (C82), the intake opening (C16) opening directly into the cavity (C82) while the canal (C83) opens directly into the groove (C93).

10 **31.** Heat exchanger (C5) according to Claims 29 or 30, in which the chamber (C81) extends along a straight line which can be inscribed inside a plane parallel to a lateral plane (CP3) of the heat exchanger (C5), which plane is orthogonal to a longitudinal plane (CP1) defining an inlet face (C8) via which an air flow (CFA) enters the heat exchanger (C5).

15 **32.** Heat exchanger (C5) according to any one of Claims 29 to 31, in which the chamber (C81) is formed within a thickness of an intermediate component (C90).

33. Heat exchanger (C5) according to Claim 32, in which the intermediate component (C90) comprises a first orifice (C94) and a second orifice (C96) which each open through a first face (C91) and a second face (C92) of the intermediate component (C90).

20 **34.** Heat exchanger (C5) according to Claims 30 and 33, in which the first orifice (C94) is in fluidic communication with the groove (C93) which opens onto the second face (C92) and is closed in the region of the first face (C91) by a first wall (C81a).

35. Heat exchanger (C5) according to either one of Claims 33 and 34, in which the first orifice (C94) and the second orifice (C96) are separated from one another by a flange
25 (C95) which accepts a first end (C83a) of the canal (C83) housed inside the first orifice (C94).

36. Heat exchanger (C5) according to any one of Claims 28 to 35, comprising a closure plate (C27) which closes the chamber (C81) and bears sleeves (C28, C29)

delimiting the intake opening (C16) and the outlet opening (C15).

37. Heat exchanger (C5) according to Claim 36, in which the first top compartment (C41) is a central compartment of the heat exchanger (C5) situated equal distances from a first longitudinal end (C17) and from a second longitudinal end (C18) of the heat exchanger (C5).

38. Use of a heat exchanger (C5) according to any one of Claims 27 to 37 as an evaporator.

39. Motor vehicle heating, ventilation and/or air conditioning installation (C7) comprising at least one heat exchanger (C5) according to any one of Claims 27 to 38 and through which there passes an air flow (CFA) circulating inside the heating, ventilation and/or air conditioning installation (C7), in which the heat exchanger (C5) is arranged in the heating, ventilation and/or air conditioning installation (C7) in such a way that the air flow (CFA) enters the heat exchanger (C5) first of all via the first layer (C9) which comprises the first top compartment (C41).

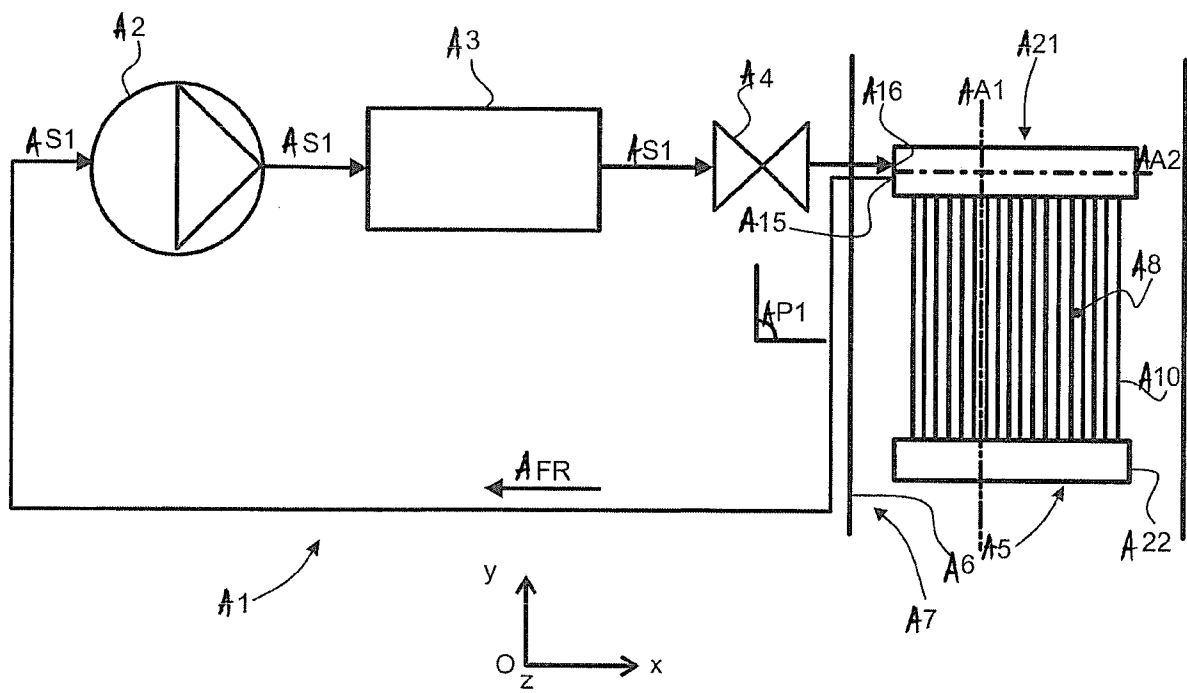


Figure 1

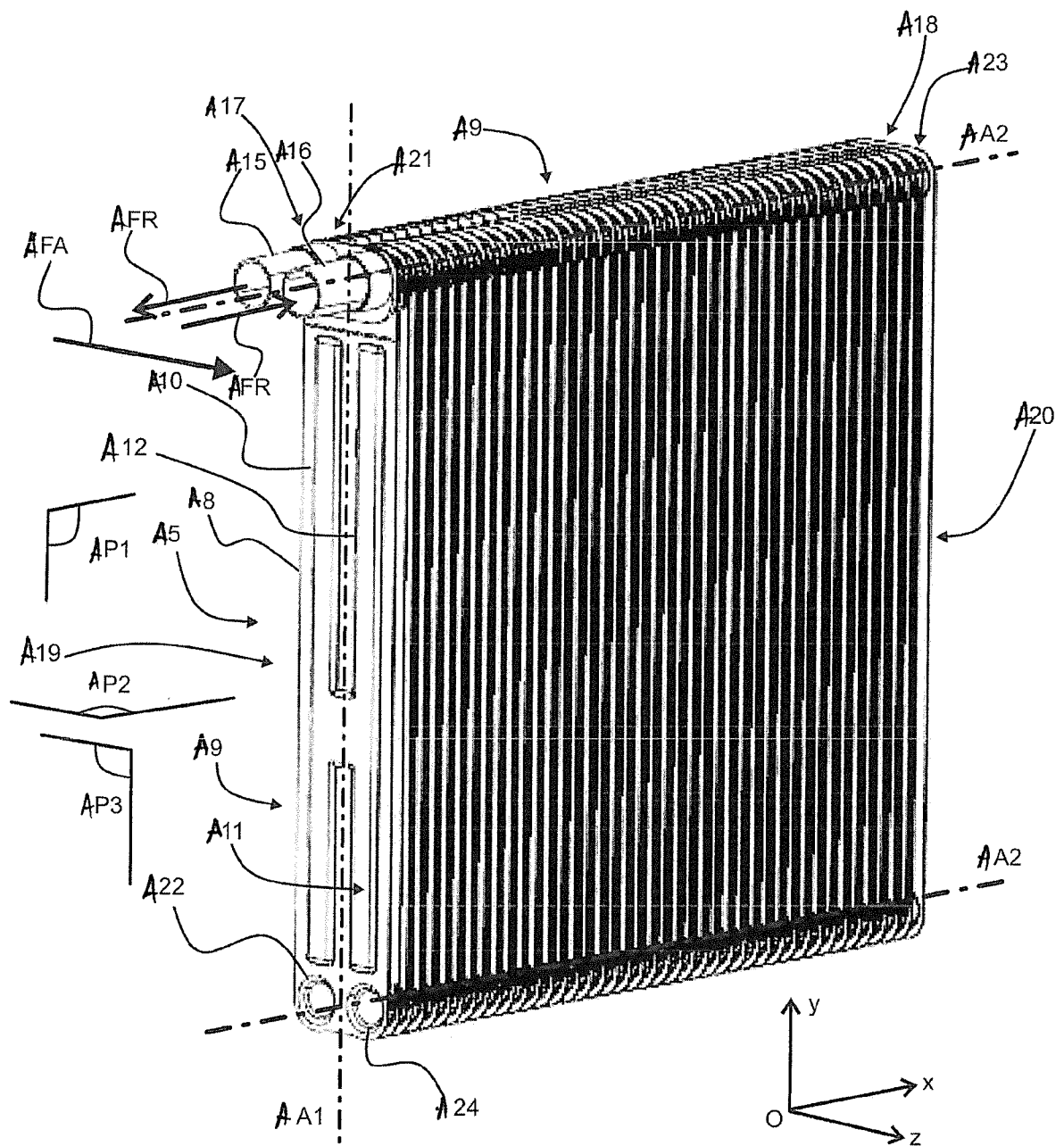
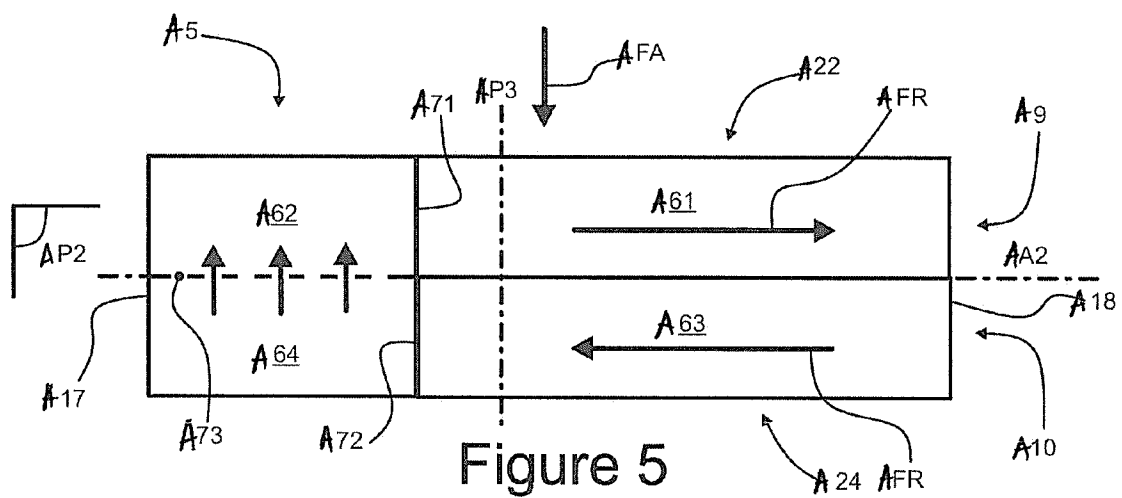
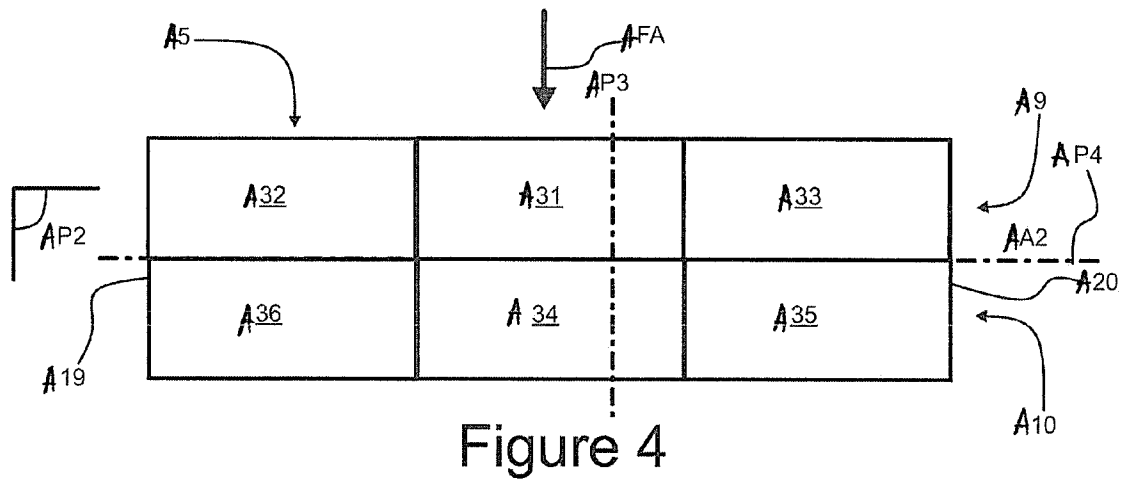
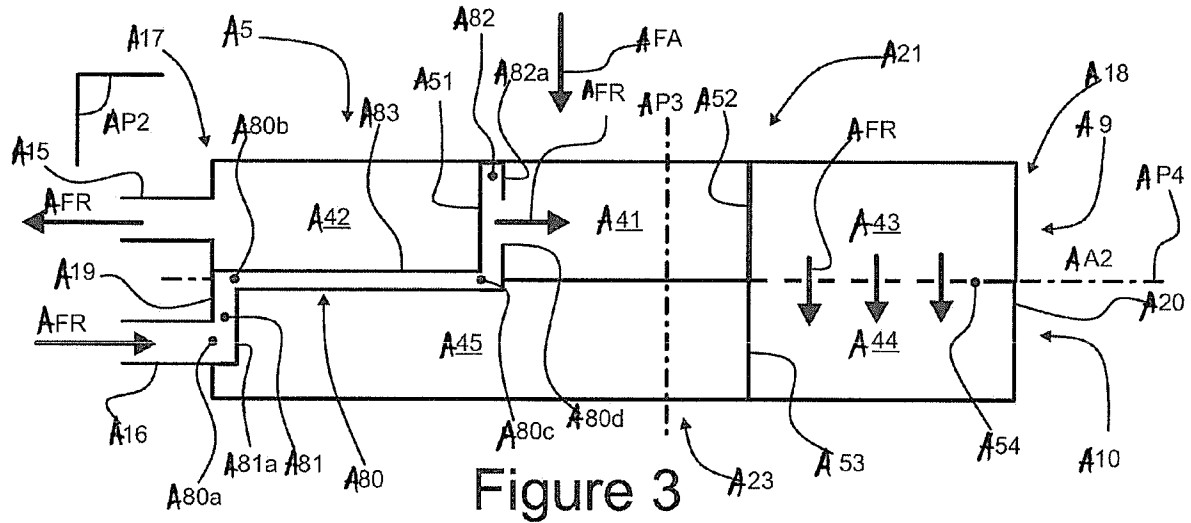


Figure 2



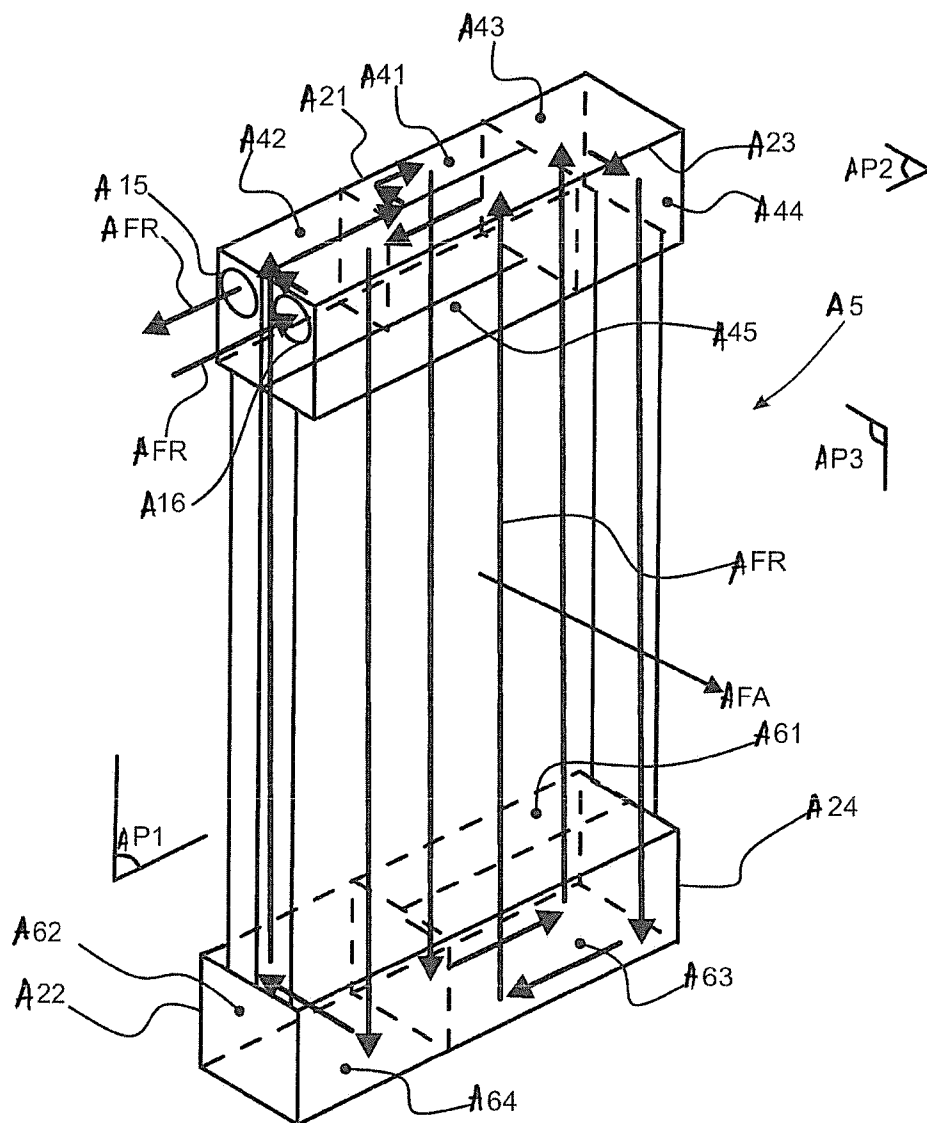


Figure 6

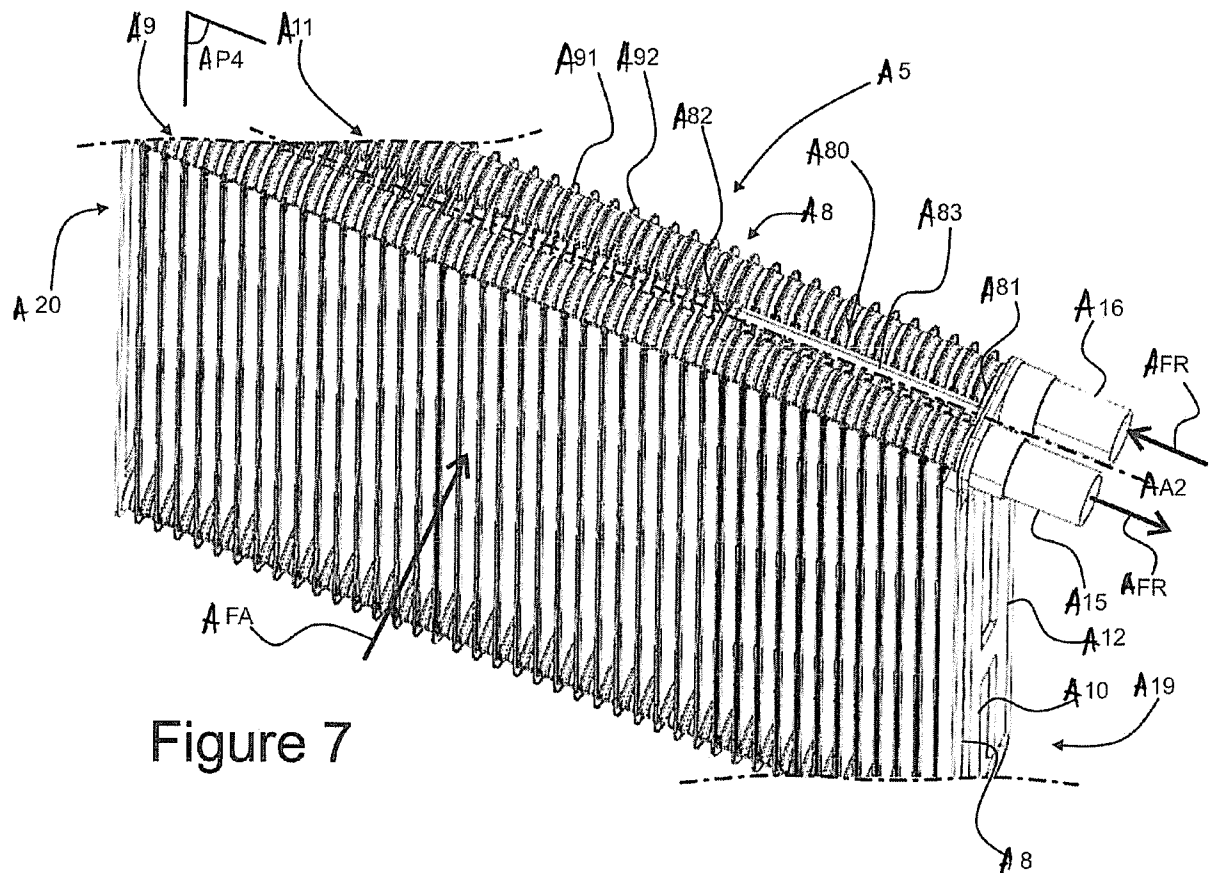


Figure 7

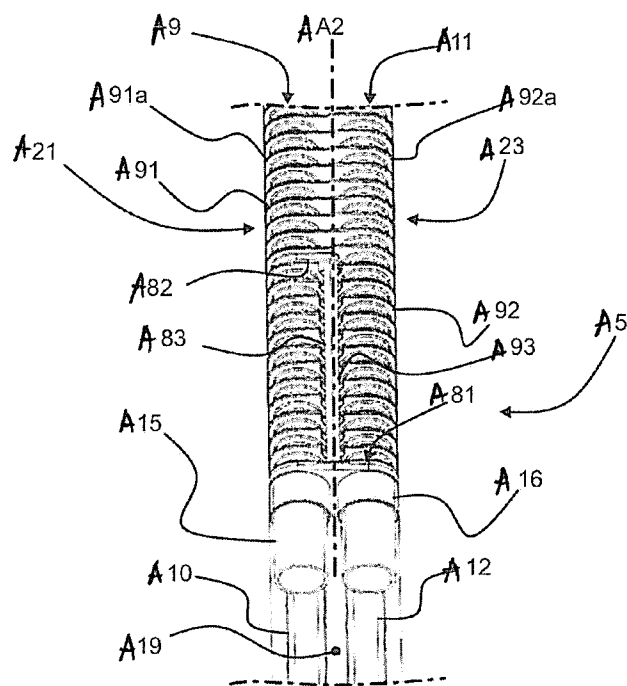


Figure 8

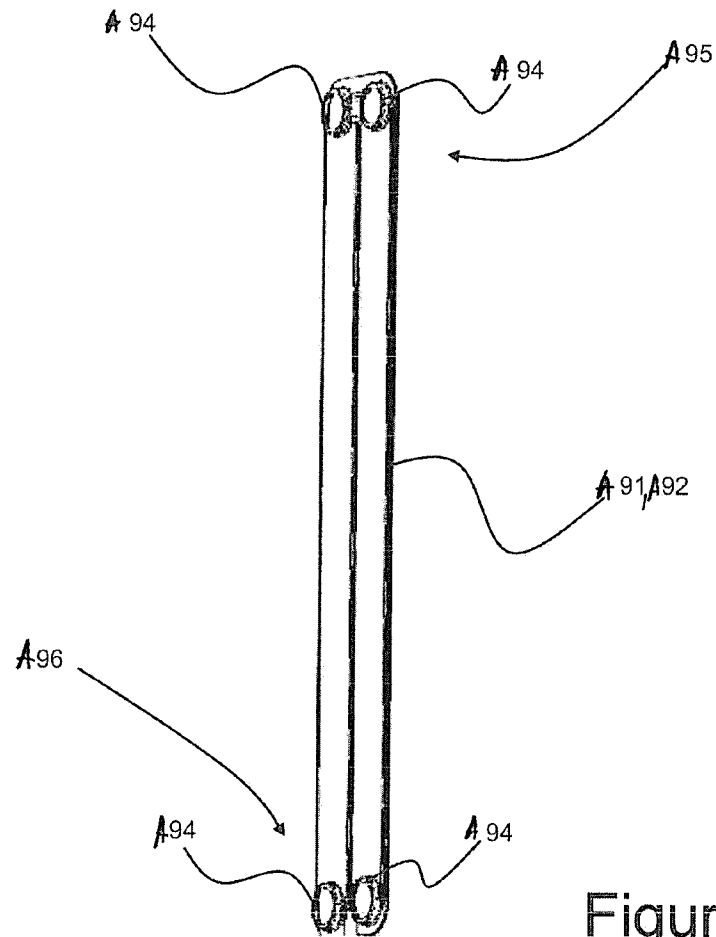


Figure 9

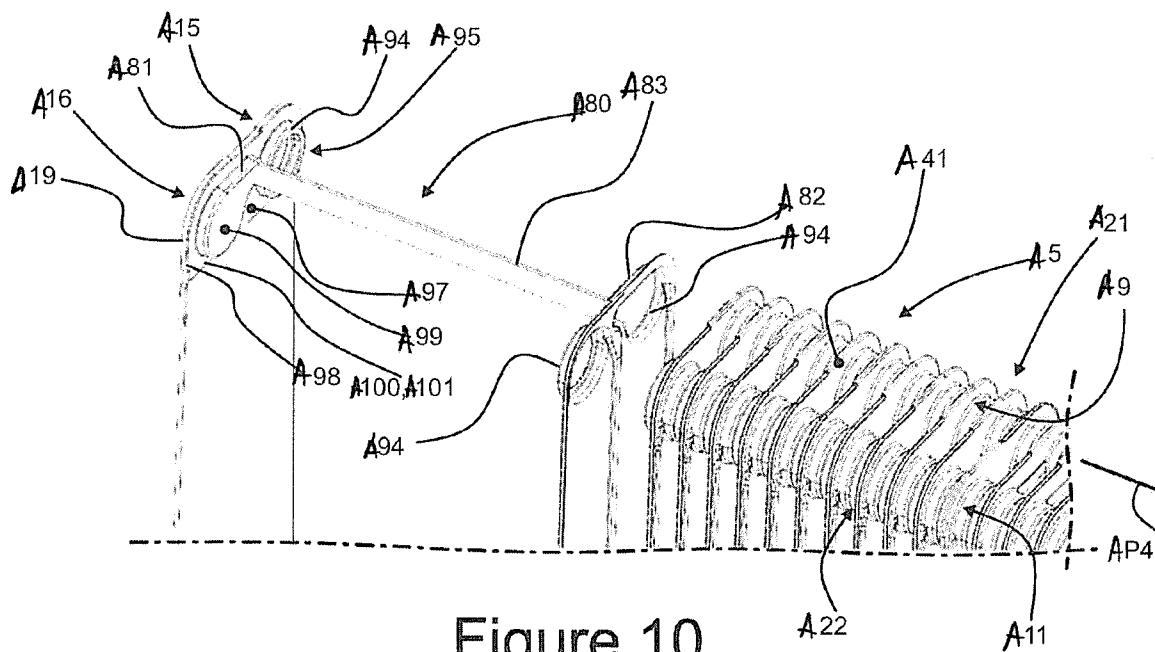


Figure 10

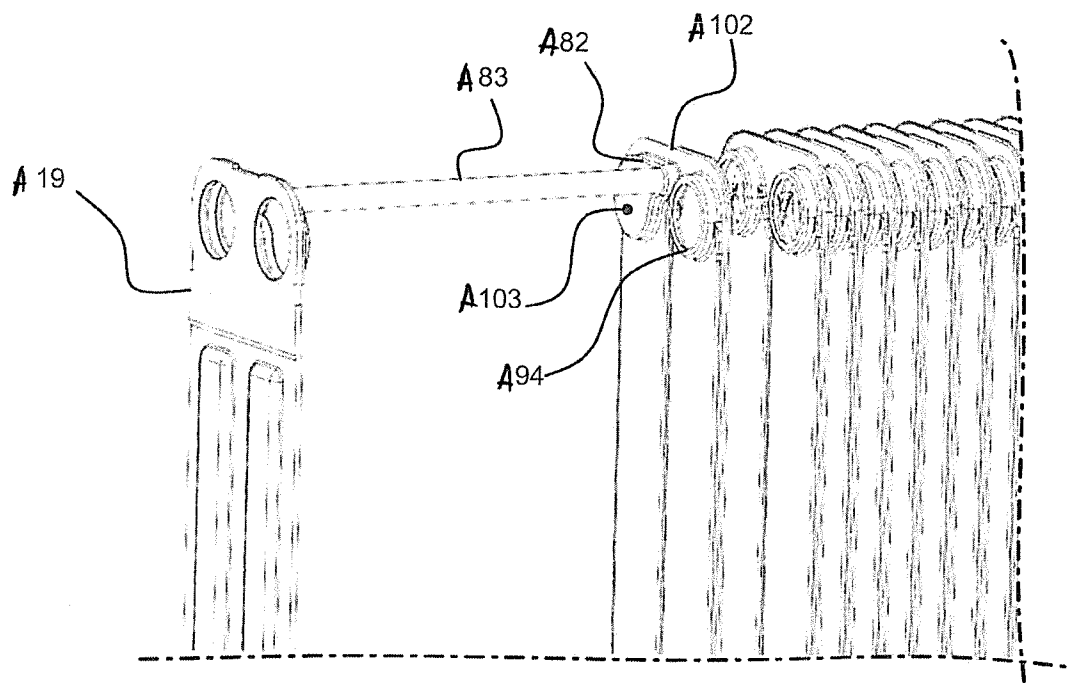


Figure 11

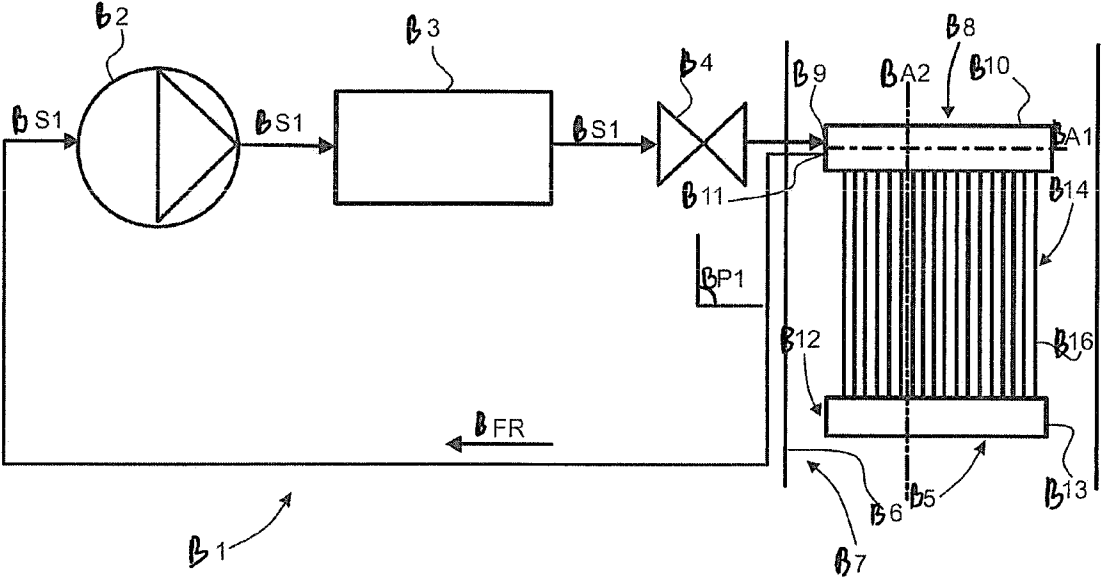


Figure 12

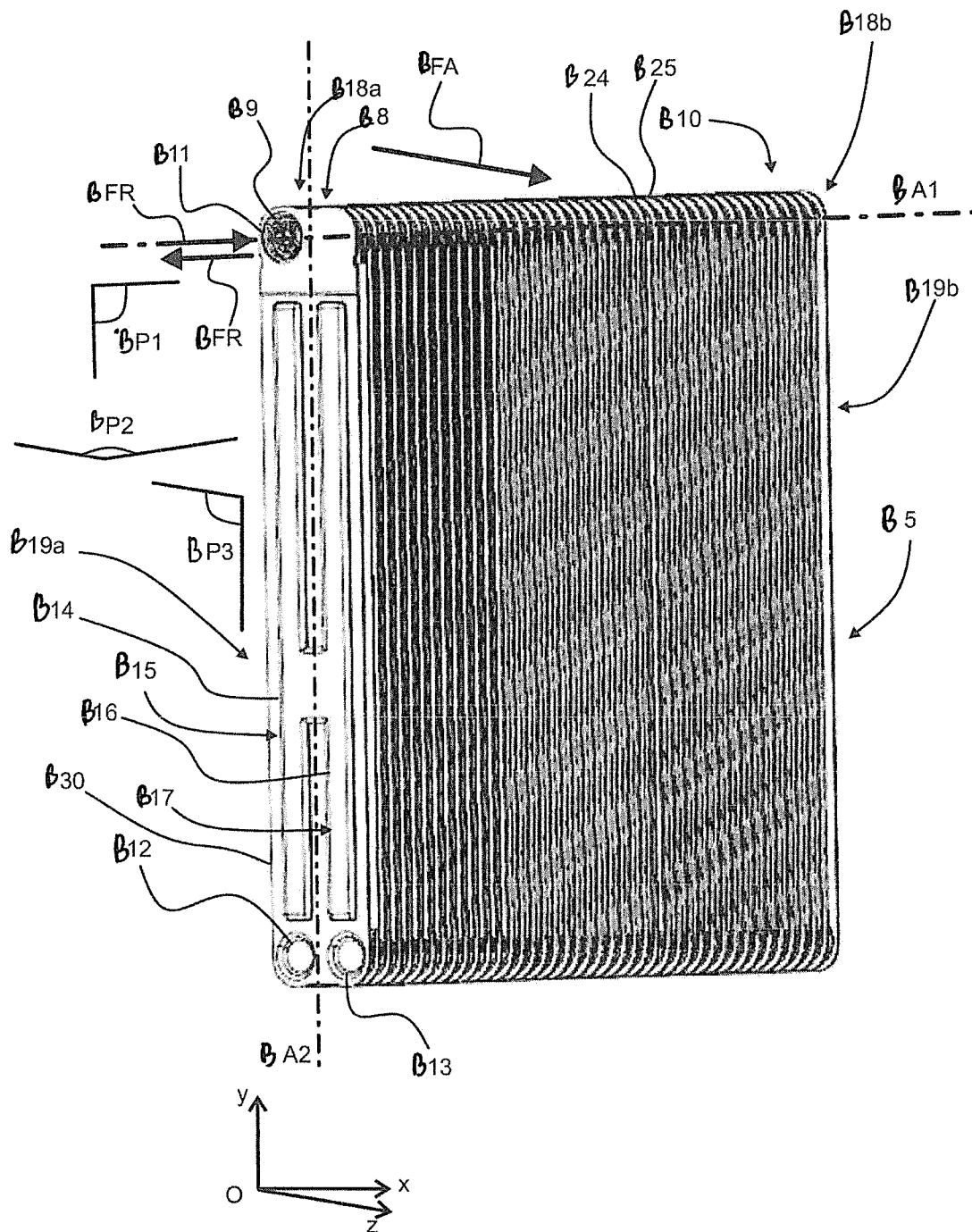
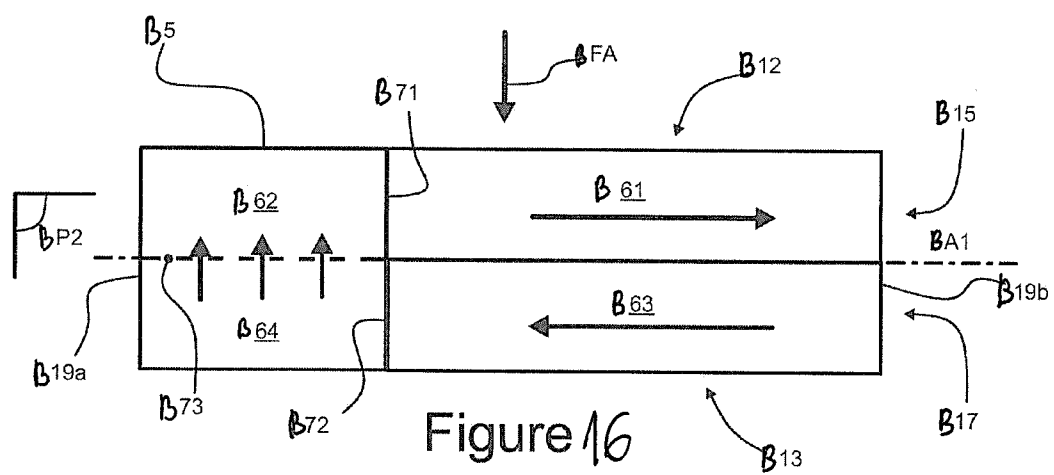
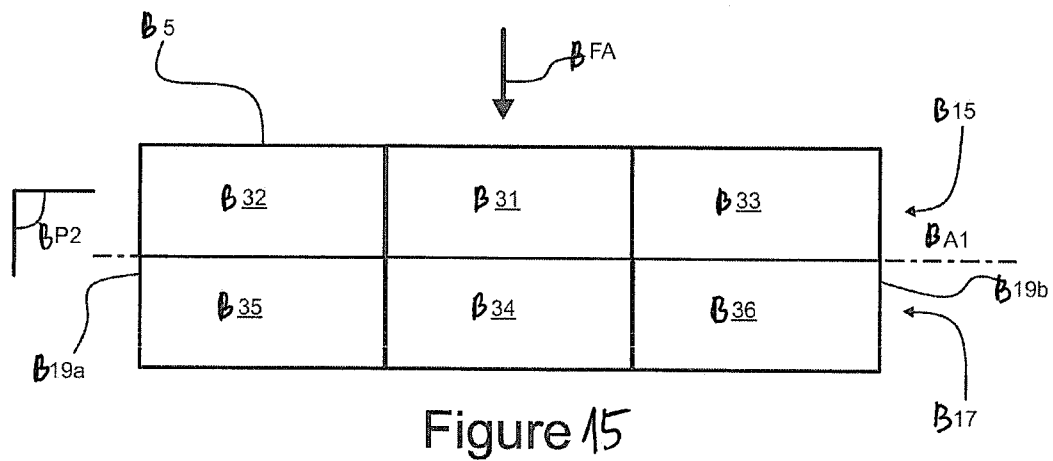
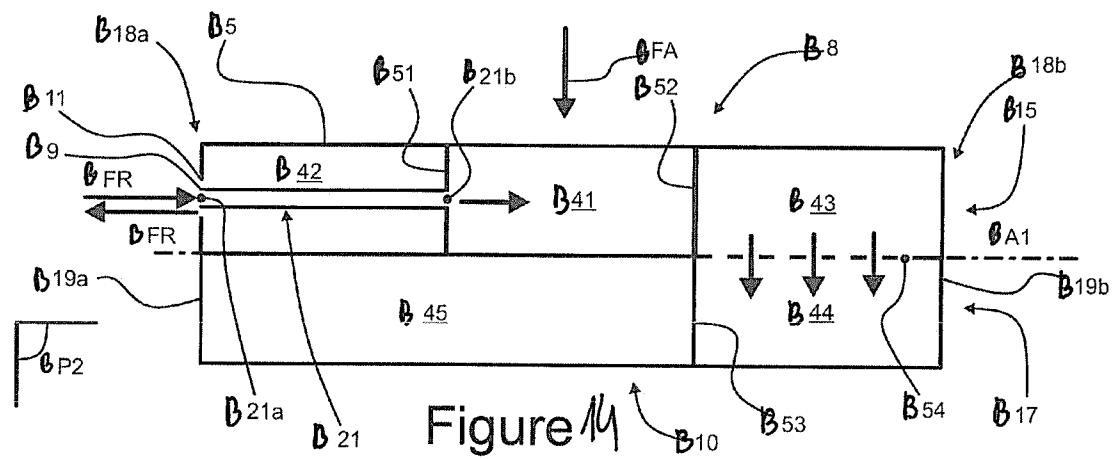


Figure 13



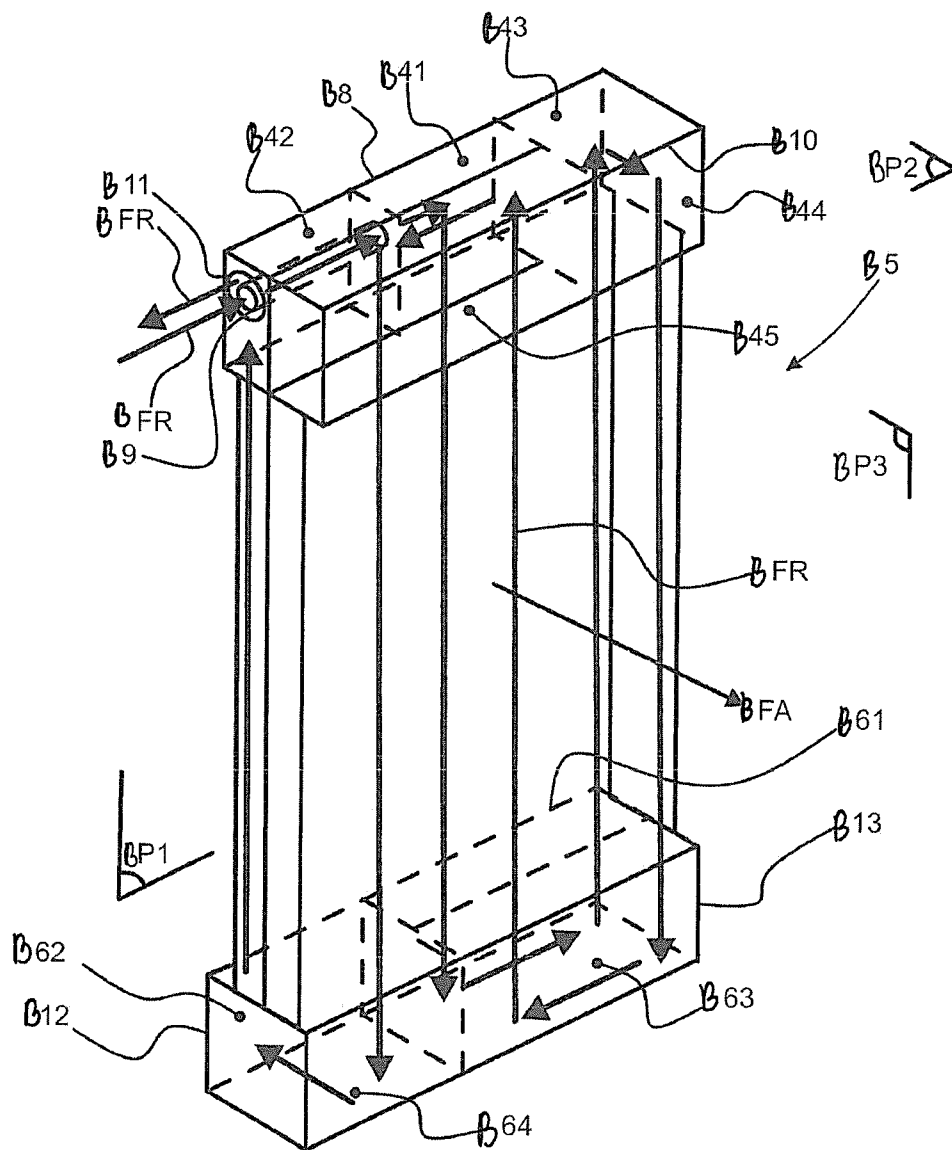


Figure 17

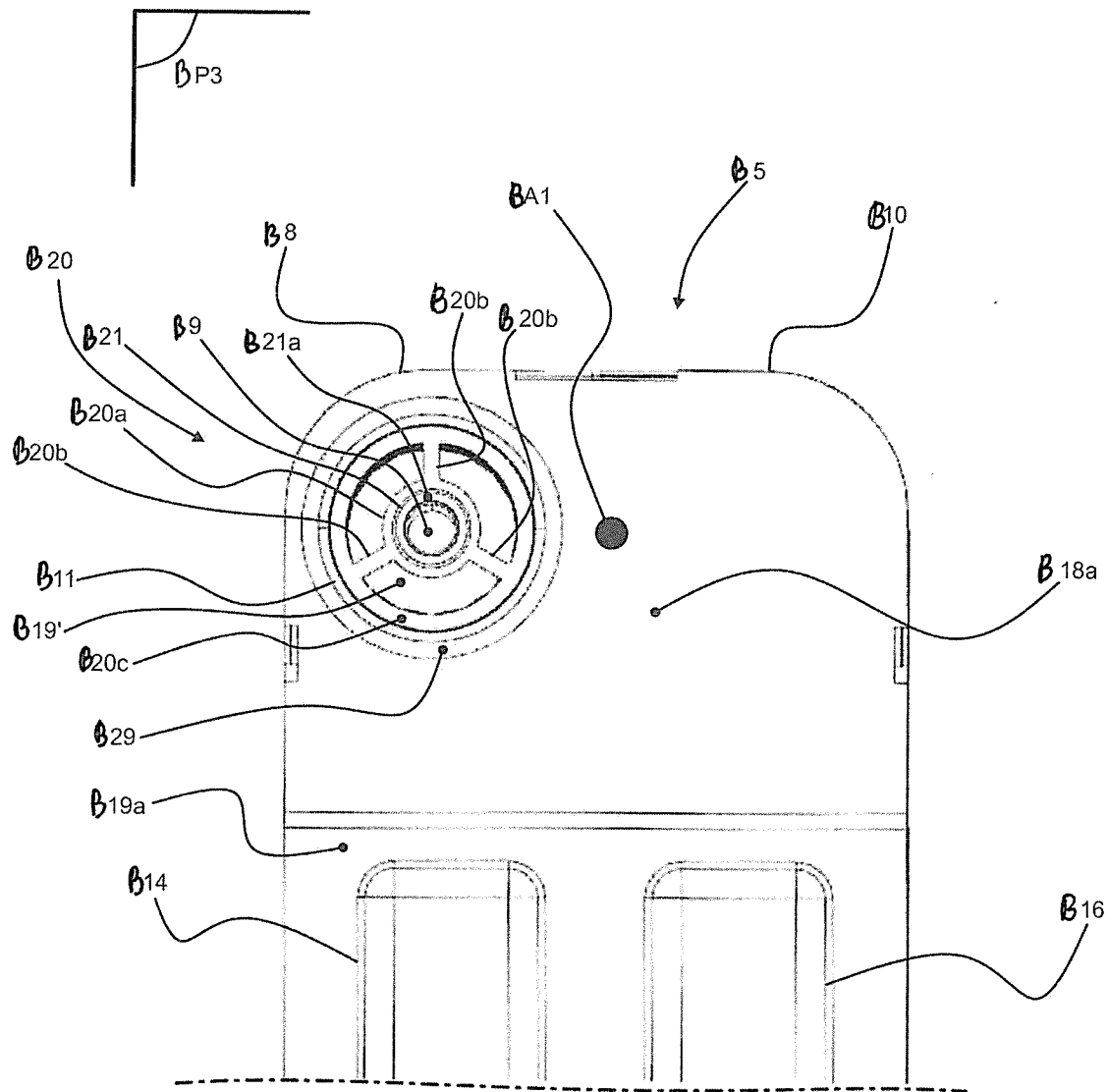


Figure 18

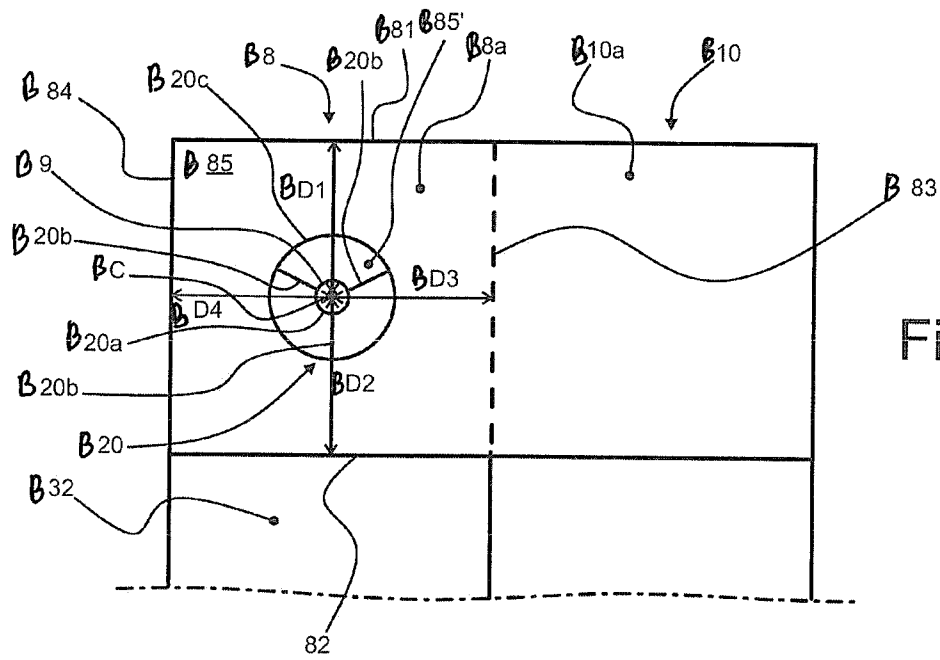


Figure 19

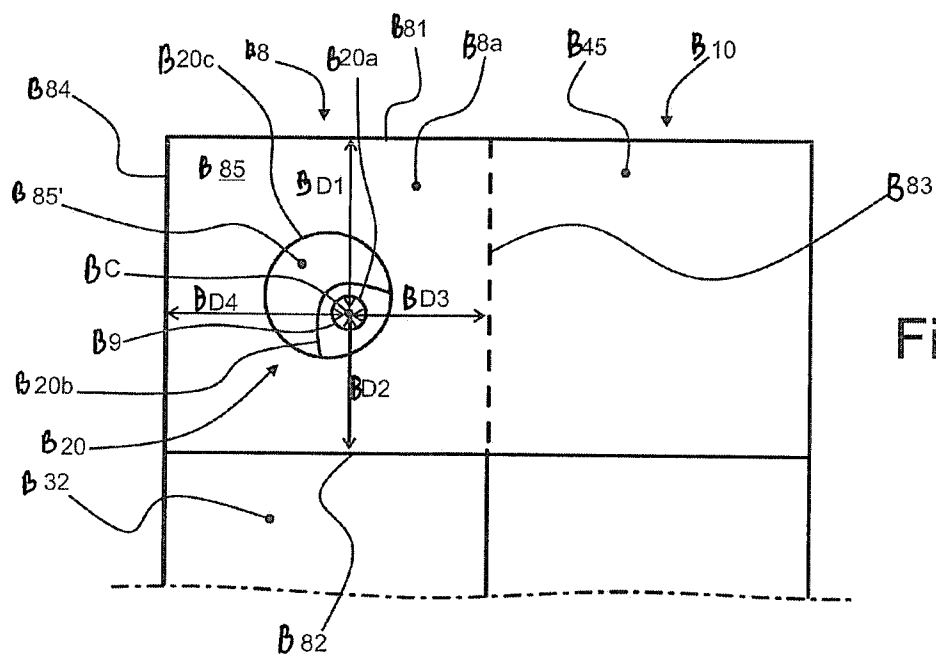


Figure 20

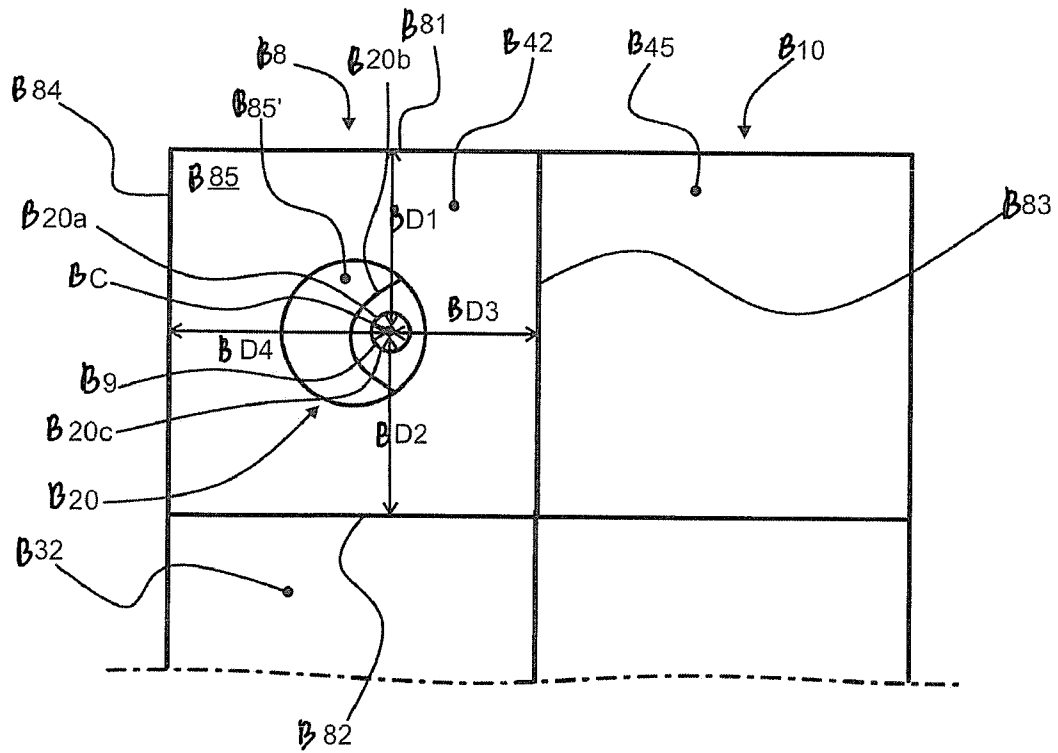


Figure 21

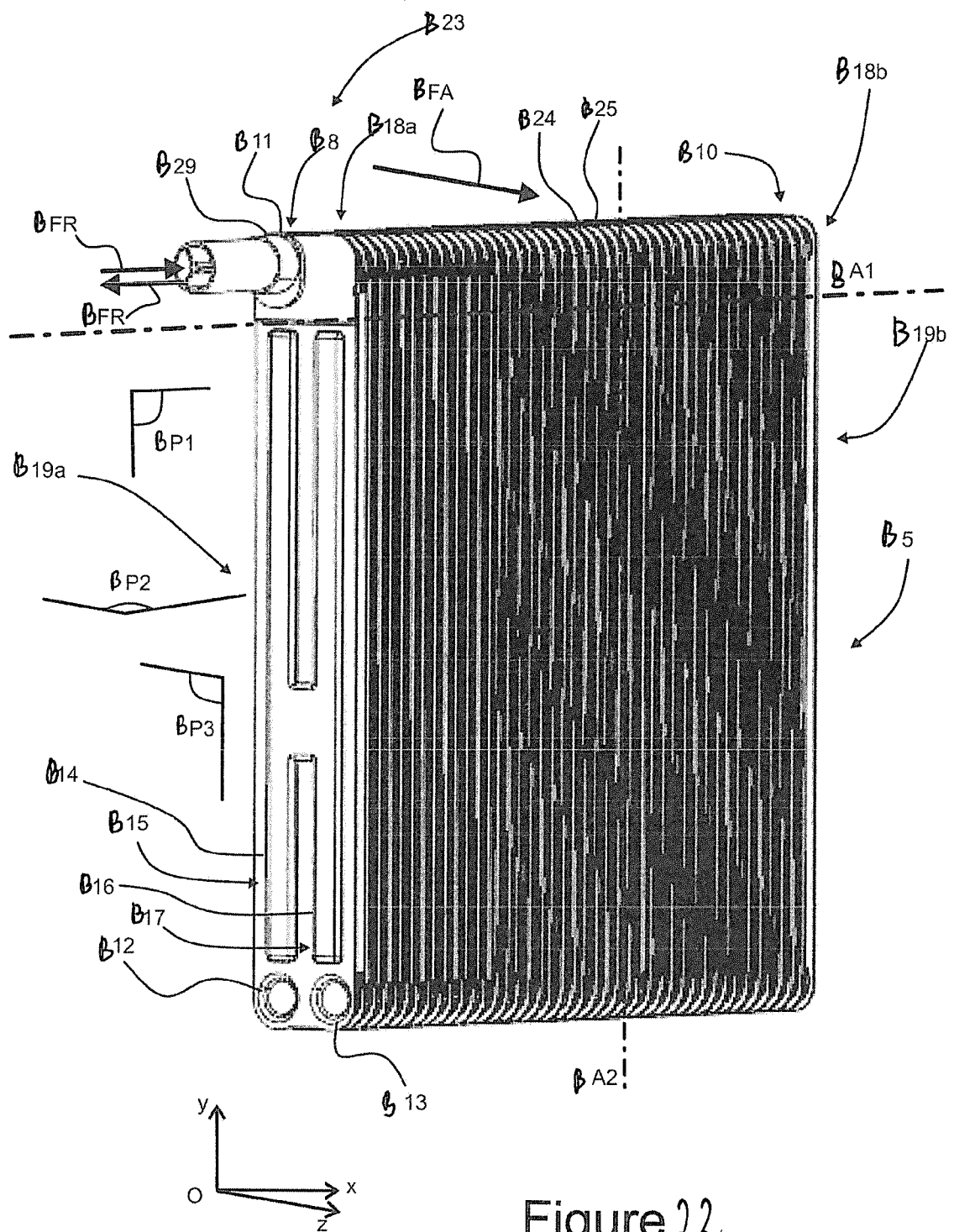


Figure 22

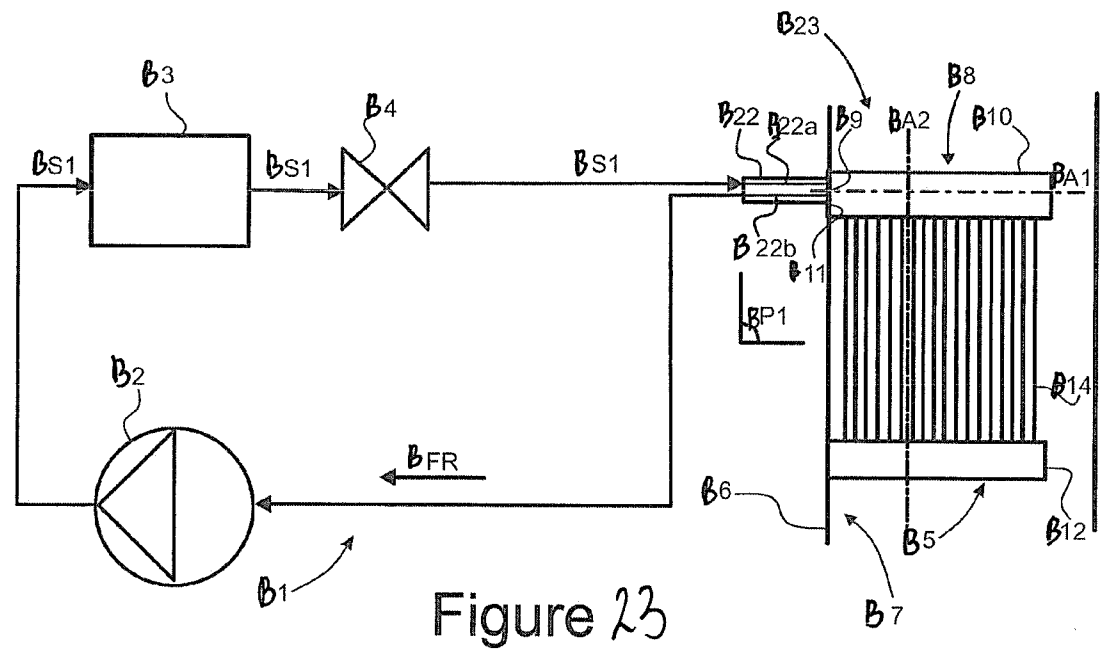


Figure 23

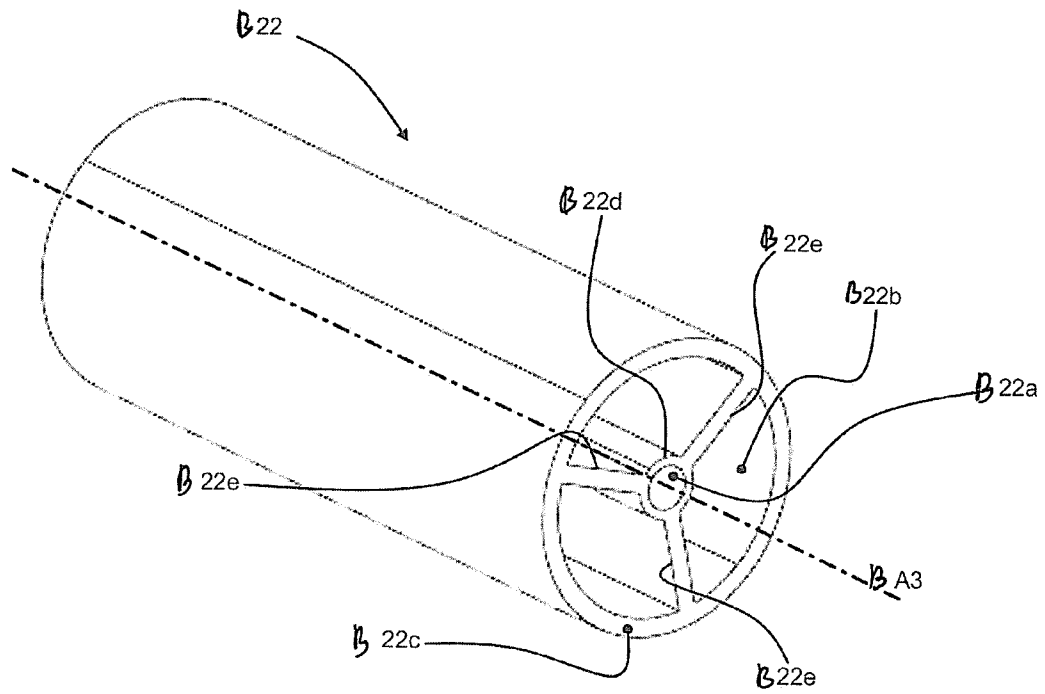


Figure 24

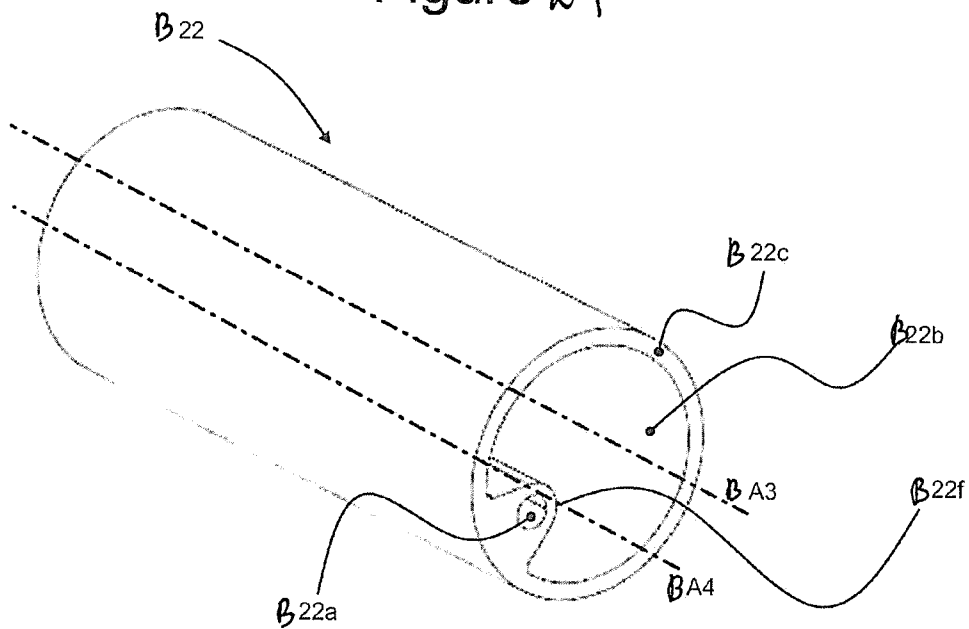


Figure 25

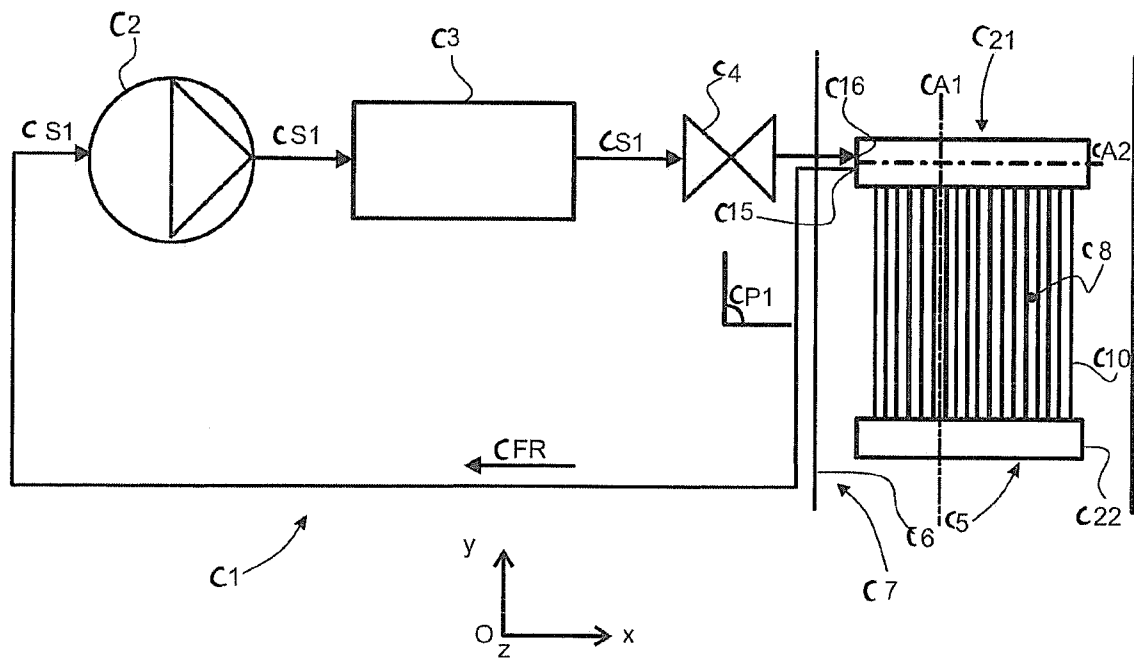


Figure 26

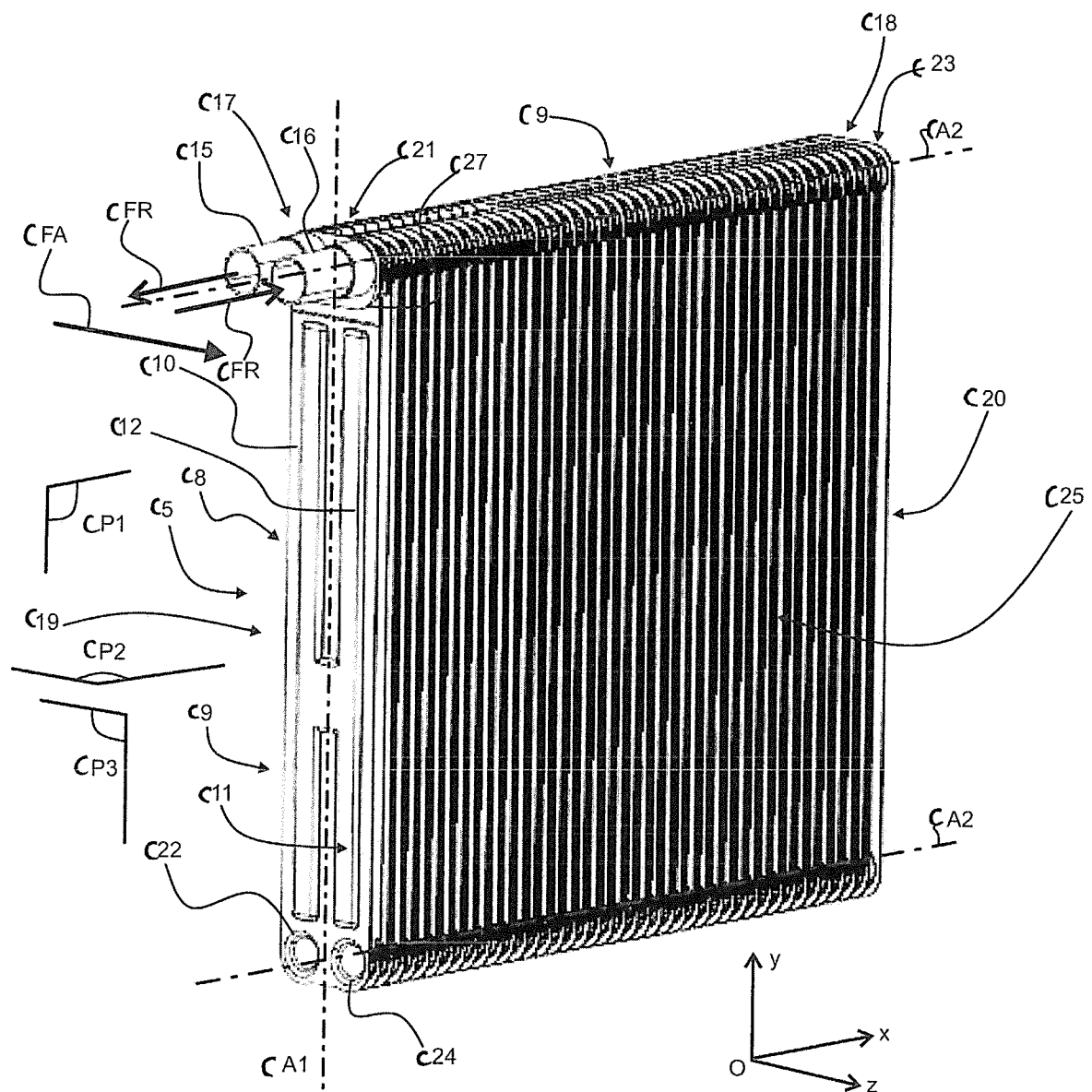
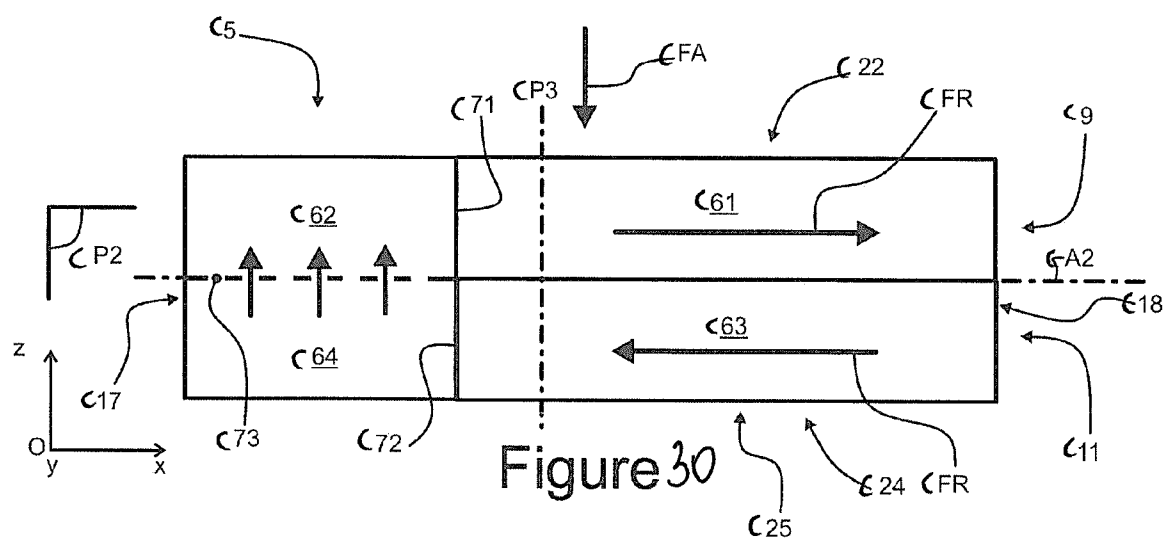
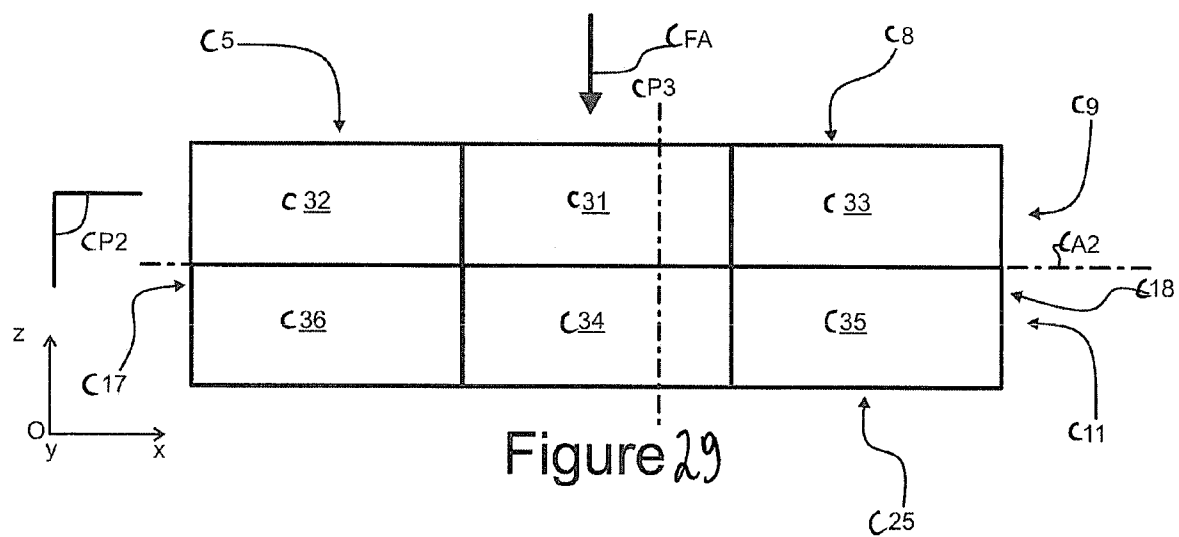
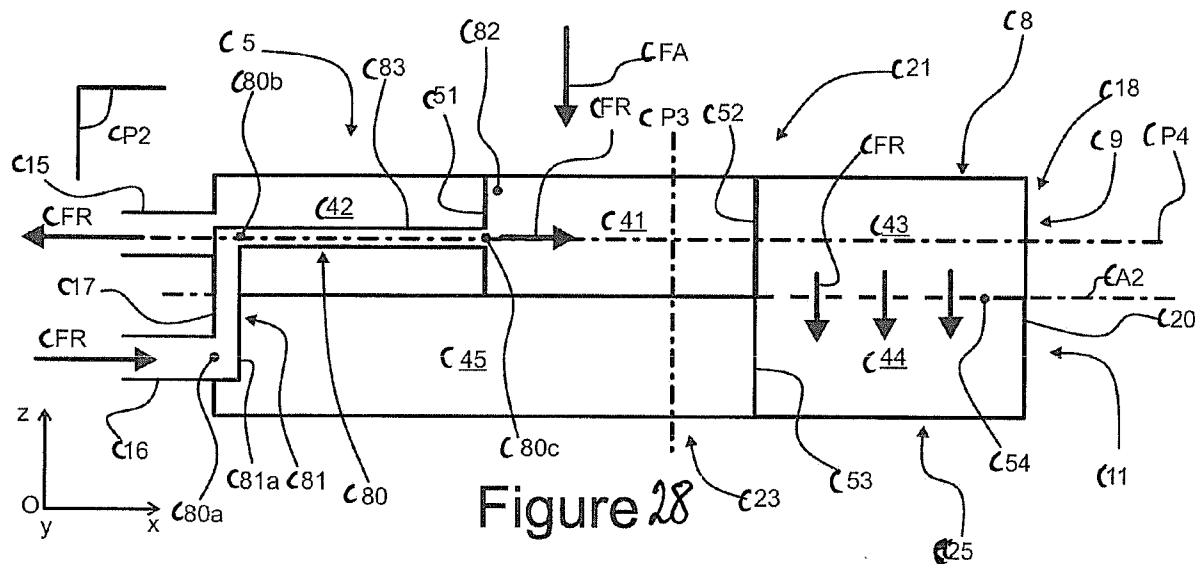


Figure 27



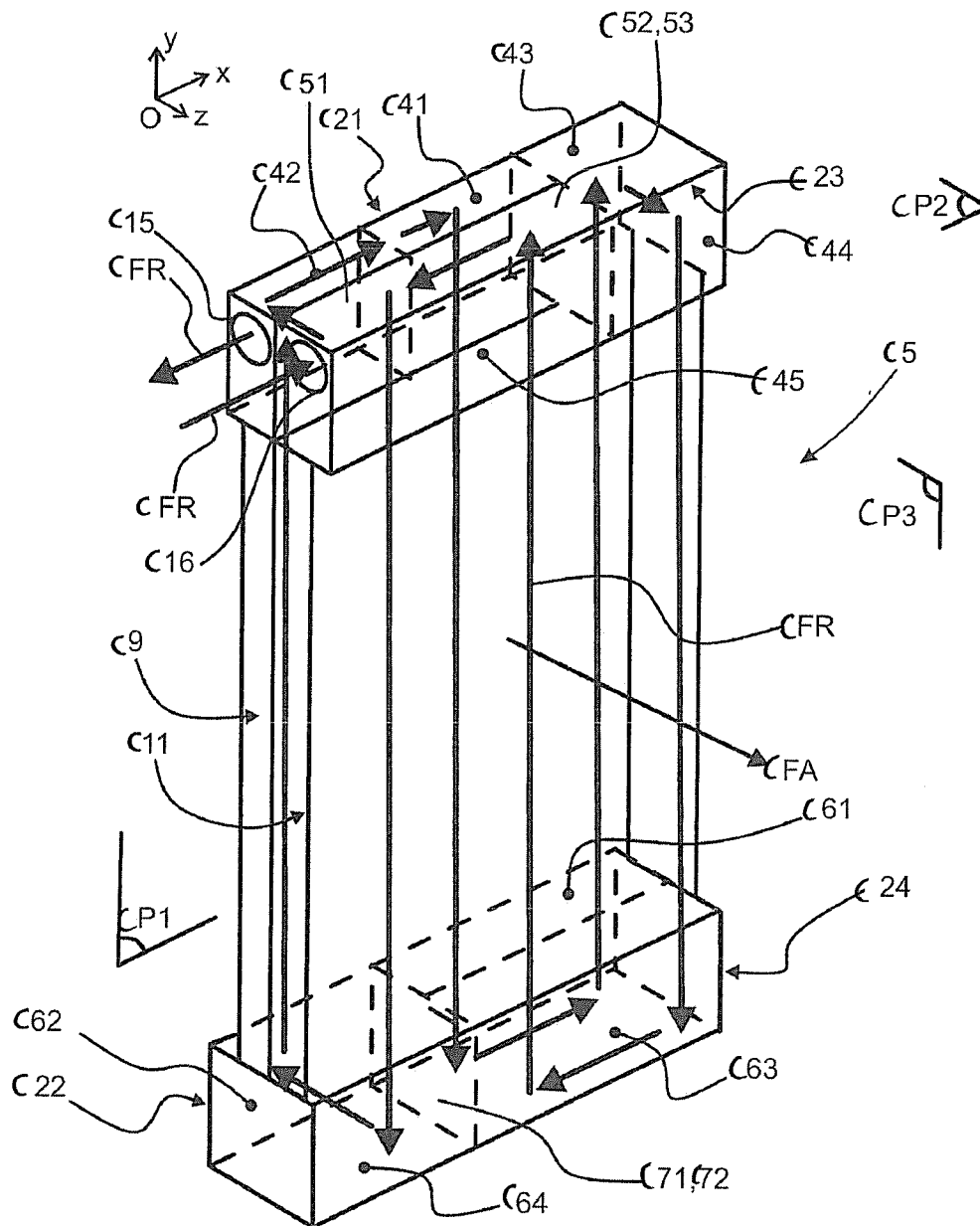


Figure 31

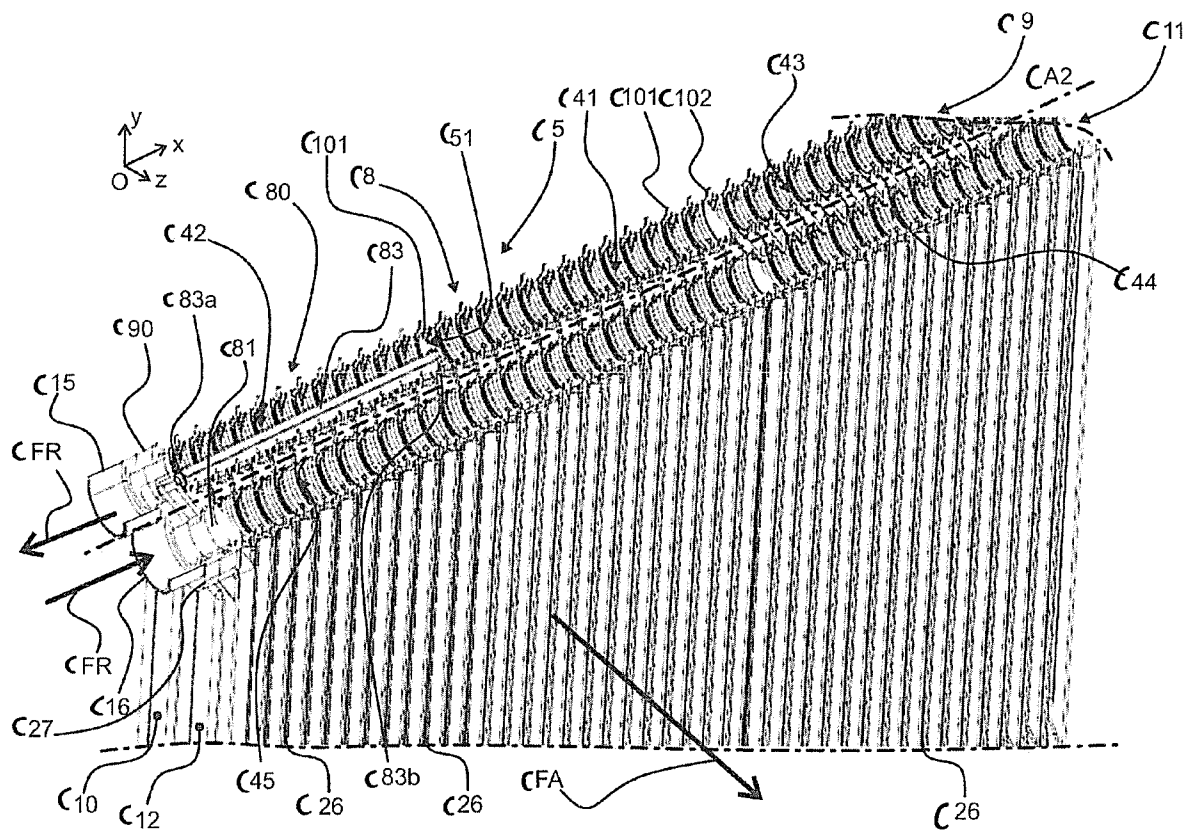


Figure 32

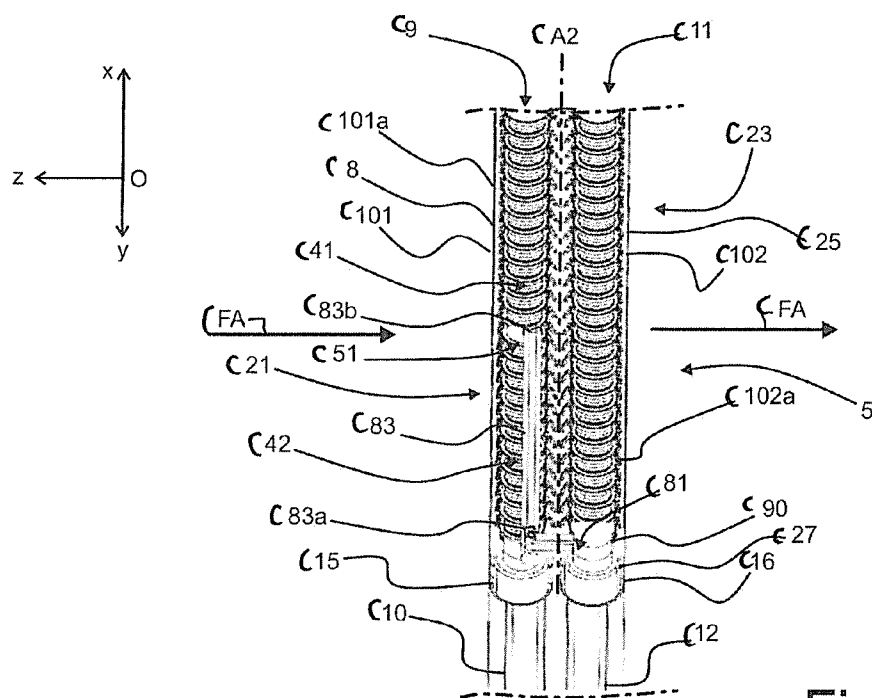


Figure 33

Figure 34

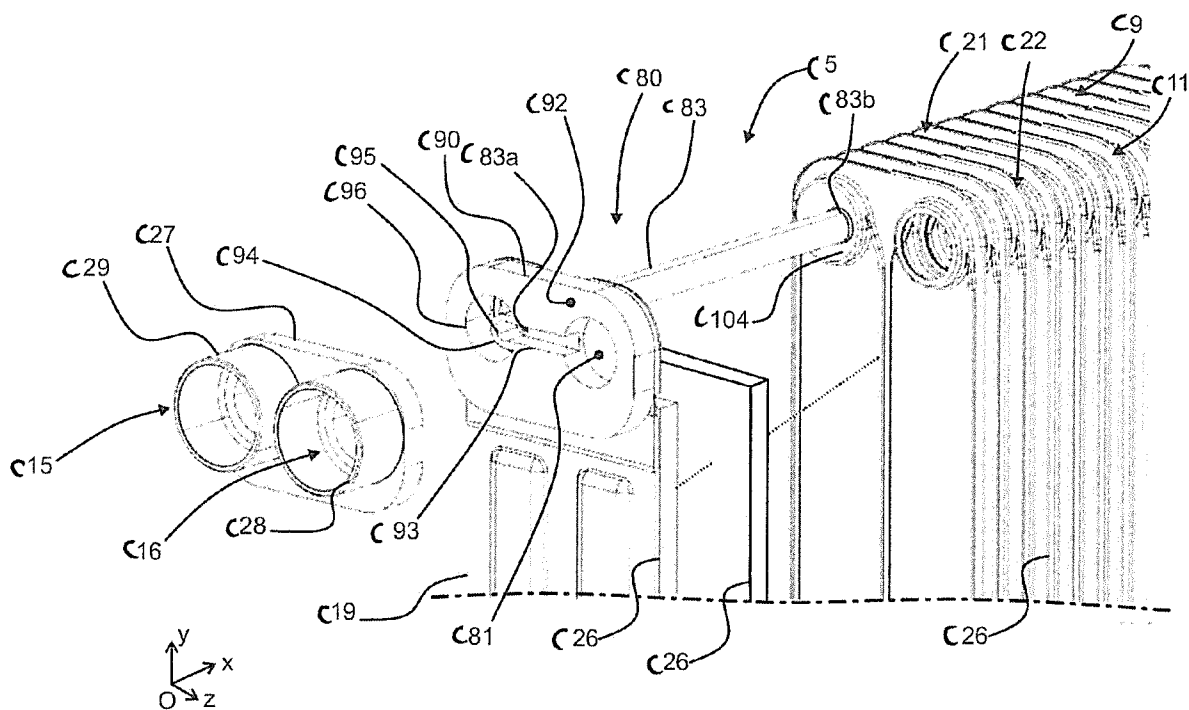
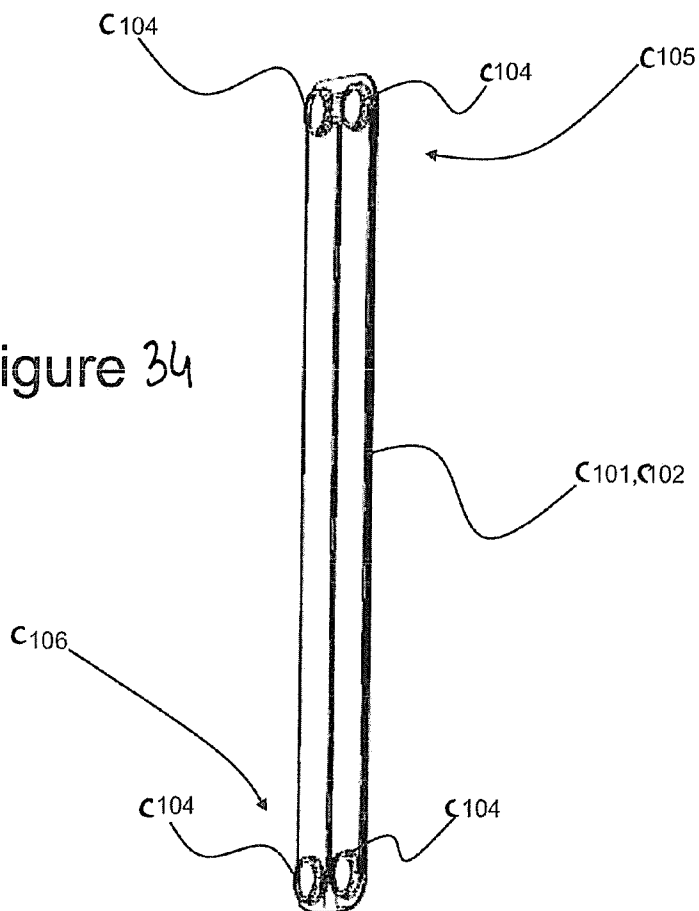


Figure 35

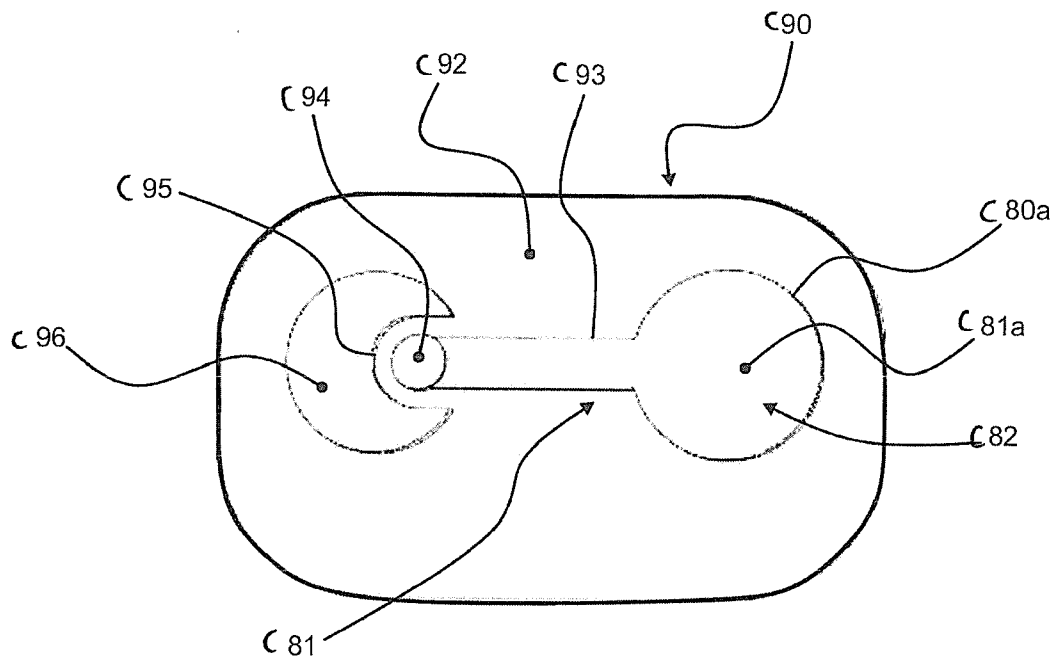


Figure 36

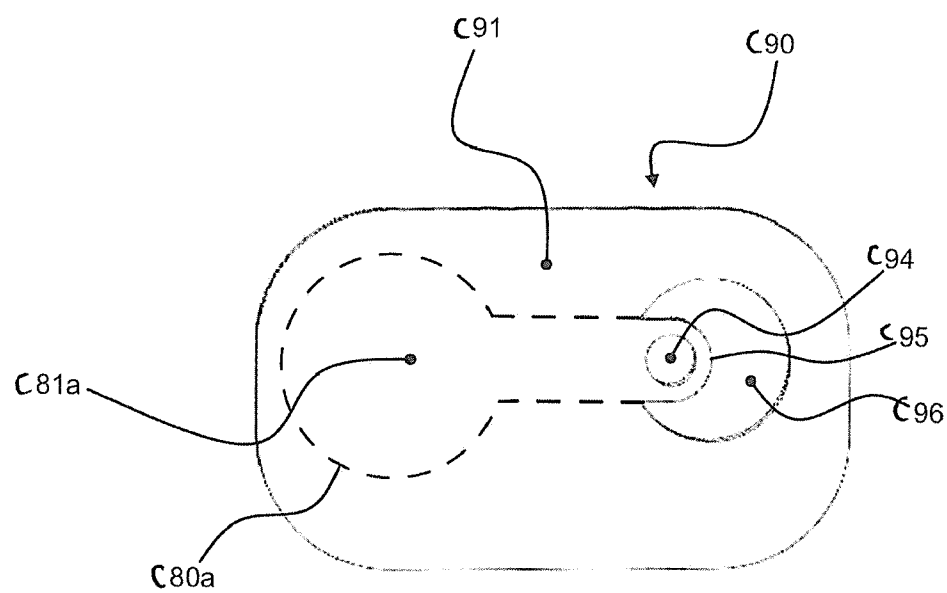


Figure 37

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/062399

A. CLASSIFICATION OF SUBJECT MATTER

INV. F28F9/02 F28D1/03 F28D1/053 F28D1/04
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)

F28F F28D

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.
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X	EP 0 798 533 A1 (SANDEN CORP [JP]) 1 October 1997 (1997-10-01) figure 5	1-4, 9, 12-20, 25-39
X	EP 0 872 698 A2 (ZEXEL CORP [JP]) 21 October 1998 (1998-10-21) figures 1a, 1b	1-11
X	EP 0 625 686 A2 (ZEXEL CORP [JP]) 23 November 1994 (1994-11-23) figures 12, 13	1-11
	----- -/-	



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See patent family annex.

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Date of the actual completion of the international search

23 July 2018

Date of mailing of the international search report

01/08/2018

Name and mailing address of the ISA/

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Vassoille, Bruno

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2018/062399

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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Y	US 2009/019885 A1 (HOSHINO RYOICHI [JP] ET AL) 22 January 2009 (2009-01-22) figure 3 -----	21
A	WO 01/04560 A1 (BOSCH AUTOMOTIVE SYSTEMS CORP [JP]; NISHISHITA KUNIHICO [JP]; HUKUSHIM) 18 January 2001 (2001-01-18) the whole document -----	1-39

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International application No

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