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(54) **WATER HEATER WITH DOUBLE REFRIGERANT CIRCUIT**

(57) The object of the present disclosure is a heating or more generally a storage water conditioning system with a heat pump wherein the heat transfer fluid is divided into at least two distinct and independent refrigerant circuits, between which there is no passage of fluid.

The two circuits define the same heat exchanger body with a tank. It is advantageous to make the exchanger with the micro channel technology which allows greater efficiency and flexibility in designing the heat exchange surfaces for a plurality of circuits on the same tank.

Compared to a single circuit heat pump, one with two distinct circuits and equal overall power, for each circuit it has less fluid charge and less power required to the compressor.

Furthermore, it is more robust with respect to a failure: a hole at any point in the circuit causes the loss of only part of the heat transfer fluid.

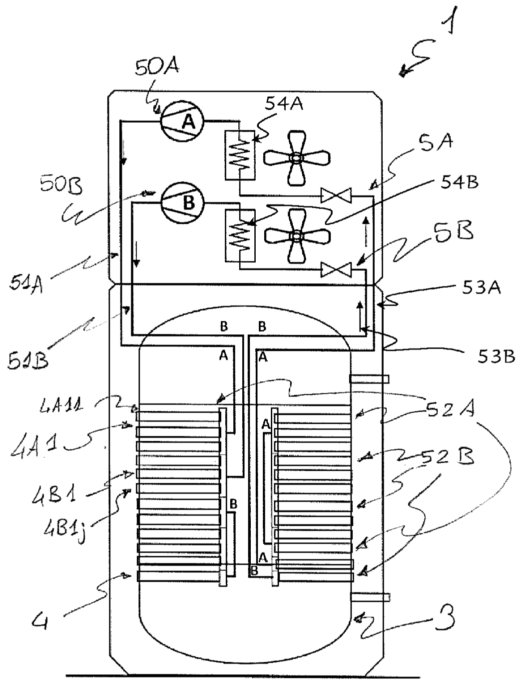

Fig. 2

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Description

[0001] The object of the present disclosure is a storage water heating system with a heat pump and optionally using propane.

[0002] More generally, the disclosure is applicable to any heat pump system comprising one heat exchanger in a heat exchange relation with a body to be heated and/or cooled, generally consisting of a fluid containing tank. Such systems may be heat pumps for sanitary water, which heat a sanitary water tank, or heat pump air conditioning systems, which condition a technical fluid intended to be fed to radiators, underfloor conditioning systems or fan coils. Heating and air conditioning may be combined in a single system.

[0003] A heat pump system comprises one refrigerant circuit wherein a heat transfer fluid flows. In the circuit the heat transfer fluid is pushed by a compressor, towards a condensing section, subsequently a first connection section leads the heat transfer fluid, condensed, through a restriction, towards an evaporation section; in the evaporation section the heat transfer fluid passes to the gaseous form and from there, through a second connection section, returns to the compressor. The condenser and the evaporator make up two heat exchangers. In the heat pump systems for air conditioning, the circulation direction of the heat transfer fluid may be reversed and the section of the refrigerant circuit that exchanges heat with the tank of the technical fluid may function both as a condenser and as an evaporator.

[0004] Since 2014 the European regulation UE No. 517/2014 on F-Gases placed a cap to the placing on the market of the fluorinated gases thus promoting their gradual reduction; therefore, the market has started developing products capable of using low environmental impact gases, low global warming potential refrigerants, among which propane R290. On the other hand, propane is odourless and highly flammable.

[0005] The technological evolution which characterised propane heat pumps is aimed at reducing risks. In particular, these machines provide for a very small amount of refrigerant in the system.

[0006] In the event of a gas leak, the risk of fire is proportional to the concentration of gas in the air at an ignition point, such as a spark. Therefore, the gas volume contained in a circuit is a risk factor. However, there is a limit to the reduction of gas in the refrigerant circuit because, other characteristics being equal, reducing the gas implies reducing the power of the heat pump.

[0007] Other improvements introduced are: hermetically sealed refrigerant circuits with no points of contact with the hydraulic circuit and compressors designed to prevent propane from leaking.

[0008] Heat pump water heaters with two heat transfer circuits configured to work in parallel are known, the double circuit here provides the flexibility to reduce the consumption when it is not necessary to have full nominal power. In the known circuits the two condensers exchange heat with different parts of the storage of Figure 1.a.

[0009] So called micro channel heat exchangers are known, which are heat exchange devices used for example in air conditioning systems for domestic or commercial vehicles. The micro channel heat exchanger comprises one body in which channels, commonly called micro channels, are obtained. The micro channel as its name says is characterised by channels having a smaller section than the traditional windings. The micro channel technology is used with the aim of increasing the contact area and therefore the efficiency of the exchanger. Such exchangers are generally flat and, seen in section, the micro channels are arranged along a line. Micro channel exchangers are known in which all the micro channels are connected at one end to a single delivery manifold from which the fluid comes and at the other end thereof to a single return manifold towards which the fluid continues its path. See figure 1.b.

[0010] The micro channel heat exchanger may be used as a condenser in a storage heating system for the production of sanitary or technical hot water or both as an evaporator and a condenser in an air conditioning system.

[0011] Solutions are therefore not known for improving the safety of propane heat pumps other than those that provide better sealing of the circuit and applications of the micro channel technology other than those aimed at improving heat exchange are not known.

[0012] The disclosure aims to improve the safety of a heat pump with respect to gas leaks. According to the disclosure this is obtained by dividing the heat transfer fluid onto two separate refrigerant circuits between which there is no possibility of mixing the heat transfer fluid; the proposed solution enables the separate circuits to define the same heat exchanger made with channels or preferably at least in part micro channels.

[0013] Here, unlike the prior art, the channels, optionally micro channels, are used to create a double crossed circuit heat exchanger, comprising two separate refrigerant circuits, and configured so as not to have fluid communication from one refrigerant circuit to the other, and which share the same heat exchanger body, configured to be traversed by a heat transfer fluid through two paths, hereinafter referred to as "flow paths". Each flow path belongs to a different refrigerant circuit and each flow path comprises a plurality of channels configured to be arranged in a heat exchange relation with at least a same body to be heated or cooled. The channels belonging to the same circuit are connected to each other to create a seamless passage from an inlet connection section located upstream of each flow path and an outlet connection section located downstream.

[0014] The two circuits both exchange heat with the same body thanks to the fact that at least part of the channels of each flow path is alternated with channels of the other flow path on a heat exchange surface between the exchanger body and the body to be heated or cooled.

[0015] The connections between the channels of the same flow path may be made directly via common connection manifolds or via a bypass connection.

[0016] Preferably, the channels are at least in part made with micro channel technology.

[0017] The availability of two compressors whose combined powers provide the maximum necessary power necessary further allows the power to be adjusted on at least two levels and the power to be reduced when the heating demand is low.

Description of the figures

[0018] The features of the present disclosure shall be better highlighted by the following description of a preferred embodiment, in accordance with the patent claims and illustrated, purely by way of a non-limiting example, in the annexed drawing tables, wherein:

- Figure 1.a shows a heat pump water heater with two refrigerant circuits according to the prior art,
- Figure 1.b shows a heat pump water heater with two refrigerant circuits having different condenser configuration according to the prior art;
- Figure 1.c shows a heat pump water heater with two refrigerant circuits and two tanks in series according to the prior art;
- Figure 2 shows a heat pump water heater with two refrigerant circuits according to a possible embodiment of the disclosure;
- Figure 3.a shows a front view of a micro channel heat exchanger according to a possible embodiment of the disclosure;
- Figure 3.b shows a micro channel heat exchanger with a section view;
- Figure 3.c shows a heat exchanger as in figure 3.a with further references to shown features;
- Figure 4.a shows a heat pump water heater with two refrigerant circuits in a further possible embodiment of the disclosure;
- Figure 4.b shows part of a heat pump system with two storages and two refrigerant circuits in a further possible embodiment of the disclosure.
- Figure 4.c shows a possible heating diagram for a double tank water heater comprising two heat pumps and two refrigerant circuits according to a possible embodiment of the disclosure;
- Figure 5 shows part of a heat pump system with two storages and two refrigerant circuits in a top view and in a further possible embodiment of the disclosure.

Detailed Description

[0019] The features of a preferred variant of the disclosure are now described, using the references contained in the figures. It should be noted that the above figures, although schematic, reproduce the elements of the disclosure according to proportions between the spatial dimensions and orientations thereof that are compatible with a possible executive embodiment.

[0020] It should also be noted that any dimensional and spatial term (such as "lower", "upper", "inner", "outer", "front", "rear" and the like) refers to the positions of the elements as shown in the annexed figures, without any limiting intent relative to the possible operating positions.

[0021] With reference to figure 2 and/or 4.a, the heat pump system 1 comprises two separate refrigerant circuits 5A, 5B, and configured so as not to have fluid communication from one refrigerant circuit 5A, 5B to the other refrigerant circuit 5B, 5A. Each refrigerant circuit comprising, listed in the sequence travelled by the fluid, one compressor 50A, 50B, one first connection section 51A, 51B, at least one condensing section 52A, 52B, 521A, 521B, at least one second connection section 53A, 53B and one evaporation section 54A, 54B. According to the disclosure, the two refrigerant circuits 5A, 5B share the same heat exchanger body 4, adapted to cooperate and exchange heat with the body 3, 31, 32 to be heated or cooled. The heat exchanger body 4 is configured to be traversed by a heat transfer fluid through at least two flow paths 52A, 52B, 521A, 521B each belonging to a respective refrigerant circuit 5A, 5B. In general, the heat exchanger 4 may act both as a condenser and as an evaporator depending on the circulation direction of the fluid which, as known, may be reversed. A heat exchanger body 4 with micro channel technology and double crossed circuit distribution is described below.

[0022] By way of a non-limiting example, for descriptive simplicity, hereinafter, see Figures 2 and 4.a, the heat pump system 1 is described as configured to heat a tank 3, 31, 32, for example a domestic or technical water storage 3, 31, 32 for air conditioning. In this case, the heat exchanger 4 is a condenser.

[0023] As shown in figure 2, and/or 4.a and/or 4.b, at least two sections 52A, 52B, 521A, 521B may be provided inside the heat exchanger 4, adapted to exchange heat with a body 3, 31, 32 to be heated or cooled; the condensing section therefore comprised and defines at least one flow path 52A, 52B, 521A, 521B configured to exchange heat with the body 3, 31, 32. With reference to figure 3.c, the heat exchanger 4 comprises two flow paths, the first 52A, 521A, comprising a plurality of channels 4A1 1, 4A12, 4A21..., 4Aij, the second 52B, 521B in turn comprising a plurality of channels 4B11, 4B12, 4B21..., 4Bij. The channels belonging to the same circuit are connected to each other to create a seamless passage from an inlet connection section 51A, 51B located upstream of each flow path 52A, 52B, 521A, 521B and an outlet connection section 53A, 53B located downstream. At least one part of the channels of each flow path 52A, 52B, 521A, 521B is alternated with channels of the other flow path 52B, 52A, 521B, 521A on a heat exchange surface between the heat exchanger body 4 and the body 3, 31, 32 to be heated or cooled.

[0024] Preferably, the channels 4A11, 4A12, 4A21, ...

4Aij, 4B11, 4B12, 4B21, ... 4Bij of the same circuit 5A, 5B are associated in one or more groups 4A1, 4A2, ... 4Aj, 4B1, 4B2, ... 4Bj, see figure 3.a. According to a possible embodiment, the channels 4A11, 4A12, 4A21, 4Aij, 4B11, 4B12, 4B21, ... 4Bij,in a group 4A1, 4A2, ... 4Aj, 4B1, 4B2, ... 4Bj, are placed side by side with each other and in thermal contact with the body 3, 31, 32 to be heated or cooled.

[0025] Preferably each flow path 52A, 521A, 52B 521B respectively comprises at least one inlet manifold 7A1, 7A2..., 7Aj and 7B1, 7B2, 7Bj and at least one outlet manifold 8A1, 8A2, 8Aj and 8B1, 8B2..., 8Bj. More precisely, each group 4A1, 4A2..., 4Aj, 4B1, 4B2..., 4Bj is associated with a common input manifold 7A1, 7A2, ... 7Aj, 7B1, 7B2, ... 7Bj and a common output manifold 8A1, 8A2, ... 8Aj, 8B1, 8B2, ... 8Bj.

[0026] Two groups 4B1 and 4B2, 4A1, 4A2 and 4A3, belonging to the same flow path 52A, 52B are consecutive if a fluid exiting the first of the two is introduced into the second of the two via a direct connection or substantial coincidence between the outlet manifold 8B1, 8A2 of the first and the inlet manifold 7B2, 7A3 of the second.

[0027] Accordingto a possible embodiment, the channels 4A11, 4A12, 4A21, ... 4Aij, 4B11, 4B12, 4B21, ... 4Bij, in a group 4A1, 4A2, ... 4Aj, 4B1, 4B2, ... 4Bj, are placed side by side and in thermal contact with the body 3, 31, 32 to be heated or cooled.

[0028] According to a possible embodiment, the exchanger body 4 comprises a first head manifold 10 comprising several manifolds 7A1, 7B1, 8B2, 8A2, ...7Aj, ...7Bj, 7Bj and dividers 10.1, 10.k adapted to implement separations between the manifolds and a second head manifold 11 comprising several manifolds 8A1, 8B1, 7B2, 7A2, ... 8Aj, ... 8Bj and dividers 11.1, 11. h.

[0029] Preferably, all the channels 4A11, 4A12, 4A21, ... 4Aij, 4B11, 4B12, 4B21, ... 4Bij are arranged so that their two ends are aligned, along the development of the head manifolds 10, 11.

[0030] Two groups relating to the same flow path, 52A, 52B respectively, may be consecutive and adjacent as, for example, in the case of the groups 4A2 4A3 or 4B1, 4B2; in this case, they are preferably connected by an outlet manifold 8A2 or 8B1 which places the first group 4A2 or respectively 4B1 in fluid communication with the second and consecutive group 4A3 or respectively 4B2. In other words, each of the aforementioned output manifolds 8A2 or 8B1 acts both directly as an output manifold of the first group and directly as an input manifold 7A3 or respectively 7B2 of the second group. The output 8A2 or 8B1 and input 7A3 or 7B2 manifolds are directly connected to each other due by the absence of the respective divider. If two consecutive groups along the same circuit are not adjacent, such as for example the groups 4A1 and 4A2 or 4B2 and 4B3, they are connected by a suitable connection or bypass 9A or respectively 9B, configured to connect the output manifold of the first group 8A1 or 8B2 with the inlet manifold of the second group 7A2 or 7B3 respectively.

[0031] As depicted in the embodiment example of figure 3.a, for each circuit 5A, 5B there are three groups 4A1, 4A2, 4A3, 4B1, 4B2, 4B3, one fitting with an external connection 9A, 9B, and a direct connection between an outlet manifold 8B1, 8A2 and the subsequent inlet manifold 7B2, 7A3. The groups may be different in number than three and not necessarily the same number for each circuit 5A, 5B.

[0032] According to a preferred embodiment, the channels 4A11, 4A12, 4A21, ... 4Aij, 4B11, 4B12, 4B21, ... 4Bij are made with the micro channel technology.

[0033] It is possible to configure the channels 4A11, 4A12, 4A21, ... 4Aij, and 4B11, 4B12, 4B21, ... 4Bij so that the distribution of the heat exchange areas of the different circuits 5A, 5B is not uniform for the entire area of the exchanger 4, but that a circuit 5A, 5B is intended to exchange heat mainly with one zone. In this case a first refrigerant circuit 5A, 5B comprises a greater number of micro channels in a sector of the single exchanger body compared to a second refrigerant circuit 5B, 5A.

[0034] In a system of heat pumps exchanging heat with a vertical and low input storage 3, 31, 32, this measure allows controlling the stratification of the temperatures. For example, a first refrigerant circuit may comprise a greater number of micro channels in the highest part of the storage 3, 31, 32 compared to a second refrigerant circuit. In this case it is preferable that the refrigerant circuit with a greater number of channels in the highest part of the accumulation 3, 31, 32 is sized to have a higher power than the other.

[0035] Preferably, the direction of passage of the fluid is from top to bottom, i.e. upstream with respect to the motion of water in the tank during the withdrawals.

[0036] Furthermore, it is possible to activate only the compressor of the refrigerant circuit, which exchanges heat mainly with the highest part of the tank if only a limited quantity of water and not the entire tank is wished to be heated.

[0037] In general, the distinct and independent circuits 5A, 5B which define the same heat exchanger body 4 configured with micro channels 4A11, 4A12, 4A21, ... 4Aij, 4B11, 4B12, 4B21, ... 4Bij and with the illustrated structure may be more than two. The heat exchanger body 4 may indifferently be either a condenser in case of a heat pump for heating or an evaporator in case of a heat pump for cooling. According to a possible embodiment, both the evaporator and the condenser may be a single exchanger body made with micro channels configured to define two or more independent circuits without connection points from one circuit to the other and therefore without the possibility of mixing heat transfer fluids. The heat pumps may be configured to heat or cool a tank 3, 31, 32, as in the case of a sanitary or technical water heater in figure 2.

[0038] Water heaters for sanitary or technical water with a storage distributed over two tanks are known. This feature is used to obtain a form factor more suitable for specific manufacturing needs. According to a possible embodiment, the same heat exchanger body 4, e.g. a condenser body 4, with micro channel technology and double-crossed circuit distribution may be made to maximise the contact surface with two side-by-side tanks 31, 32 as in figure 4.a and 4.b. In this case the heat exchanger body in contact with the tanks may advantageously be provided with thermal bridges 44 which increase the heat exchange along the slots that are formed among the contact line between the two tanks and the exchanger 4. Such thermal bridges 44 may be made with any heat-conductive material.

[0039] According to a possible embodiment, in a double-tank water heater the channels of the heat exchanger body 4 belonging to a first refrigerant circuit 5A, 5B mainly exchange heat with a first tank 31, 32, i.e. at least one of the two refrigerant circuits exchanges more heat with a tank than with the other. The heat pump system and in particular the double-crossed heat exchanger may be configured so that each tank 31, 32 may be subject to the same or to a different amount of heat exchange. In either case, it is possible that each tank 31, 32 is subject to heat exchange in different proportions with respect to each of the two refrigerant circuits 5A, 5B. A variation in the rate of heat exchange from a refrigerant circuit 5A, 5B between the two tanks 31, 32 can be obtained e.g. by a different heat exchange area of a refrigerant circuit 5A, 5B vs a first tank 31, 32 rather than the second tank 32, 31, or by contacting the initial part of the circuit with a first tank 31, 32 rather than the second tank 32, 31. Where the initial part of the circuit is the part in which flows the fluid that is at the highest absolute temperature difference with the tanks inner temperature.

[0040] As an example, the two tanks can be connected in series, the first tank 31 can be the input tank, connected to a cold water pipe, while the second tank 32, can be the output tank connect the a hot water output pipe or faucet, the input tank 31 is connected in series to the output tank 32 so that water from the cold water pipe can flow from the input tank 31 to the output tank 32. A first refrigerant circuit 5A can be configured to exchange, on average, less than 50% of its heat with the first tank 31 and the remaining amount with the second tank 32. E.g. the first circuit can be configured to exchange 30% or 20% of the heat with the first tank and the remaining with the second (output) tank. The expert of the field will understand that heat exchange depends on the relative temperature difference between a refrigerant circuit 5A, 5B and a water tank 3, 31, 32; so the expression "configured to exchange, on average, less than 50% of its heat with the first tank 31 and the remaining with the second tank 32" means that the relative percentage of heat exchange refers to a situation wherein the tanks 31, 32 have substantially the same temperature.

[0041] It is advantageous to provide one tank of water at a set temperature in a given heating time rather than both tanks at the same set temperature in a much longer heating time. This means that one user needs to wait a shorter time to take one shower; in any case a second user needs to wait substantially the full double tank heating time for a second shower amount of water to be heated.

[0042] According to an aspect of the disclosure the first refrigerant circuit 5A is configured to exchange on average more than 50% of its heat with the output tank 32, and the rest with the input tank 31. This allows to concentrate more than half the power of the first heat pump A to the output tank and thereby shorten the time to reach a set temperature in the output tank. In this case it is possible that the second refrigerant circuit 5B is configured to deliver opposed percentages of heat exchange to the two tanks e.g. more than 50% to the input tank. According to an aspect of the disclosure a method to heat water with a heat pump system 2 comprising double crossed circuits 5A, 5B and two tanks 31, 32 comprises the steps of switching on a first heat pump A corresponding to a refrigerant circuit 5A configured to exchange more than 50% of its heat with the output tank 32 until the output tank has reached a set temperature and then switching off the first heat pump A and switching on a second heat pump B corresponding to a refrigerant circuit 5B configured to exchange more than 50% of its heat with the input tank 31 until the input tank 31 has reached a set temperature. This system has the following advantages: each tank can receive the full heat exchange of the two heating circuits 5A, 5B if both heat pumps are turned on, a preferred tank can be preferentially heated if only one heat pump is turned on. The heating speed of the output tank can be improved vs the heating speed of the input tank by an appropriate design of the double-crossed refrigerant circuits. It is to be noted that once the output tank 32 approaches the set temperature and until the input tank 31 is below the set temperature an increasing amount of heat exchange naturally occurs with the input tank 31 until the input tank 31 has reached the set temperature. Therefore, both refrigerating circuits 5A, 5B could be configured to exchange more than 50% of their heat with the output tank 32 while the tanks are at the same temperature.

[0043] As an alternative, a possible embodiment of the disclosure is a tank water heating heat pump system comprisingtwo heat pumps and two tanks connected in series a first tank configured to serve as input tank for cold water, the second tank configured to serve as output tank for hot water, each heat pump comprising a refrigerating circuit, the refrigerating circuits configured to exchange heat with the tanks, and at least one refrigerating circuit configured to exchange heat with both tanks, the couple of refrigerating circuits configured to heat the output tank at a higher speed than heating the input tank at least until the output tank has reached a set temperature. The two heat exchanging circuits, in case of a water heater are two condenser circuits.

[0044] For the version with double tanks in series it is possible, but not necessary that the two refrigerating circuits have at least part of the channels of each flow path alternated with channels of the other flow path, i.e. it is not necessary that the two refrigerating circuits are of the double crossed type. The advantage of this embodiment is the construction simplicity, in case the refrigerating circuits are not of the double crossed type, and the capability to deliver a greater amount of the heat to the output tank, so that hot water for one shower is available in a time shorter than that required to heat the full water volume (both tanks).

[0045] A possible diagram of the heating time for each tank is shown in Figure 4.c, this effect is obtained when at least one the condenser heat exchangers is configured to exchange more heat with the output tank, as the output tank approaches the maximum temperature to which the heat pump can heat it, then more heat will be exchanged with the input tank due to the higher temperature difference between the input tank and any of the two condenser heat exchangers.

[0046] Once the output tank is heated, less heat will be exchanged with the output tank and more heat with the input tank. A possible embodiment of the double tanks in series version is one in which the percentages of the heat that each refrigerating circuit is configured to exchange with each tank, the tanks being at the same initial temperature, is different from one circuit to the other; i.e. one circuit exchanges more heat with the input tank than the other. So an aspect of the disclosure is a method to heat a double tank water heater comprising two tanks connected in series a first tank configured to serve as input tank for cold water, the second tank configured to serve as output tank for hot water, and two heat pumps, each heat pump comprising a condenser heat exchanger, the condenser heat exchangers configured to exchange heat with the tanks, and at least one condenser heat exchanger configured to exchange heat with both tanks and at least one condenser heat exchanger configured to exchange more heat with the output tank than with the input tank, the method comprising the steps:

- switching on and maintaining active a first heat pump comprising a condenser heat exchanger configured to exchange more heat with the output tank than with the input tank until the water in the output tank has reached a set temperature,
- optionally switching off the first heat pump and maintaining active at least one of the heat pumps comprising a condenser heat exchanger configured to exchange heat with the input tank until the water in the input tank has reached a set temperature.

[0047] In general, the micro channel heat exchanger body 4 with double-crossed circuit distribution may cooperate with a body with which to exchange heat 3, 31, 32 not exclusively a cylindrical shape.

[0048] An aspect of the disclosure is a method for implementing the heat exchanger body 4 wherein the channels are characterised by a double-crossed circuit distribution. The method comprises a channel extrusion step, with preferably cylindrical profiles,

- a manufacturing step of the head manifolds 10, 11, through extrusion and/or drawing.
- an assembling step of the channels with the head manifolds 10, 11,
- a step of placing a solder adapted to solder or weld and soldering or welding through a heating step in an oven. Preferably, the drawing of the head manifolds comprises aluminium.

[0049] This process guarantees versatility on the various designs that may be made in terms of number, size and shape of the channel section and dimensions of the exchanger.

Claims

1. Heat pump system (1, 2) with double crossed circuit, comprising two separate refrigerant circuits (5A, 5B), having no fluid communication from one refrigerant circuit (5A, 5B) to the other refrigerant circuit (5B, 5A), wherein:

   - the two refrigerant circuits (5A, 5B) share the same heat exchanger body (4), associated to a body (3, 31, 32) to be heated or cooled, the heat exchanger body (4) configured to be traversed by a heat transfer fluid through two flow paths (52A, 52B, 521A, 521B) each belonging to one of the two refrigerant circuits (5A, 5B), each flow path (52A, 52B, 521A, 521B) comprising a plurality of channels (4A11, 4A12, 4A21, ... 4Aij, 4B11, 4B12, 4B21, ..., 4Bij) connected to each other to create a seamless passage from an inlet connection section (51A, 51B) located upstream of each flow path (52A, 52B, 521A, 521B) to an outlet connection section (53A, 53B) located downstream,
   - and wherein on a heat exchange surface between the heat exchanger body (4) and the body (3, 31, 32) to be heated or cooled at least part of the channels of each flow path (52A, 52B, 521A, 521B) is alternated with channels of the other flow path (52B, 52A, 521B, 521A)

   characterised in that the channels (4A11, 4A12, 4A21, ... 4Aij, 4B11, 4B12, 4B21, ..., 4Bij) of a same circuit (5A, 5B) are associated in one or more groups (4A1, 4A2, ..., 4Aj, 4B1, 4B2, ..., 4B) of side-by-side channels and in a thermal exchange relationship with the body (3, 31, 32) to be heated or cooled.

2. Heat pump system (1, 2) according to the previous claim, wherein each flow path (52A, 521A, 52B, 521B) comprises, associated with each group (4A1, 4A2, ..., 4Aj, 4B1, 4B2, ..., 4Bj), a common inlet manifold (7A1, 7A2, , 7Aj, 7B1, 7B2, ..., 7Bj) and a common outlet manifold (8A1, 8A2, ..., 8Aj, 8B1,

8B2, ..., 8Bj) and two groups in the same flow path (52A, 52B, 521A, 521B) that are consecutive and adjacent (4A2, 4A3 or 4B1, 4B2) are connected to each other by an outlet manifold (8A2 or 8B2) which acts directly as an inlet manifold (7A3 or 7B2) of the consecutive group and two groups that are consecutive and non-adjacent are connected by a suitable connection or bypass (9A, 9B), configured to connect the outlet manifold of the first group (8A1, 8B2) with the inlet manifold of the second group respectively (7A2, 7B3).

3. Heat pump system (1, 2) according to any one among the previous claims, wherein the channels (4A11, 4A12, 4A21, ..., 4Aij, 4B11, 4B12, 4B21, ..., 4Bij) are at least in part micro channels (4A11, 4A12, 4A21, ..., 4Aij, 4B11, 4B12, 4B21, ..., 4Bij).

4. Heat pump system (1, 2) according to any one of the previous claims, comprising propane gas in at least one of the two refrigerant circuits (5A, 5B).

5. Storage water heater (1, 2) comprising a heat pump system according to any previous claim, wherein the heat exchanger body (4) comprises the condensing sections (52A, 52B, 521A, 521B) of the two refrigerant circuits (5A, 5B) and the body (3, 31, 32) to be heated or cooled comprises a storage tank (3, 31, 32) of a heat transfer or domestic fluid.

6. Storage water heater (1, 2) according to claim 5, wherein the storage tank (3, 31, 32) is configured to be arranged vertically with an inlet from below and an outlet from above, and a first refrigerant circuit (5A, 5B) comprises a greater number of channel s in the heat exchanger body (4) in the upper part of the storage (3, 31, 32) with respect to a second refrigerant circuit (5B, 5A).

7. Storage water heater (2) according to claims 5 or 6, wherein the body (3, 31, 32) to be heated or cooled comprises two tanks (31, 32).

8. Storage water heater (2) according to claim 7, comprising at least one thermal bridge (44) located in the space defined between the shared heat exchanger body (4) and the junction line between the two tanks (31, 32).

9. Storage water heater (2) according to any of the claims 7 or 8, wherein the channels of the heat exchanger body (4) belonging to a first refrigerant circuit (5A, 5B) are configured to exchange heat with a first tank (31, 32) more than with a second tank (32, 31).

10. Storage water heater (2) according to any of the claims 7 or 8, wherein the channels of the heat exchanger body (4) belonging to at least one of the refrigerant circuits (5A, 5B) are configured to exchange heat with the output tank (32) more than with the input tank (31) while the two tanks have substantially the same temperature.

11. Method to heat a double tank water heater comprising two tanks connected in series wherein a first tank is configured to serve as input tank for cold water, the second tank configured to serve as output tank for hot water, the double tank water heater further two heat pumps, each heat pump comprising a condenser heat exchanger, the condenser heat exchangers configured to exchange heat with the tanks, and at least one condenser heat exchanger configured to exchange heat with both tanks and at least one condenser heat exchanger configured to exchange more heat with the output tank than with the input tank, the method comprising the steps:

- switching on and maintaining active a first heat pump comprising a condenser heat exchanger configured to exchange more heat with the output tank than with the input tank until the water in the output tank has reached a set temperature,
- optionally switching off the first heat pump and,
- maintaining active at least one of the heat pumps comprising a condenser heat exchanger configured to exchange heat with the input tank until the water in the input tank has reached a set temperature.

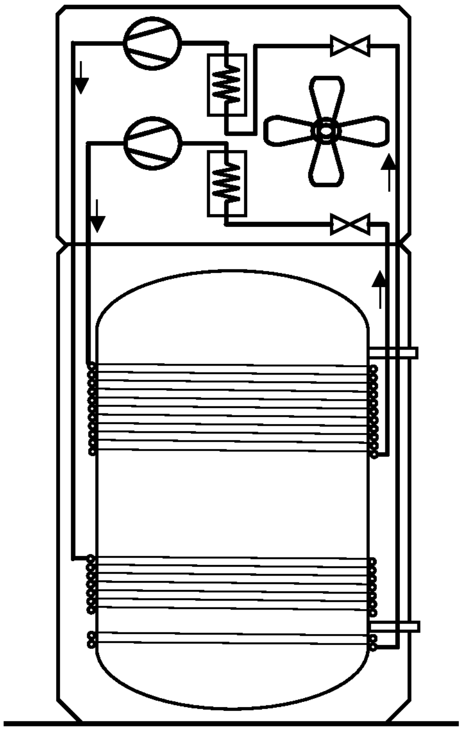


Fig 1.a

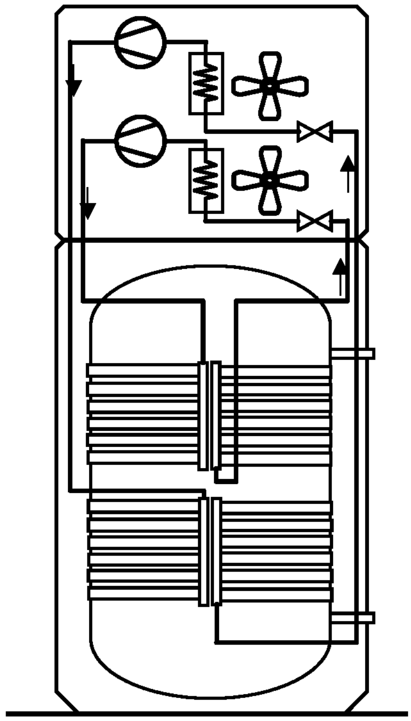


Fig 1.b

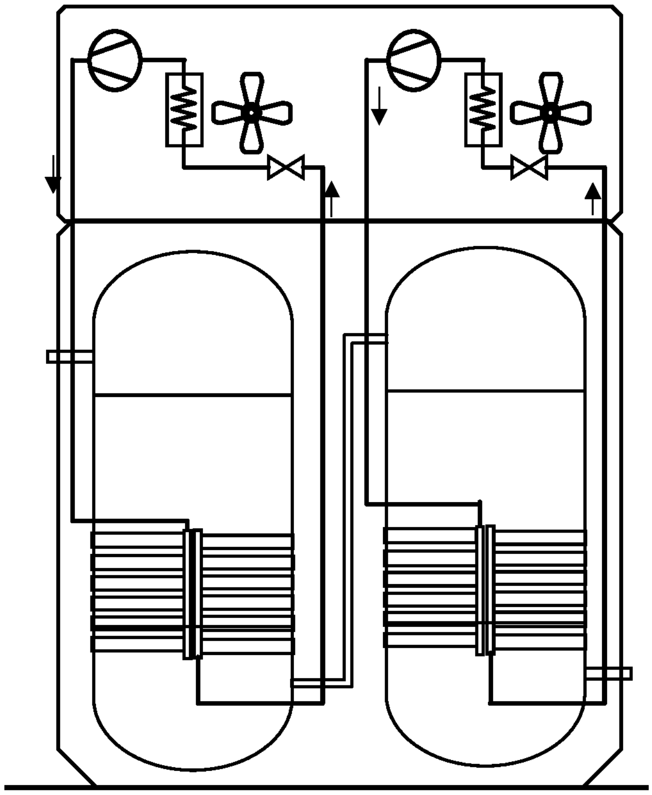
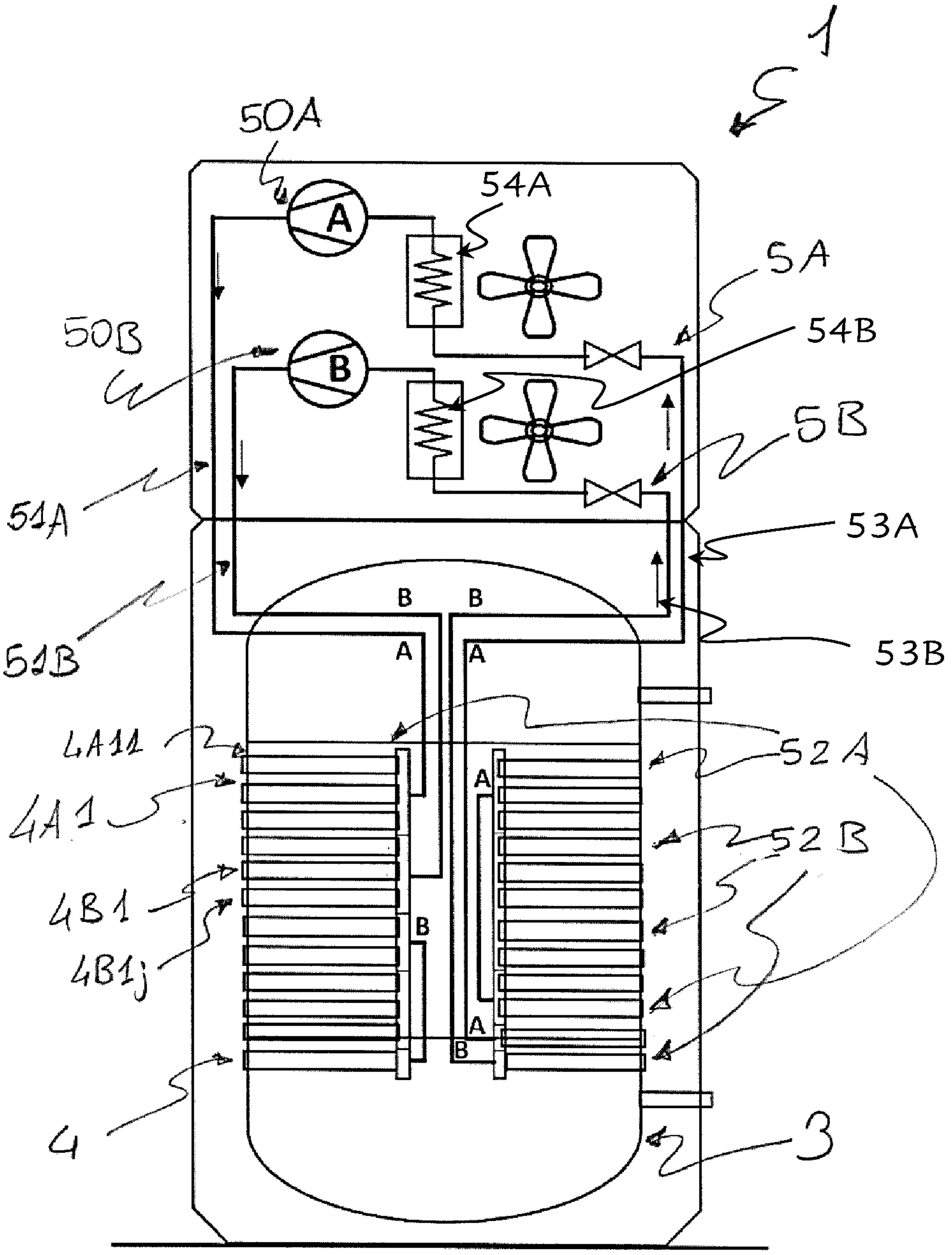


Fig. 1.c


1
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5A
50B
54B
5B
51A
53A
51B
53B
4A11
52A
4A1
52B
4B1
4B1j
4
3
A
B

Fig. 2

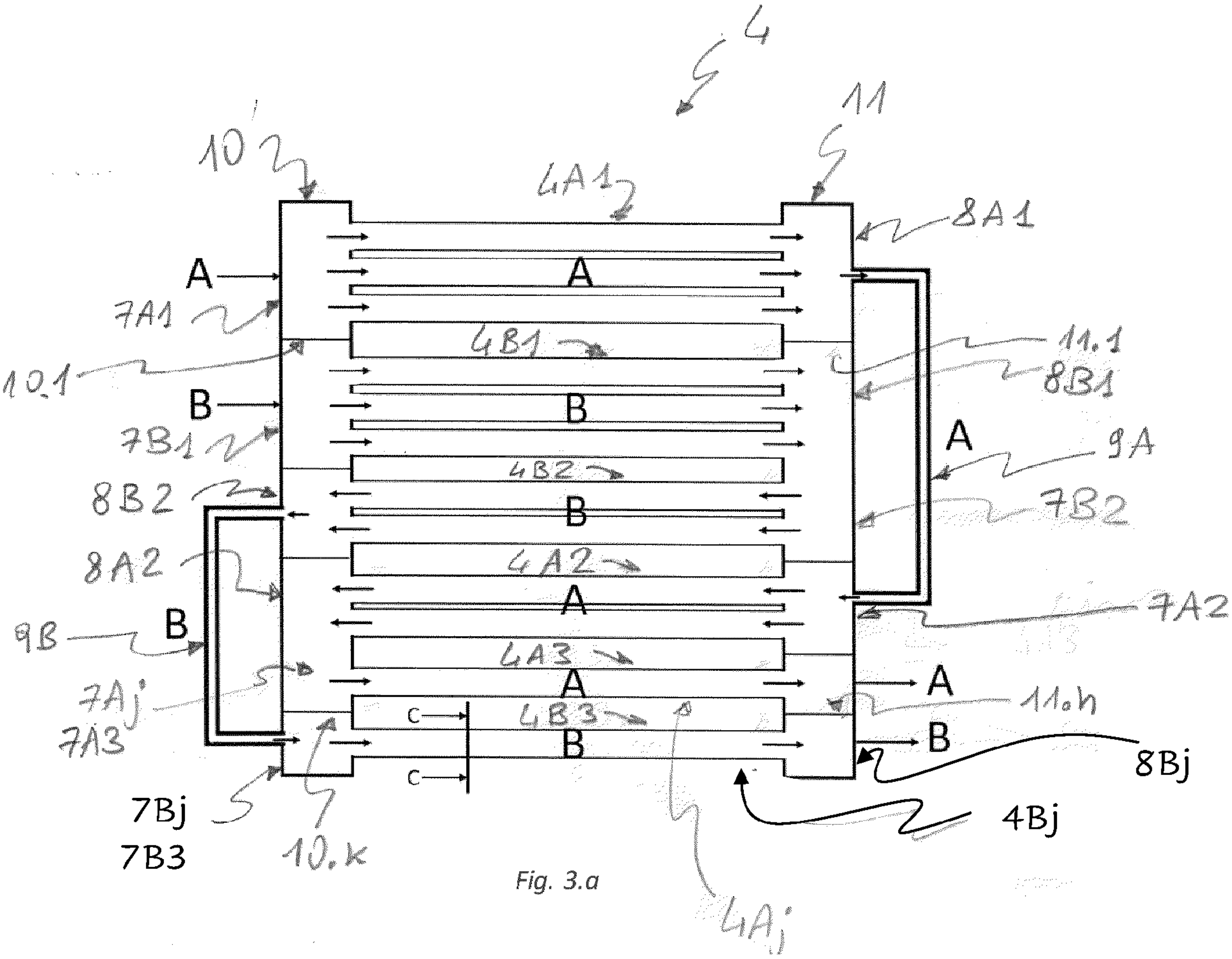
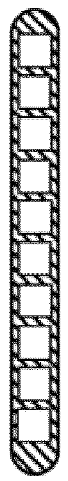
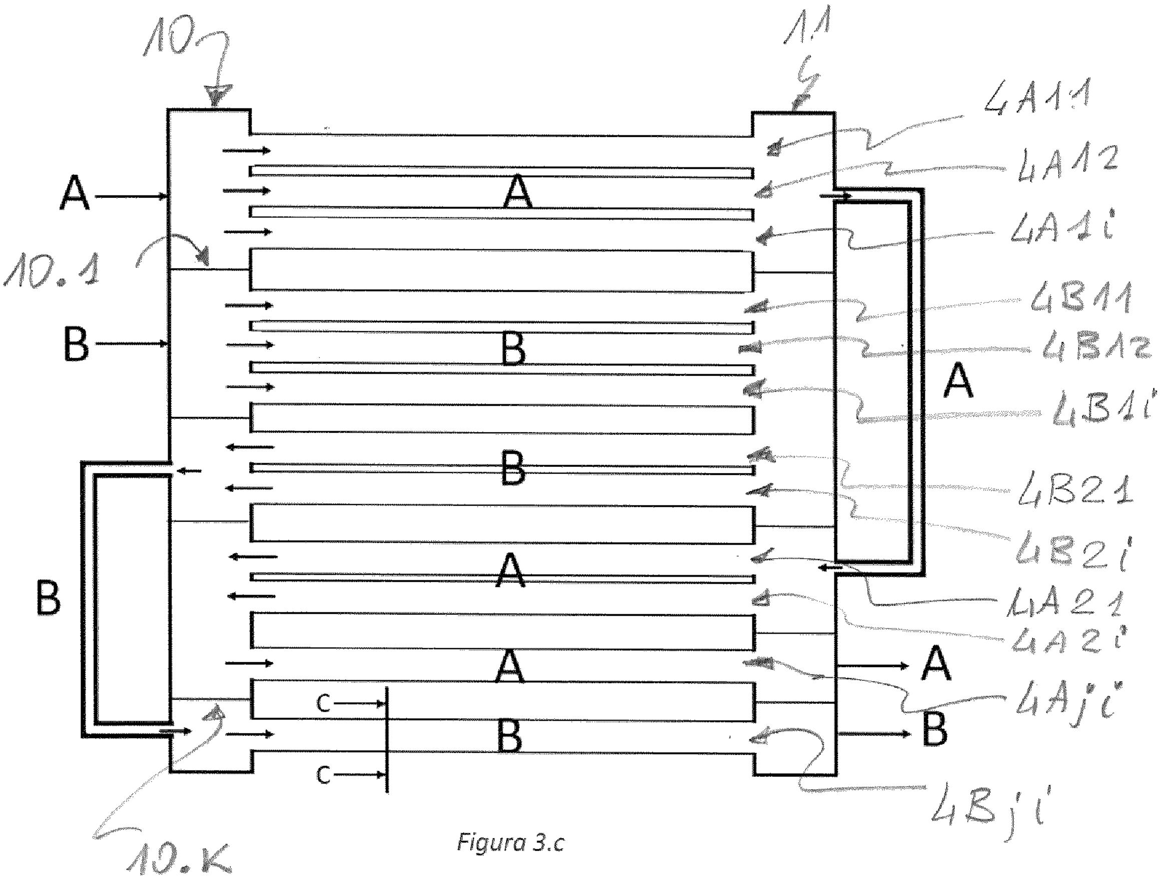


Fig. 3.a



Section C-C

Fig. 3.b


10
11
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4A12
4A1i
A
10.1
4B11
B
4B12
4B1i
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4A21
4A2i
4Aji
4Bji
10.K
C
C
Figura 3.c

Fig. 3.c

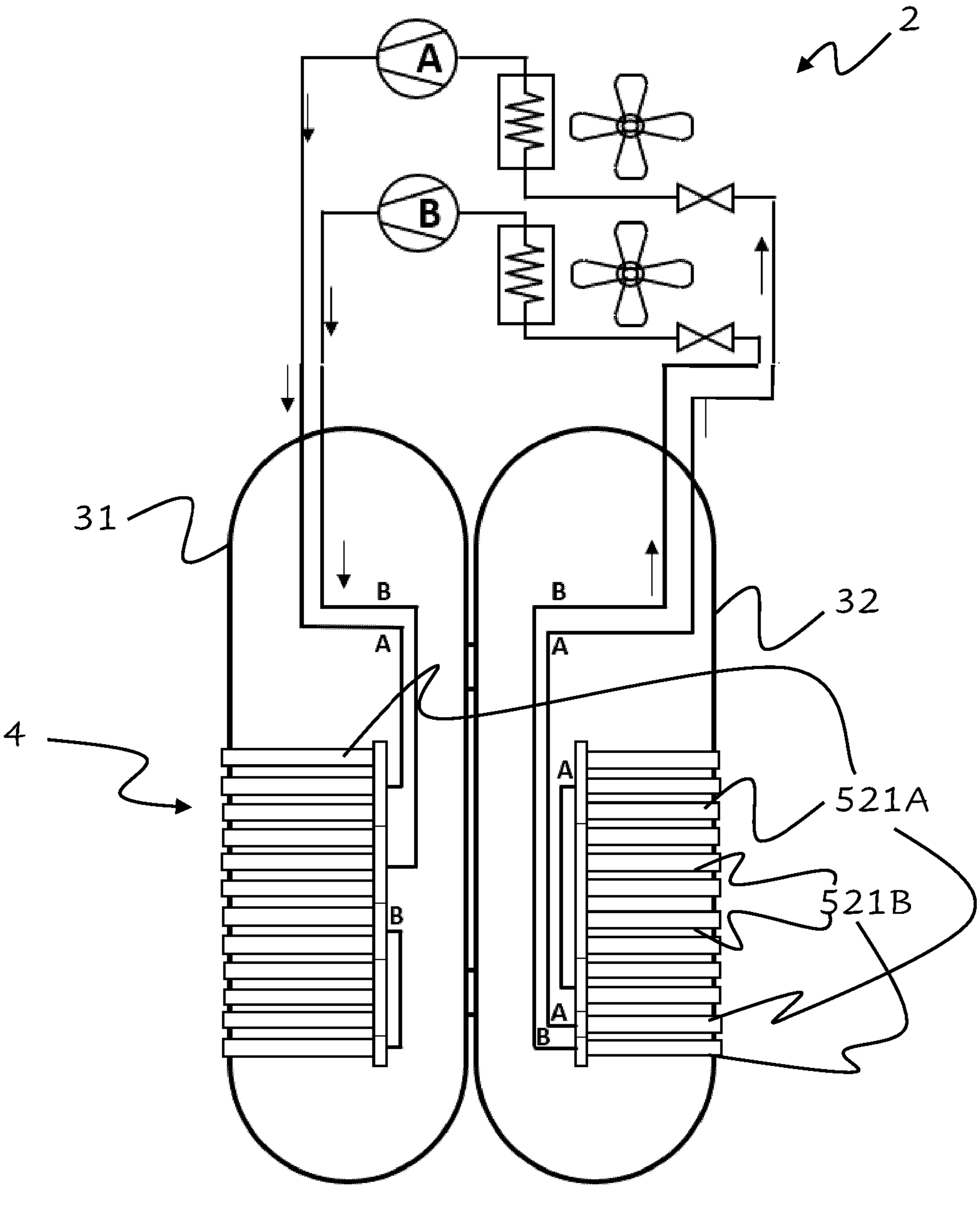

Fig. 4.a

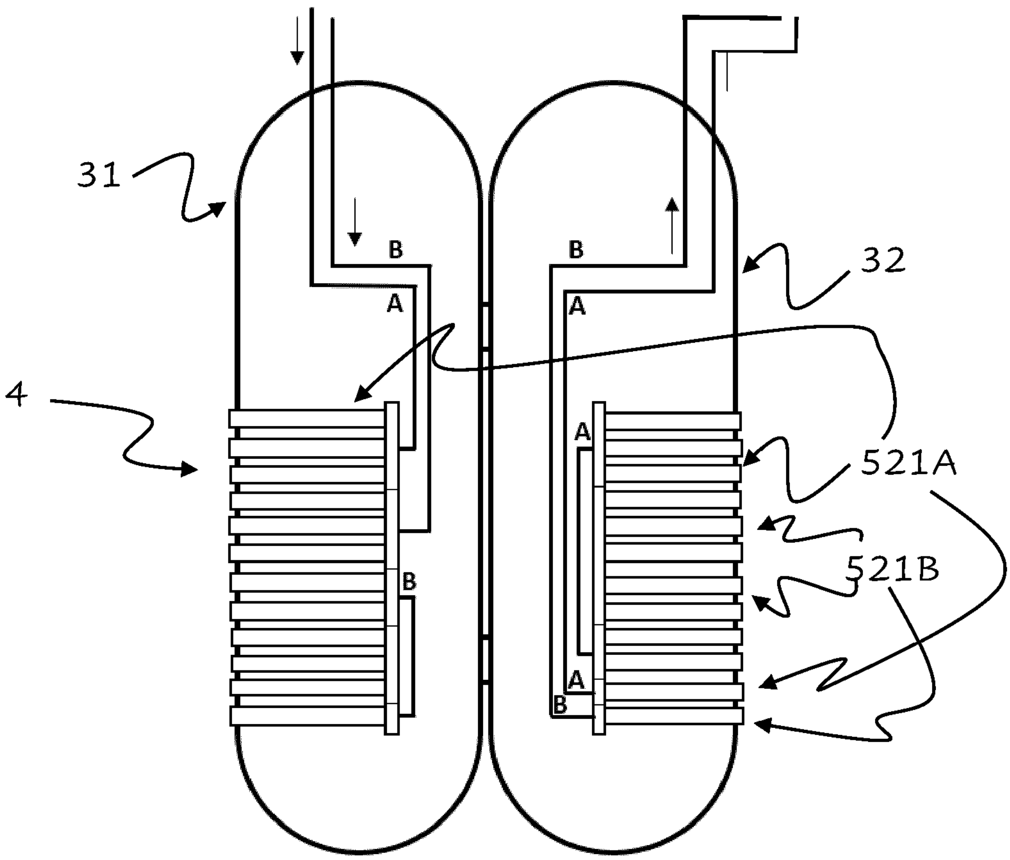

Fig. 4.b

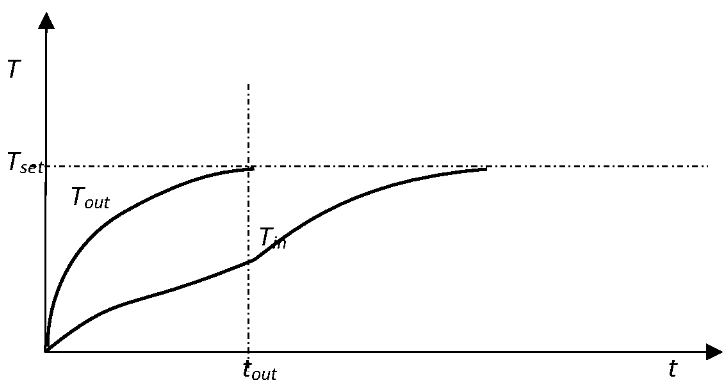

Fig. 4.c

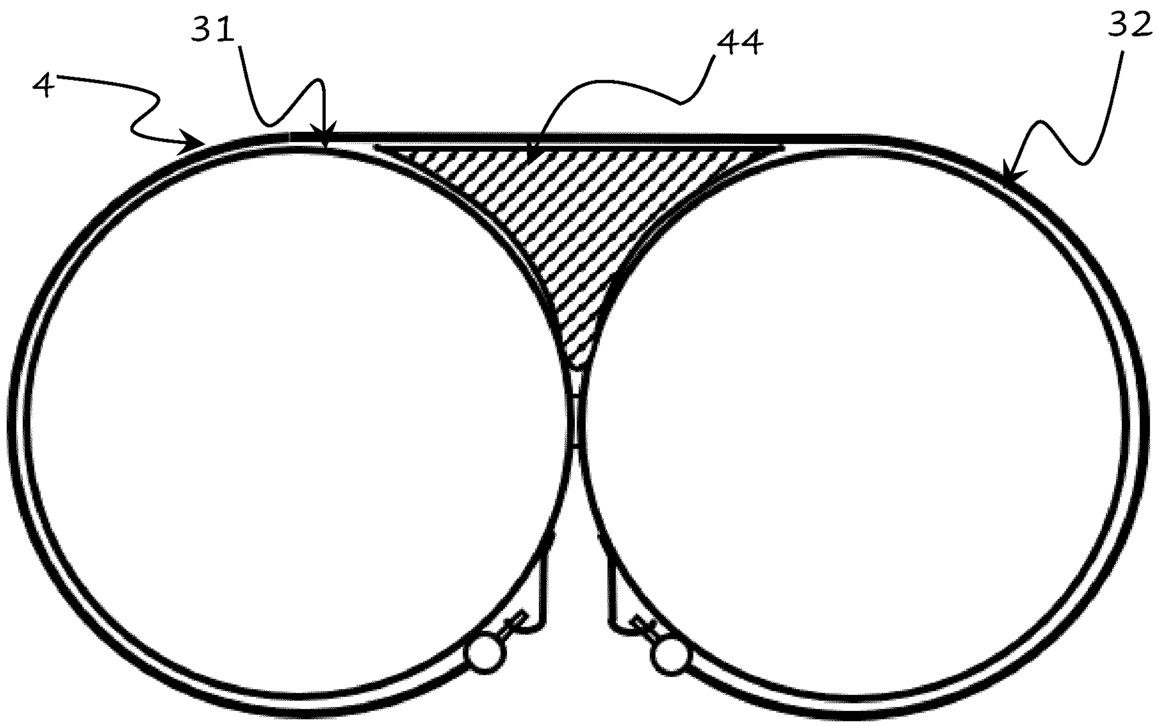

Fig. 5