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(54) **HVAC AIR CONDITIONING UNIT WITH IMPROVED EFFICIENCY**

(57) The present invention relates to an air conditioning unit (1) for heating or cooling the air (A_M) destined for an indoor environment (400). Said unit (1) comprises at least one refrigeration machine (5) that includes at least one refrigeration circuit (CF, CF_1 , CF_2) configured to produce a refrigeration cycle with a respective operating fluid. This circuit comprises a first air-to-liquid/gas heat exchanger (11, 11-1, 11-2) configured to generate, in a first heat exchange section (110), a heat exchange between said operating fluid and the treated air (A_M) destined for said indoor environment (400). The circuit further comprises a second air-to-liquid/gas heat exchanger (12, 12-1, 12-2) configured to generate, in a second heat ex-

change section (120), a heat exchange between said operating fluid and the air (A_E) of the outdoor environment (500). According to the invention, the air conditioning unit comprises a third heat exchange section (130) comprising suction means for sucking return air (A_R) coming from the indoor environment (400) into a chamber (30) partially delimited by a portion (12B, 12-1B, 12-2B) of the second heat exchanger (12, 12-1, 12-2) so that the return air (A_R) sucked into this chamber (30) is ejected into said outdoor environment (500) through said second portion (12B, 12-1B, 12-2B) of said second heat exchanger (12, 12-1, 12-2).

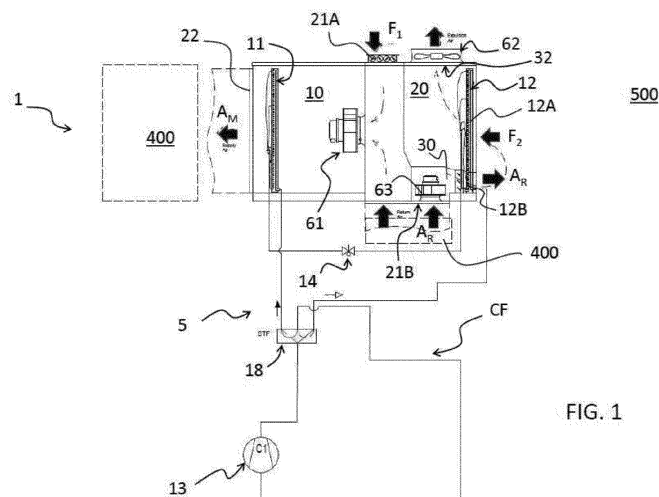


FIG. 1

Description

FIELD OF THE INVENTION

[0001] The present invention falls within the scope of the production of air conditioning systems for renewing and conditioning the air in open space environments, preferably, but not exclusively, of average volume. In particular, the present invention relates to an HVAC unit with improved efficiency.

BACKGROUND ART

[0002] In the heating and cooling sector, the use of air conditioning units indicated with the initials HVAC (Heating Ventilating and Air Conditioning) is widely known. These air conditioning units can be destined for residential buildings or for open space environments, such as shopping centres, cinemas, public buildings, hospitals or industries. In the case of open space environments, the air conditioning units are installed on the roofs of the buildings that delimit said environment and for this reason they are called rooftop air conditioning units.

[0003] In general, the main function of rooftop units is for conditioning the air aimed for the environment to be conditioned, commonly also indicated as "*treated air*". For this purpose, a rooftop unit is configured to draw air from the outdoor environment, commonly indicated as "*renewal air*", purify it and treat it, in terms of temperature and humidity, before being input, through suitable ducts, into the indoor environment to be conditioned. At the same time, a rooftop unit is configured to extract the exhaust air (also indicated as "*return air*") and to eject it into the outdoor environment. According to the level of crowding of the indoor environment, a fraction of the return air, instead of being ejected, can be re-treated and input into the indoor environment as treated air (also indicated as "*supply air*"). In general, it is known that the percentage of renewal air coming from the outdoor environment increases as the level of crowding of the indoor environment increases. Consequently, for indoor environments that are not particularly crowded, the major fraction of return air re-used as treated air can be increased.

[0004] In order to heat or cool the renewal air and the return air, a rooftop unit comprises a refrigeration machine that can be configured only to cool the air (*cooling mode*), only to heat the air (*heating mode*) or more frequently both to heat and to cool the air (*cooling and heating mode*). In general, to allow operation of the refrigeration machine, a rooftop unit has a first heat exchange section at which heat treatment of the supply air takes place and a second heat exchange section, separate from the first, where exchange with the outdoor environment takes place. According to the operating mode of the refrigeration machine (*heating or cooling*), the *outdoor environment* acts as heat sink for the refrigeration cycle.

[0005] Practice has shown that the part of the return

air from the indoor environment aimed to be ejected outside (defined as "*ejected air*"), can be used to improve the operation of the refrigeration machine or to improve its effectiveness. This is with a view to obtaining a general reduction in consumptions linked to conditioning. In this regard, for certain applications in the tertiary sector, some regulations and laws actually oblige manufacturers to equip the rooftop unit with an energy recovery system based on utilization of the exhaust air. In a first known configuration thereof, conventional recovery systems are based on the use of passive air-to-air heat exchangers (e.g. cross flows, enthalpy wheel, etc.) configured so as to carry out a transfer of thermal energy, and in some cases also of humidity, between a flow of exhaust air and the flow of renewal air destined for the environment to be conditioned. This transfer of thermal energy can be carried out directly between the two flows or through the use of intermediate fluids.

[0006] It has been seen that the efficiency of these recovery systems is greatly affected by variations in the outdoor conditions. In continental and mild climates, for example, where the difference between the indoor and outdoor temperature is very low, passive recovery systems have substantially no return. Moreover, the use of passive heat exchangers in any case requires larger ventilation systems that increase their total energy consumption.

[0007] In a second known configuration, a further dedicated refrigeration circuit is provided, in reference to which the exhaust air acts as heat sink in relation to the air to be input into the environment. The use of this additional refrigeration circuit further increases the complexity and the costs of the air conditioning unit, as well as also increasing the total amount of refrigerant of the unit.

[0008] Practice has shown that these recovery systems are somewhat critical in terms of design and hence also in terms of final costs. The configuration of these systems is in fact relatively complex, requires numerous components and hence also in terms of maintenance it is not particularly advantageous.

[0009] In a third known operative configuration, recovery systems use an air-coolant heat exchanger (of finned pack type) to carry out a heat exchange between the exhaust air, that acts as heat sink, and the operating fluid/refrigerant circulating in the external heat exchanger. In substance, according to the operating mode of the refrigeration machine (*heating or cooling mode*), the exhaust air is used as heat source to transfer or alternatively subtract energy, to the operating fluid/refrigerant of the external heat exchanger. Overall, these systems produce an energy recovery that directly affects the conditions of the main refrigeration cycle with the aim of increasing the overall effectiveness.

[0010] These last two energy recovery systems are more effective than the first one described above, as they are not affected by variations in the outdoor conditions and do not require excessive consumptions linked to ven-

tilation. Also in terms of design, in almost all cases, recovery systems that use a heat exchange with the operating fluid are less complex compared to the others described above. However, in absolute terms, the improvement of the effectiveness resulting from the recovery of energy contained in the exhaust air is in any case still limited. The patent EP 3663673 discloses an air conditioning system aimed to be housed inside a residential building for conditioning a plurality of rooms. This system has a plurality of air conditioning units, each of which comprises a refrigeration circuit with a first heat exchanger and a second exchanger arranged in a first housing, while the compressor of the refrigeration circuit is housed in a second housing, different from the first. For each air conditioning unit, the first housing delimits a first volume for the passage of air in which the first heat exchanger is located, wherein this first volume makes the inlet of the return air (connected with the environment to be heated or cooled) communicating with the supply opening of the treated air (also connected with the environment to be conditioned). The first housing also delimits a second volume for the passage of air in which the second heat exchanger is located, wherein this second volume makes the inlet of the renewal air (connected with the outdoor environment) communicating with an exhaust outlet through which the air is ejected into the environment outside the building.

[0011] In the solution of EP 3663673, an air-to-air heat exchanger is provided inside the first housing, arranged between two inner walls that define a first passage that makes the inlet of the renewal air communicating with the discharge opening through said air-to-air heat exchanger and said first volume for the passage of air. These transverse walls also define a second passage that makes the inlet of the return air communicating with the exhaust outlet through the air-to-air heat exchanger and the second volume for the passage of air.

[0012] Due to its complex internal structure, the system described in EP 3663673 is evidently unsuitable for conditioning open space environments and hence for treating large air flow rates such as those normally treated by rooftop units. In addition to this, the system at issue also has an energy recovery based on the use of a passive air-to-air heat exchanger with all the limitations mentioned above.

[0013] Therefore, there is the need to provide a new technical solution that allows the effectiveness of the refrigeration machine to be increased without complicating the configuration of the air conditioning unit in order to limit the production costs.

SUMMARY

[0014] The main aim of the present invention is to provide an air conditioning unit that allows the problems cited above to be overcome. Within this aim, a first object of the present invention is to provide a rooftop air conditioning unit that recovers the thermal energy contained in the

exhaust air through an exchange with the operating fluid/refrigerant circulating in the external heat exchanger of the refrigeration machine. Another object is that of providing an air conditioning unit in which, with the same performance, recovery of the thermal energy contained in the return air is more effective and quantifiable with respect to that of known solutions. A further object is to provide an air conditioning unit with a particularly simple and compact configuration. One more object of the present invention is to provide an air conditioning unit that is reliable and easy to produce at very competitive costs.

[0015] The Applicant has observed that the aim and the objects indicated above can be achieved by forcing the return air to transfer or remove thermal energy to/from the operating fluid/refrigerant circulating in a portion of the heat exchanger of the refrigeration machine designed to operate, depending on the case, as condenser or as evaporator, wherein the outdoor environment acts as heat sink or as cold source for condensation or evaporation of the operating fluid. In substance, according to the invention, the return air is exploited to modify the heat level of the operating fluid circulating in the heat exchanger by usefully varying the temperature at which condensation or evaporation of the operating fluid is completed.

[0016] In particular, the aim and the objects described above are achieved by means of an air conditioning unit for treating air aimed to an indoor environment to be conditioned, wherein said unit comprises a housing structure and at least one refrigeration machine that includes at least one circuit configured to implement a refrigeration cycle with a respective operating fluid. This refrigeration circuit comprises at least:

- a first heat exchanger of the air-liquid/gas type configured to carry out a heat exchange between said operating fluid and the treated air aimed to said indoor environment;
- a second heat exchanger of the air-liquid/gas type configured to carry out a heat exchange between the operating fluid and the air of the outdoor environment;
- a compressor to increase the pressure of said operating fluid to a value characteristic of condensation and expansion means to reduce the pressure of said operating fluid to a value characteristic of evaporation of said operating fluid.

[0017] The air conditioning unit according to the invention is characterized by comprising:

- a first heat exchange section defining a first chamber in which said first heat exchanger is housed, said first chamber comprising at least a first inlet connected with said outdoor environment and at least one outlet adapted to be communicating with said indoor environment, said first section comprising first suction means for sucking at least a first flow of external

air from said outdoor environment;

- a second heat exchange section defining a second chamber at least partially delimited, with respect to said outdoor environment, by a first portion of the second heat exchanger, said second section, comprising second suction means for sucking a second flow of external air into the second chamber through said first portion of the second heat exchanger, said second chamber comprising at least one discharge opening for the return of the second flow into said outdoor environment.

[0018] According to the invention, the air conditioning unit further comprises a third heat exchange section defining a third chamber separate from the first chamber and from the second chamber, said third chamber comprising at least a second inlet configured to be communicating, directly or indirectly, with said indoor environment, wherein said third section comprises third suction means configured for sucking into said third chamber return air coming from said indoor environment, wherein said third chamber is at least partially delimited, with respect to said outdoor environment, by a second portion of said second heat exchanger so that said return air sucked into said third chamber is ejected (ejected air) into said outdoor environment through said second portion of said second heat exchanger.

[0019] In accordance with an embodiment, the second chamber and the third chamber are configured so that, following activation of the second suction means, the second flow of external air is sucked into the second chamber passing through the first portion from an outer side thereof toward an inner side thereof and so that the flow of return air, sucked by means of the third suction means, is ejected from the third chamber passing through said second portion starting from an inner side thereof toward an outer side thereof.

[0020] Preferably, the heat exchangers of the refrigeration circuit are of the finned pack type.

[0021] In accordance with a preferred embodiment, the refrigeration circuit comprises valve means able to reverse the refrigeration cycle.

[0022] In accordance with a preferred embodiment, the housing structure extends mainly along a longitudinal direction, along a transverse direction orthogonal to the longitudinal direction and along a vertical direction orthogonal to the directions, said third chamber being longitudinally comprised between the first chamber and the second chamber.

[0023] The first chamber and the third chamber are separated by a first dividing wall, while the second chamber and the third chamber are separated by a second dividing wall, wherein these dividing walls extend mainly along said transverse direction.

[0024] In accordance with a possible embodiment, the air conditioning unit 1 comprises a first longitudinal side and a second longitudinal side that extend along the longitudinal direction and along the vertical direction, a first

transverse side and a second transverse side that extend along the transverse direction and along the vertical direction, at least one lower wall and at least one upper wall opposite said at least one lower wall; said sides and said walls are defined by one or more parts of said housing structure, connected to one another so as to at least partially delimit the chambers.

[0025] Preferably, the first inlet for the first flow of external air is defined on the first longitudinal side, while the outlet for the treated air is defined on the second longitudinal side.

[0026] In a possible embodiment, the second inlet for said return air is defined along said first longitudinal side.

[0027] In accordance with a possible embodiment, the air conditioning unit comprises a further inlet connectable with the indoor environment to be conditioned for the entry of return air, said further inlet being defined along the first longitudinal side of said housing structure and being communicating with the inlet of said third chamber, wherein said first inlet for said return air is defined through said first dividing wall.

[0028] In accordance with a preferred embodiment, said further inlet for the return air is also connected with said outlet of said treated air.

[0029] In a possible embodiment thereof, the first portion of said second heat exchanger comprises a first part and a second part that extend orthogonally to each other, said parts defining two walls of the second chamber orthogonal to each other.

[0030] In accordance with an embodiment, the air conditioning unit comprises a third heat exchanger operatively arranged inside the third chamber and configured to carry out a heat exchange between the operating fluid circulating in the refrigeration circuit and the return air before this is ejected through the second portion of the second heat exchanger.

[0031] In a possible embodiment, the air conditioning unit comprises a baffle element to deflect the flow of return air ejected from the third chamber in the direction of the first portion of the second heat exchanger and/or parallel thereto.

[0032] In accordance with a possible embodiment, the refrigeration machine includes at least a first circuit and a second circuit, each configured to carry out a refrigeration cycle with a respective operating fluid, wherein each refrigeration circuit comprises:

- a first heat exchanger of the air-liquid/gas type configured to carry out a heat exchange between said operating fluid and the treated air aimed to said indoor environment;
- a second heat exchanger of the air-liquid/gas type configured to carry out a heat exchange between said operating fluid and the air coming from said outdoor environment;
- a compressor to increase the pressure of said fluid to a value characteristic of condensation and expansion means to reduce the pressure of said operating

fluid to a value characteristic of evaporation of said operating fluid.

[0033] For each of said refrigeration circuits, the corresponding first heat exchanger is housed in the first chamber for conditioning the treated air and the corresponding second heat exchanger at least partially delimits the second chamber with a first portion thereof and the third chamber with a second portion thereof.

[0034] Preferably, the second heat exchanger of the first circuit and the second heat exchanger of the second circuit are arranged so as to define opposite sides of the second chamber and of the third chamber.

LIST OF FIGURES

[0035] Further features and advantages of the invention will be more apparent by examining the following detailed description of some preferred, but not exclusive, embodiments of the air conditioning unit, illustrated by way of non-limiting example, with the aid of the accompanying drawings, wherein:

- Fig. 1 is a circuit scheme relating to a first embodiment of an air conditioning unit according to the invention comprising a reversible refrigeration machine provided with a single refrigeration circuit;
- Figs. 2 to 6 are schematic views each relating to a possible embodiment of an air conditioning unit according to the invention comprising a refrigeration machine provided with a single refrigeration circuit;
- Fig. 7 is a circuit diagram relating to another possible embodiment of an air conditioning unit according to the invention comprising a reversible refrigeration machine that includes two refrigeration circuits;
- Fig. 8 is a further schematic view of the air conditioning unit of Fig. 7;
- Figs. 9 and 10 are views from different observation points of a housing structure of the air conditioning unit of Figs. 7 and 8, respectively;
- Fig. 11 is a plan view of the air conditioning unit of Figs. 7 and 8 with parts of the housing structure removed;
- Figs. 12 to 14 are schematic views, each relating to a possible embodiment of an air conditioning unit according to the invention comprising a reversible refrigeration machine that includes two refrigeration circuits.

[0036] The same reference numbers and letters in the figures identify the same elements or components.

DETAILED DESCRIPTION

[0037] With reference to the aforesaid figures, the present invention relates to a rooftop air conditioning unit 1 for the treatment of the renewal air and the return air aimed to an open space indoor environment to be con-

ditioned. For the purposes of the present invention, the term "*treatment*" indicates both filtering (purification, sanitization, etc.) and conditioning thereof, namely heating or cooling.

[0038] The expression "*indoor environment to be conditioned*" generically indicates a space inside a building for which heating or cooling of the air is required. The expression "*outdoor environment*" instead indicates the environment in which the air conditioning unit 1 is located.

[0039] In the description below, the air conditioning unit 1 will also be indicated with the expression "*operating unit 1*". The indoor environment is indicated generically with the reference number 400, while the outdoor environment with the reference number 500.

[0040] The air conditioning unit 1 comprises a housing structure 50 housing at least one refrigeration machine 5 that includes at least one refrigeration circuit CF configured to carry out a refrigeration cycle, preferably reversible, through a respective operating fluid. The housing structure 50 can be installed on a roof or on a terrace of a building, in any case on the outside thereof.

[0041] The refrigeration circuit CF includes at least a first internal heat exchanger 11 configured to carry out a heat exchange between the operating fluid and the air destined for the environment to be conditioned (generically indicated in the drawings with the reference number 400), indicated below with the expression treated air or alternatively supply air A_M . According to the operating mode (cooling or heating) of the refrigeration machine, the first heat exchanger 11 acts as evaporator or as condenser of the operating fluid in order to remove or transfer heat from/to the treated air A_M .

[0042] The refrigeration circuit CF further comprises at least a second heat exchanger 12 (or external heat exchanger 12) configured to carry out a heat exchange between the operating fluid and the external air A_E of the outdoor environment 500. Also the external heat exchanger 12 acts as condenser or evaporator according to the operating mode of the refrigeration machine 5. In particular, it acts as evaporator when the refrigeration machine 5 operates in heating mode, i.e., when the first heat exchanger 11 acts as condenser. On the contrary, when the refrigeration machine 5 operates in cooling mode, i.e., when the first heat exchanger 11 operates as evaporator, then the second heat exchanger 12 acts as condenser.

[0043] For the purposes of the present invention, the heat exchangers 11, 12 are of air-liquid/gas type, i.e., of the type comprising tubes for circulation of the operating fluid (in liquid and/or gaseous state) and metal fins/plates in thermal contact with said circulation tubes. In particular, "*finned pack*" heat exchangers, used in the conditioning sector, are particularly suitable. In these heat exchangers, heat exchange takes place between the air that passes through the "*finned pack*" and the operating fluid circulating in the tubes, typically made of copper, that support the fins, typically made of aluminium. These heat exchangers have a substantially prismatic structure

that is well suited to form a wall delimiting the second chamber 20 or the third chamber 30. In any case, the possibility of using heat exchangers of different type, such as "microchannel" heat exchangers, also falls within the scope of the present invention.

[0044] The refrigeration circuit CF of the refrigeration machine 5 further comprises at least one compressor 13 to increase the pressure of the operating fluid from a value in which its evaporation takes place to a value in which condensation takes place. The refrigeration circuit further comprises expansion (or lamination) means to return the pressure of said operating fluid from the value characteristic of the condensation phase to a value characteristic of the evaporation phase. Since this is not relevant in relation to the invention, the compressor and the expansion means can be of any type known to those skilled in the art and which can be used for the purpose. In any case, according to the invention, the compressor 13 and the expansion (or lamination) means, just as the other components of the refrigeration machine 5 are housed in the housing structure 50.

[0045] The operating unit 1 according to the invention comprises a first heat exchange section 110 (or first section 110) in which the internal heat exchanger 11 operates and a second heat exchange section 120 in which the external heat exchanger 12 operates. In practice, in the first section 110 the treated air A_M is substantially conditioned, while in the second section 120 heat exchange with the outdoor environment 500 is caused. The latter acts as cold source or heat sink according to the operating mode (*heating or cooling*) of the refrigeration machine 5. The first section 110 comprises at least a first chamber 10 in which the internal heat exchanger 11 is housed. This first chamber 10, delimited with respect to the outdoor environment 500 by the housing structure 50, comprises at least one inlet 21A connected with the outdoor environment 500 and at least one outlet 22 aimed to be communicating, through suitable ducts, with the indoor environment 400.

[0046] The first section 110 further comprises first suction means 61 for sucking at least a first flow F_1 of external air A_E into the first chamber 10 and to allow this first flow F_1 to reach, after being conditioned (i.e., after heat exchange with the first heat exchanger 11), the outlet 22, i.e., the environment 400 to be conditioned.

[0047] The second heat exchange section 120 (or second section 120) comprises a second chamber 20 at least partially delimited, with respect to the outdoor environment 500, by a first portion 12A of the external heat exchanger 12. This second chamber 20 is at least partially delimited also by the housing structure 50. Therefore, the first portion 12A of the external heat exchanger 12, in substance, represents a perimeter portion of the second chamber 20 that separates it from the outdoor environment 500. In particular, the inner volume of the second chamber 20 is communicating with the outdoor environment 500 through the first portion 12A so that a second flow F_2 of external air A_E can be sucked inside said sec-

ond chamber 20 by the action of second suction means 62. The latter are thus operatively associated with the second heat exchange section 120.

[0048] The second chamber 20 comprises a discharge opening 32 to allow the external air A_E sucked to return to the outdoor environment 500. In practice, following a vacuum pressure generated in the second chamber 20 by the activation of the second suction means 62, the second flow F_2 of external air A_E passes through the first portion 12A of the external heat exchanger 12 exchanging thermal energy with the operating fluid circulating in said first portion 12A. The air flow F_2 is subsequently discharged into the outdoor environment 500 through the discharge opening 32. Therefore, if on the one hand the first portion 12A of the external heat exchanger 12 at least partially delimits the second chamber 20 with respect to the outdoor environment 500, on the other hand it is configured so as to allow the external air A_E to enter the second chamber 20 to pass through it and then return to the outdoor environment 500 through the discharge opening 32. In practice, the first portion 12A defines the passage for entry of the external air A_E from the outdoor environment 500 into the second chamber 20.

[0049] According to the present invention, the air conditioning unit 1 comprises a third heat exchange section 130 (or third section 130) defining a third chamber 30 physically separated from the first chamber 10 and from the second chamber 20 defined above. This third chamber 30 comprises an inlet 21B aimed to communicate, directly or indirectly, with the indoor environment 400. For this purpose, third suction means 63 are associated with the third heat exchange section 130. The third suction means 63 are configured for sucking, from said environment to be conditioned, a flow $F-A_R$ of return air A_R (or exhaust air A_R) which passes through the inlet 21B. According to the invention, the third chamber 30 is at least partially delimited, with respect to the outdoor environment 500, by a second portion 12B of the external heat exchanger 12, different from the first portion 12A, so that the return air A_R , sucked by means of the third suction means 63, can be ejected directly into the outdoor environment 500 through the second portion 12B of the external heat exchanger 12. Therefore, the second portion 12B of the external heat exchanger 12 represents a perimeter portion of the third chamber 30. The latter is at least partially delimited also by the housing structure 50.

[0050] According to the operating mode of the refrigeration machine, the return air A_R , which is ejected from the third chamber 30, transfers or removes (during this ejection) thermal energy to/from the operating fluid circulating in the second portion 12B of the external heat exchanger 12. This heat exchange improves the conditions in which the external heat exchanger 12 operates and thus improves the effectiveness of the refrigeration machine 5.

[0051] If on the one hand the second portion 12B of the external heat exchanger 12 at least partially delimits

the third chamber 30 with respect to the outdoor environment 500, on the other hand it is configured so as to allow the return air A_R to be ejected directly into said outdoor environment 500. In practice, the second portion 12B defines the only passage for discharge of the return air A_R from the third chamber 30 to the outdoor environment 500. Advantageously, the third chamber 30 is configured so that has no outlets for exhausting the return air A_R except for through the second portion 12B of the external heat exchanger 12. Therefore, this part of the return air A_R that enters the third chamber 30 is necessarily ejected and forced to perform the aforesaid heat exchange.

[0052] It must be observed that as the third chamber 30 is separated from the second chamber 20, the return air A_R cannot enter the second chamber 20 unless it has first been ejected into the outdoor environment 500.

[0053] For the purposes of the present invention, the suction means 61, 62, 63 associated with the different exchange sections 110, 120, 130 can comprises one or more blowers, fans or other functionally equivalent devices capable of generating a vacuum pressure inside a corresponding chamber that generates a flow of air that passes through the same chamber. Moreover, the term "external air" is meant as air coming from the outdoor environment 500. Instead, the term "return air" or "exhaust air" is meant to specifically indicate the air coming from the indoor environment 400, i.e., from the same environment for which the treated air A_M treated in the first section 110 is aimed.

[0054] With reference to the external heat exchanger 12, an external side $12A_{ES}$ and an internal side $12A_{INT}$ are identified for the first portion 12A thereof. Similarly, an external side $12B_{ES}$ and an internal side $12B_{INT}$ are identified for the second portion 12B indicated above. For both portions 12A, 12B, the external side $12A_{ES}$, $12B_{ES}$ is the one facing the outdoor environment 500, while the internal side $12A_{INT}$, $12B_{INT}$ is the one facing the inner volume of the second chamber 20 or of the third chamber 30 depending on whether the first portion 12A or the second portion 12B is being considered.

[0055] In accordance with a preferred embodiment, schematized in the figures, as a result of the second suction means 62, the second flow F_2 of external air A_E is sucked into the second chamber 20 passing through the first portion 12A from the external side $12A_{ES}$ toward the internal side $12A_{INT}$. Instead, the flow $F-A_R$ of part of the return air A_R , sucked by means of the third suction means 63, is ejected from the third chamber 30 directly into the outdoor environment 500, passing through the second portion 12B from the internal side $12B_{INT}$ toward the external side $12B_{ES}$. In the case in which the two portions 12A, 12B are adjacent and substantially coplanar, as schematized in the figures, then the second flow F_2 of external air A_E is sucked into the second chamber 20 substantially in counterflow with respect to the flow $F-A_R$ of return air A_R ejected from the third chamber 30.

[0056] In accordance with a preferred embodiment schematized in Fig. 1, the refrigeration circuit CF of the

refrigeration machine 5 comprises valve means 18 that allow reversal of the cycle, i.e., that allow the operating mode to be varied from heating to cooling or vice versa. In particular, in the circuit scheme of Fig. 1, the white arrow and the black arrow indicate, respectively, the direction of circulation of the operating fluid in cooling and in heating operating mode. Considering cooling operating mode, the external heat exchanger 12 operates as condenser, while the internal heat exchanger 11 operates as evaporator. The operating fluid circulating in the second section 12B of the external heat exchanger 12 transfers part of its thermal energy to the part of return air A_R that is ejected directly into the outdoor environment 500 through said second portion 12B and which has a temperature lower than that of the air A_E of the outdoor environment. This transfer of thermal energy to the ejected return air A_R causes a reduction of the average temperature at which condensation of the operating fluid takes place and hence leads to an increase of the useful effect. On the contrary, in the case in which the refrigeration machine 5 operates in heating mode, i.e., when the second heat exchanger 12 operates as evaporator, then during its discharge from the third chamber 30, the return air A_R transfers heat to the operating fluid being at a higher temperature than that of the outdoor environment 500. In this case, the thermal energy of the ejected return air A_R is recovered to improve the evaporation conditions, in any case improving the useful effect of the refrigeration machine 5. Moreover, this improvement of the evaporation conditions reduces the overall number of defrosts over the course of a day slowing down the formation of ice on the heat exchanger 12.

[0057] Figs. 2 to 6 are schematic views relating to possible embodiments of an air conditioning unit 1 according to the invention. In general, in these embodiments the refrigeration machine 5 comprises a single refrigeration circuit CF. On the contrary, in the embodiments shown in Figs. 7 to 13, the refrigeration machine 5 is provided with two refrigeration circuits CF_1 and CF_2 .

[0058] As schematized in the figures, preferably the housing structure 50 has a substantially prismatic configuration extending mainly along a longitudinal direction Y, along a transverse direction X orthogonal to the longitudinal direction Y and along a vertical direction Z orthogonal to the two directions indicated above (X, Y). Within the scope of the present invention, the extension of the housing structure 50 along the longitudinal direction Y is greater with respect to the extension along the transverse direction X.

[0059] In accordance with a preferred embodiment, visible in the figures, the third section 130 is longitudinally comprised between the first section 110 and the second section 120. In other words, the third chamber 30 is comprised, in the sense of the longitudinal direction Y, between the first chamber 10 and the second chamber 20 defined above. In particular, as shown in the figures, the first chamber 10 and the third chamber 30 are separated by a first dividing wall 401 that preferably extends in trans-

verse direction (X). Analogously, the second chamber 20 and the third chamber 30 are separated by a second dividing wall 402 that also extends in transverse direction. The two dividing walls 401, 402 are inside the housing structure 50.

[0060] Overall, the air conditioning unit 1 comprises a first longitudinal side 201, a second longitudinal side 202, a first transverse side 301 and a second transverse side 302. The two longitudinal sides 201, 202 extend along the vertical direction Z and the longitudinal direction Y relating to the housing structure 50, while the two transverse sides 301, 302 extend along the vertical direction Z and the transverse direction X, again relating to the housing structure 50.

[0061] The air conditioning unit 1 is closed at the bottom by at least one lower wall and at the top by at least one upper wall opposite said at least one lower wall. The lower wall and the upper wall are parts of the housing structure 50. In general, the sides 201, 202, 301, 302, said lower and/or upper wall, are formed by one or more parts of the housing structure 50, preferably made of metal material, connected to one another so as to delimit the first chamber 10 and at least partially the other two chambers 20, 30 so that these are passed through by the external air A_E and/or by the return air A_R according to the modes already described above.

[0062] In accordance with a possible embodiment visible in Figs. 2 to 6, the internal heat exchanger 11 is housed in the first chamber 10 so that its main sides 11A, 11B, i.e., those with the largest extension, are arranged parallel to the longitudinal sides 201, 202. The position of the internal heat exchanger 11 divides the first chamber 10 into a first portion 10-A adjacent to the first side 201 of the housing structure 50 and a second portion 10-B adjacent to the second side 202. In the case schematized in the figures, the first inlet 21A for the first flow F_1 of external air A_E is defined on the first longitudinal side 201, while the outlet 22 for the treated air A_M is defined on the second longitudinal side 202. The first suction means 61 are arranged in the second portion 10-B so that the first flow F_1 of external air A_E is sucked into the first portion 10-A and reaches the second portion 10-B after the heat exchange with the first heat exchanger 11.

[0063] Overall, the first chamber 10 is longitudinally delimited between the first transverse side 301 and the first dividing wall 401. Said first chamber 10 is closed at the top by a part of the upper wall and is closed at the bottom by a part of the lower wall of the housing structure 50. In this way, the first flow F_1 of external air is guided in transverse direction from the first inlet 21A to the outlet 22.

[0064] In a possible embodiment, not shown in the figures, filters can be arranged in one, or in both, of the portions 10-A, 10-B of the first chamber 10, to filter and/or sanitize the air aimed for the outlet 22. In alternative embodiments (not shown/schematized in the figures), the outlet 22 could be defined through the upper wall and hence the first chamber 10 could be closed along a trans-

verse side. In a further variant, the position of the inlet and of the outlet could be reversed with respect to the schematization shown in the figures.

[0065] In the embodiment schematized in Fig. 2, the inlet 21B of the third chamber 30 is defined along a longitudinal side 201. In particular, the inlet 21B of the third chamber 30 is defined on the same side in which the first inlet 21A of the first chamber 10 is defined.

[0066] Alternatively, the inlet 21B of the third chamber 30 could be defined through the upper wall of the housing structure 50 that closes the third chamber 30 at the top. In this case, the inlet 21B could be communicating directly with the indoor environment 400 for sucking the exhaust air A_R . This configuration is particularly suitable in the case in which the environment to be conditioned is a kitchen, i.e., in the case in which the entire flow of return air A_R must necessarily be ejected into the outdoor environment 500.

[0067] Instead, in the embodiments schematized in Figs. 3 to 6, the air conditioning unit 1 comprises a further inlet 21C connectable with the indoor environment 400 to be conditioned through the return air A_R inlet. This further inlet 21C is defined along the first longitudinal side 201 (i.e., the same side along which the first inlet 21A of the first chamber 10 is defined) and is communicating at least with the inlet 21B of the third chamber 30. The latter is defined as an opening through the first dividing wall 401. Therefore, in these embodiments, the inlet 21B of the third chamber 30 is connected indirectly with the indoor environment 400 through said further inlet 21C.

[0068] According to the installation, said further inlet 21C of the return air A_R may or may not be communicating with the outlet 22 of the treated air A_M . Once again considering the case in which the environment to be conditioned is a kitchen, then said further inlet 21C will evidently be kept isolated from the outlet 22. Therefore, the exhaust air A_R sucked in will be completely ejected through the third chamber 30. In other cases, by suitably adjusting the first suction means 61 and the third suction means 63, it will be possible to modulate the flow of return air A_R aimed to be treated in the first chamber 10 (i.e. aimed for the outlet 22) and the flow aimed to be ejected in accordance with the purposes of the present invention. In this regard, according to a known principle, the percentage of return air A_R sent to the outlet 22 may increase when the level of crowding of the indoor environment 400 to conditioned decreases.

[0069] In the embodiments shown in the figures, the third suction means 63 are installed inside the third chamber 30, substantially at the second inlet 21B. Alternatively, they could also be installed outside the third chamber 30, at the second inlet 21B.

[0070] In accordance with a preferred embodiment, schematized in Figs. 2 to 6, the first portion 12A of the external heat exchanger 12 comprises a first part 12-L and a second part 12-T that extend orthogonally to each other. In practise, the first part 12-L and the second part 12-T form a longitudinal wall and a transverse wall of the

second chamber 20, respectively, which help to delimit it, together with the housing structure 50, with respect to the outdoor environment 500. Preferably, these parts 12-L, 12-T have structural capacities, helping to vertically support the housing structure 50.

[0071] As visible from the figures, preferably, the first part 12-L forms a part of a longitudinal side (the second longitudinal side 202 in the figures) of the air conditioning unit 1, while the second part 12-T defines a part of a transverse side (the second transverse side 302 in the figures).

[0072] The second chamber 20 is delimited in transverse direction by the second dividing wall 402 which is opposite the second part 12-T and by a part of the first longitudinal side 201, where this part is opposite the first part 12-L of the external heat exchanger 12. The second chamber 20 is also delimited by the lower wall and by the upper wall of the housing structure 50. The latter also defines the discharge opening 32, which in an alternative solution could be defined through the side opposite the first part 12-T of the heat exchanger 12. The second suction means 62 can be installed in the inner volume of the second chamber 20 or alternatively externally at the discharge opening 32. As they preferably have load-bearing capacities, the parts 12-L, 12-T of the second heat exchanger 12 also concur to support the upper wall of the housing structure 50.

[0073] In any case, through the walls defined by the parts 12-L and 12-T, the external air A_E is sucked by means of the second suction means 62 into the second chamber 20 so as to perform a heat exchange with the operating fluid to condensate or evaporate it according to the operating mode of the refrigeration machine 5.

[0074] In the case illustrated, the first portion 12A and the second portion 12B are coplanar and defined by the first part 12-L so as to define, seamlessly, a wall of the second chamber 20 and a wall of the third chamber 30, respectively, which extend in longitudinal direction. In the figures, the first part 12-L defines part of the second longitudinal side 202 of the air conditioning unit 1. Therefore, the third chamber 30 is delimited, with respect to the outdoor environment 500, along the second longitudinal side 202 by the second portion 12B and along the first longitudinal side 201 by a closed part of the housing structure 50.

[0075] In accordance with an embodiment schematized in Fig. 4, the air conditioning unit 1 comprises at least one baffle element 80 (or deflector 80) to deflect the return air A_R ejected from the third chamber 30 toward the external side 12A_{ES} of the first portion 12A of the external heat exchanger 12. In substance, the deflector 80 directs the portion of the return air A_R , immediately after it is ejected from the third chamber 30, so that it can be sucked into the second chamber 20 as a result of the action of the second suction means 62. With this solution, the ejected return air A_R can be subjected to a further heat exchange with the operating fluid, which in this case takes place through the first portion 12A of the second

heat exchanger 12. In the case in which the refrigeration machine 5 is operating in cooling mode, for example, it is possible that after the heat exchange with the second portion 12B of the external heat exchanger 12, the ejected return air A_R will still have a temperature lower than the temperature of the outdoor environment 500. The use of the deflector 80 advantageously allows this condition to be exploited to improve the efficiency of the refrigeration machine. From a construction point of view, the deflector 80 can be formed by a wall that emerges from the second longitudinal side 202 in a position close to the first part 12-L of the external heat exchanger 12. This wall is configured so as to direct the flow of exhaust air $F-A_R$ toward the first portion 12A or parallel thereto. In other words, the deflector 80 deflects the exhaust air so as to subject it to the vacuum pressure generated by the second suction means 62. In any case, the deflector 80 is external to the third chamber 30 in order to deflect the return air A_R as soon it is ejected into the outdoor environment 500.

[0076] In accordance with another embodiment schematized in Fig. 5, the refrigeration machine 5 comprises a third heat exchanger 15 operatively arranged inside the third chamber 30 and configured to generate a heat exchange between part of the return air A_R and the operating fluid circulating in the refrigeration circuit CF before the return air A_R is ejected from said third chamber 30. In particular, in the refrigeration circuit CF, the third heat exchanger 15 is operatively positioned between the external heat exchanger 12 and the expansion means 14 and allows a further increase in the effectiveness of the refrigeration machine 5.

[0077] In the case in which the refrigeration machine 5 operates in cooling mode, said third heat exchanger 15 acts as sub-cooler of the operating fluid condensed in the external heat exchanger 12. Therefore, through the third heat exchanger 15, the operating fluid transfers thermal energy to the return air A_R before it is ejected. Instead, if the refrigeration machine 5 operates in heating mode, then the third heat exchanger 15 evaporates part of the operating fluid so that the external heat exchanger 12 operates in conditions more favourable for evaporation. In this second case, through the third heat exchanger 15, the return air A_R transfers thermal energy to the operating fluid before passing through the second portion 12B of the external heat exchanger 12.

[0078] From a construction point of view, also the third heat exchanger 15 is preferably, but not exclusively, of the finned pack type. As schematized in Fig. 5, the third heat exchanger 15 is installed in the third chamber 30 preferably in a position immediately downstream of the third suction means 63.

[0079] The third heat exchanger 15 may or may not be installed in combination with the deflector element 80. For example, in the embodiment schematized in Fig. 5 only the third heat exchanger 15 is provided, while the deflector element 80 is not present. Instead, in the embodiment schematized in Fig. 6 the two devices (heat

exchanger 15 and deflector 80) are provided in combination.

[0080] With reference once again to the diagrams in Figs. 2 to 6, the compressor 13 and the expansion means 14 are preferably housed in the inner volume of the second chamber 20. In this regard, the housing structure 50 has at least one removable part to allow access to this inner volume and hence the intervention on these components (13 and 14). In the case schematized, the removable wall could be the one along the first longitudinal side 201 and hence opposite the first portion 12A of the external heat exchanger 12. Alternatively, or in combination, for the same purpose, also the second transverse side 302, which closes the second chamber 20 transversally, could comprise a removable wall.

[0081] As already indicated above, Fig. 7 is a circuit scheme relating to another embodiment of the air conditioning unit 1 in which the refrigeration machine 5 comprises a first refrigeration circuit CF_1 and a second refrigeration circuit CF_2 , physically separate. With this it is meant that a operating fluid circulates in each refrigeration circuit CF_1 and CF_2 , wherein said operating fluid is independent from that circulating in the other refrigeration circuit CF_1 and CF_2 .

[0082] Each refrigeration circuit CF_1 , CF_2 comprises a first heat exchanger 11-1, 11-2 configured to exchange heat with the air aimed for the environment to be conditioned 400 and a second heat exchanger 12-1, 12-2 configured to exchange heat with a flow of external air A_E sucked from the environment 500 surrounding the operating unit 1. Each refrigeration circuit CF_1 , CF_2 further comprises a corresponding compressor 13-1, 13-2 and a corresponding expansion valve 14-1, 14-2. According to the needs, the refrigeration machine 5 can activate a single refrigeration circuit or both the circuits CF_1 , CF_2 .

[0083] Again, with reference to Fig. 7, in accordance with the invention, for each of the two refrigeration circuits CF_1 , CF_2 , the first heat exchanger 11-1, 11-2 (or internal heat exchanger 11-1, 11-2) is housed in the first chamber 10 defined by the first heat exchange section 11 for conditioning the treated air A_M . For each refrigeration circuit CF_1 , CF_2 , the corresponding second heat exchanger 12-1, 12-2 (or external heat exchanger 12-1, 12-2) is arranged so as to at least partially delimit the second chamber 20 with a first portion 12-1A, 12-2A thereof and the third chamber 30 with a second portion 12-1B, 12-2B thereof.

[0084] In accordance with an embodiment shown in Figs. 7 to 13, the two external heat exchangers 12-1, 12-2 are arranged symmetrically/ mirror-like with respect to a longitudinal reference plane PL (indicated in Figs. 7, 8 and 10) which extends vertically with respect to the support plane PO of the operating unit 1 (indicated in Fig. 8). Therefore, these external heat exchangers 12-1, 12-2 partially delimit the second chamber 20 and the third chamber 30 at opposite parts of the longitudinal sides 201, 202 of the air conditioning unit 1. In the embodiments from 7 to 14, the external heat exchangers 12-1, 12-2

each define a part of a corresponding longitudinal side 201, 202. Preferably, each external heat exchanger 12-1, 12-2 has load-bearing capacities so as to concur to support the housing structure 50.

[0085] With reference once again to Fig. 8, in accordance with the invention, the efficiency of the refrigeration machine 5 is improved by the energy recovery obtained by utilizing the return air A_R that passes through the third chamber 30, analogously to what has already been described above. A part or all of the return air A_R is sucked inside the third chamber 30 through the third suction means 63, also in this case preferably arranged inside said third chamber 30. The latter remains in any case separated from the first chamber 10 and from the second chamber 20, by the first dividing wall 401 and by the second dividing wall 402, respectively, and closed at the bottom and at the top so that the part of the flow of return air A_R is obligatorily directed toward the second portions 12-1B, 12-2B of the external heat exchangers 12-1, 12-2. Therefore, in this configuration a first flow F_1-A_R and a second flow F_2-A_R of the return air A_R are ejected into the outdoor environment 500 through the second portion 12-1B of the external heat exchanger 12-1 of the first circuit CF_1 and through the second portion 12-2B of the external heat exchanger 12-2 of the second circuit CF_2 , respectively. In accordance with the objects of the invention, while being ejected from the third chamber 30, the two flows F_1-A_R , F_2-A_R exchange thermal energy with the operating fluid circulating in the second portion 12-1B, 12-2B of the corresponding external heat exchanger 12-1, 12-2 so as to optimize the operating condition of the same heat exchanger.

[0086] Figs. 9 and 10 are perspective views of the air conditioning unit 1 defined in accordance with the circuit scheme of Fig. 7 and with the schematic view of Fig. 8. In Figs. 9 and 10 in particular it is possible to observe the prismatic structure of the air conditioning unit 1. In accordance with the schematization in Fig. 8, the inlet 21A for the external air and the inlet 21C for the return air are defined along the first longitudinal side 201 (see Fig. 9), while the outlet 22 is defined at the second longitudinal side 202 (see Fig. 10). Again in Figs. 9 and 10, it is possible to observe the arrangement of the two external heat exchangers 12-1, 12-2 indicated above, each of which defines, with an external side thereof, a part of a corresponding longitudinal side 201, 202 of the operating unit 1.

[0087] Figs. 9 and 10 show, along the longitudinal direction Y, the three heat exchange sections 110, 120, 130 inside which the corresponding chambers 10, 20, 30 are defined. In particular, Figs. 8 and 9 indicate the parts 110A, 120A, 130A of the upper wall of the housing structure 50 that close/delimit the corresponding chambers 10, 20, 30 at the top. In these figures it is also possible to observe a preferred installation of the second suction means 62 comprising two fans installed over the upper part 120A of the housing structure 50 at corresponding discharge openings 32.

[0088] Fig. 11 is a plan view of the air conditioning unit 1 of Figs. 9 and 10 without the upper walls 110A, 120A, 130A indicated above. For greater clarity, in Fig. 10 not all the components of the two refrigeration circuits CF_1 , CF_2 schematized in Figs. 6 and 7 are shown.

[0089] With reference once again to Fig. 11, the first chamber 10 is delimited in longitudinal direction between the first transverse side 301 and the first dividing wall 401 that separates it from the third chamber 30. The first chamber 10 is communicating with the outdoor environment 500 only through the first inlet 21A, while the outlet 22 is communicating to the indoor environment 400 to be conditioned. The first heat exchange section 110 also defines the inlet 21C connectable to the indoor environment 400 to be conditioned for suction of the return air A_R . In accordance with the invention, the two internal heat exchangers 11-1, 11-2 are arranged in the first chamber 10 so that their longer sides are perpendicular with the direction of the flows of air (external and/or return) entering said first chamber 10.

[0090] As schematized, the two internal heat exchangers 11-1, 11-2 can be defined as a single finned pack heat exchanger array in which the fins are supported by circulation pipes in part for circulation of the operating fluid of the first refrigeration circuit CF_1 and in part for circulation of the operating fluid of the second refrigeration circuit CF_2 . In particular, the two heat exchangers 11-1, 11-2 are arranged so that the heat exchange surface of the fins is mainly parallel to the transverse direction X defined above.

[0091] With reference once again to the view in Fig. 11, in an embodiment, the first chamber 10 has a transverse inner wall 52 arranged transversally in the first portion 10A of said chamber. This internal wall 52 keeps the first flow F_1 of external air, sucked in through the first inlet 21A, separated from the flow $F-A_R$ of return air A_R sucked in through the third inlet 21C. In this regard, the first suction means 61 preferably comprise a first suction device 61A and a second suction device 61B which, when activated, sucked in the external air A_E and the return air A_R , respectively.

[0092] In the case illustrated in Fig. 11, the third suction means 63 comprise a suction device arranged in the third chamber 30 at the second inlet 21B defined through the first dividing wall 401. Activation of this suction device 63 allows the return air A_R to enter the third chamber 30 and then separate into two flows F_1-A_R , F_2-A_R which are ejected from the second portion 12-1B, 12-2B of a corresponding of said external heat exchangers 12-1, 12-2, respectively. Only in the case in which the second suction device 61B of the first suction means 61 is deactivated, the flow of return air sucked into the third chamber 30 coincides with the flow sucked through the third inlet 21C. Otherwise, the flow rate of the flow sucked into the third chamber 30 and the flow rate of the flow sucked toward the outlet 22 will depend on the operating conditions of the two suction devices 63, 61B involved.

[0093] In the embodiment schematized in Fig. 12, the

air conditioning unit 1 comprises, for each longitudinal side 201, 202, a corresponding deflector element 80A, 80B arranged at the second portion 12-1B, 12-2B of the corresponding external heat exchanger 12-1, 12-2. Each deflector element 80A, 80B intercepts a corresponding flow of return air F_1-A_R , F_2-A_R ejected into the outdoor environment from the third chamber 30 (through the second portion 12-1B, 12-2B of the corresponding external heat exchanger 12-1, 12-2) deflecting it parallel to or toward the first portion 12-1A, 12-2A of the corresponding external heat exchanger 12-1, 12-2.

[0094] In general, the deflectors 80A, 80B have the same function, the same purposes as the deflector 80 described above in relation to the embodiment in Fig. 5. Therefore, reference should be made to the description already provided above.

[0095] With reference to Fig. 13, also in the case in which the refrigeration machine 5 comprises two refrigeration circuits CF_1 , CF_2 a third heat exchanger 15, having the same function and the same purposes as the one described above with reference to Fig. 5, can be provided. In particular, in this embodiment, the third heat exchanger 15 will comprise a first part 15-1 and a second part 15-2 to exchange heat with the operating fluid of the first refrigeration circuit CF_1 and with that of the second refrigeration circuit CF_2 , respectively. For this purpose, the third heat exchanger 15 can be of the finned pack type and manufactured to be conceptually equivalent to the one described above defining the two internal heat exchangers 11-1, 11-2 of the two circuits CF_1 , CF_2 .

[0096] In a possible variant of embodiment, shown in Fig. 14, the air conditioning unit 1 can comprise the third heat exchanger 15 and at the same time the two deflector elements 80A, 80B. In this case, the return air A_R sucked into the third chamber 30 is subjected to a first heat exchange at the first heat exchanger 15, to a second heat exchange at the second portion 12-1B, 12-2B of one of the two external heat exchangers 12-1, 12-2 and to a further heat exchange at the first portion 12-1A, 12-2A adjacent to the second portion 12-1B, 12-2B. Therefore, this embodiment allows the maximum energy recovery possible from the exhaust air.

[0097] With the air conditioning unit 1 described above it is possible to fully achieve the aim and the objects set.

The technical solutions adopted make it possible to obtain effectiveness regardless of the operating mode of the refrigeration machine. In particular, when the machine operates as heat pump (heating mode) the ejection of the return air through a portion of the external heat exchanger helps to prevent the formation of ice on said heat exchanger, thus reducing the number of defrosts required. This translates into an increase of the operating continuity and hence of the overall efficiency of the system. Energy recovery from the exhaust air is in any case obtained without complicating the configuration of the air conditioning unit, which is particularly compact and hence easy to position, resulting in a competitive overall cost.

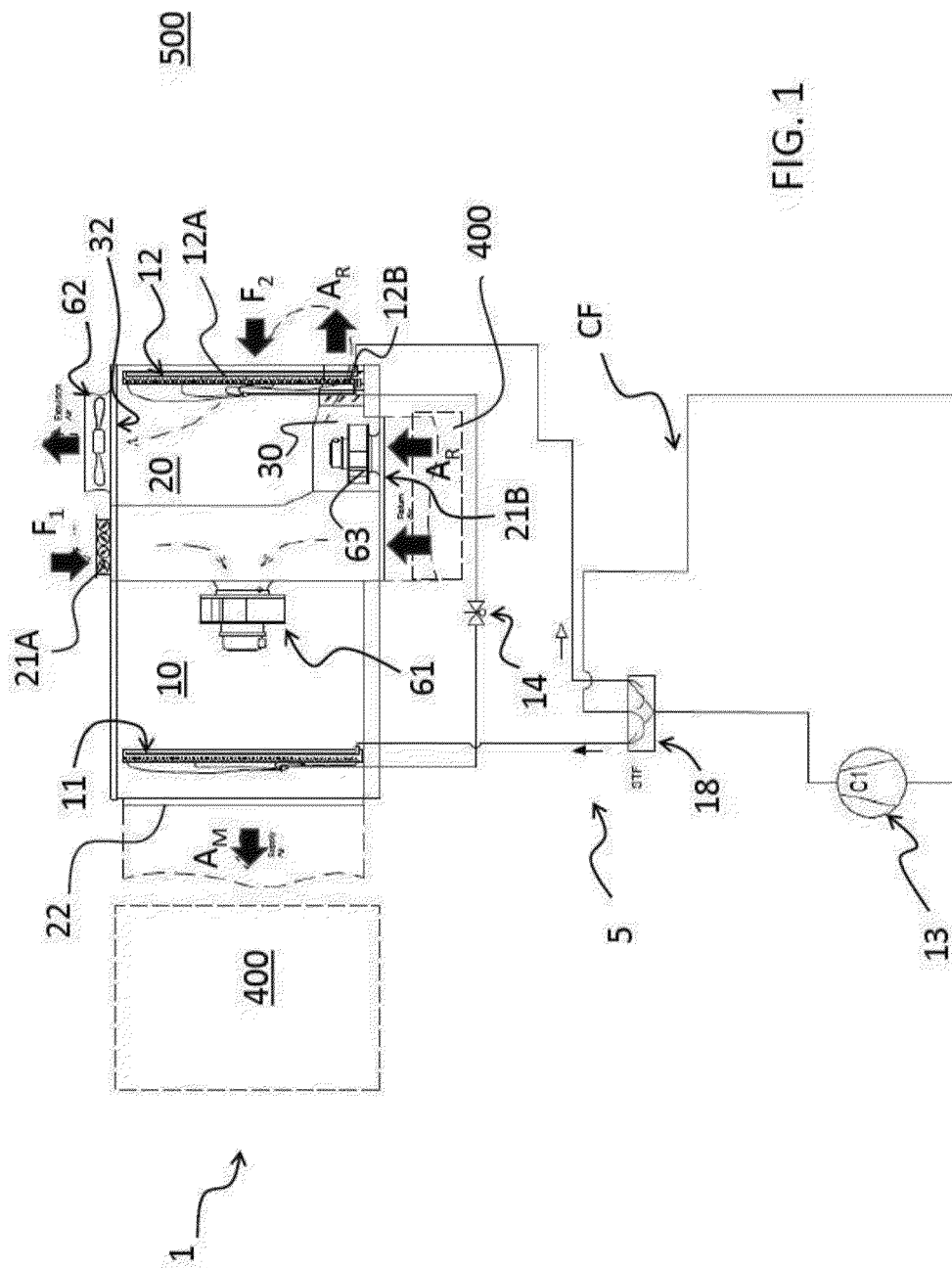
Claims

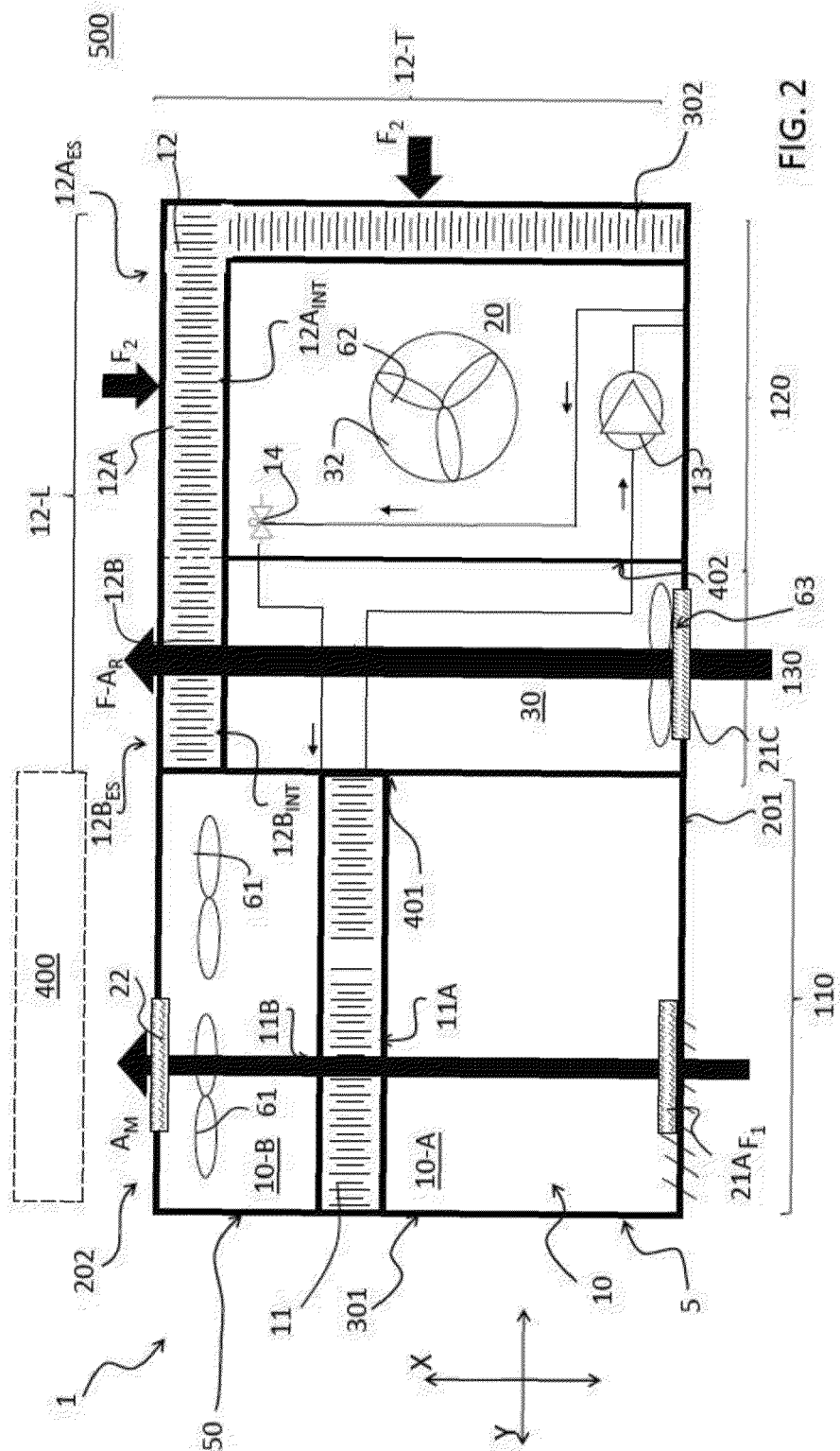
1. Air conditioning unit (1) for conditioning air (A_M) aimed for an indoor environment (400), wherein said air conditioning unit (1) comprises at least one housing structure (50) and a refrigeration machine (5) that includes at least one circuit (CF, CF_1 , CF_2) configured to carry out a refrigeration cycle with a respective operating fluid, wherein said refrigeration circuit CF, CF_1 , CF_2) comprises at least:
 - a first heat exchanger (11, 11-1, 11-2) of the air-liquid/gas type configured to carry out a heat exchange between said operating fluid and the treated air (A_M) destined for said indoor environment (400);
 - a second heat exchanger (12, 12-1, 12-2) of the air-liquid/gas type configured to carry out a heat exchange between said operating fluid and the air (A_E) of the outdoor environment (500);
 - a compressor (13, 13-1, 13-2) to increase the pressure of said fluid to a value characteristic of condensation and expansion means (14, 14-1, 14-2) to reduce the pressure of said operating fluid to a value characteristic of evaporation of said operating fluid,

characterized in that said air conditioning unit (1) comprises:

 - a first heat exchange section (110) defining a first chamber (10) in which said first heat exchanger (11, 11-1, 11-2) is housed, said first chamber (10) comprising at least a first inlet (21A) communicating with said outdoor environment (500) and at least one outlet (22) suitable to be communicating with said indoor environment (400), said first section (110) comprising first suction means (61) for sucking at least a first flow (F_1) of external air (A_E) from said outdoor environment (500);
 - a second heat exchange section (120) defining a second chamber (20) at least partially delimited, with respect to said outdoor environment, by a first portion (12A, 12-1A, 12-2A) of said second heat exchanger (12, 12-1, 12-2), said second section (120) comprising second suction means (62) for sucking a second flow (F_2) of external air (A_E) inside said second chamber (20) through said first portion (12A, 12-1A, 12-2A) of said second heat exchanger (12, 12-1, 12-2), said second chamber (20) comprising at least one discharge opening (32) for the return of said second flow (F_2) into said outdoor environment (500);
 - a third heat exchange section (130) defining a third chamber (30) separated from said first chamber (10) and from said second chamber
- (20), said third chamber (30) comprising at least a second inlet (21B) configured to be communicating, directly or indirectly, with said indoor environment (400), wherein said third section (130) comprises third suction means (63) configured for sucking into said third chamber (30) a flow ($F-A_R$) of return air (A_R) coming from said indoor environment (400), wherein said third chamber (30) is at least partially delimited, with respect to said outdoor environment (500), by a second portion (12B, 12-1B, 12-2B) of said second heat exchanger (12, 12-1, 12-2) so that said return air (A_R) sucked into said third chamber (30) is ejected directly into said outdoor environment (500) through said second portion (12B, 12-1B, 12-2B) of said second heat exchanger (12, 12-1, 12-2).
2. Air conditioning unit (1) according to claim 1, wherein said second chamber (20) and said third chamber (30) are configured so that following activation of said second suction means (62), said second flow (F_2) of external air (A_E) is sucked into said second chamber (20) passing through said first portion (12A) from an external side (12A_{ES}) thereof toward an internal side (12A_{INT}) thereof and so that said flow ($F-A_R$) of return air (A_R), sucked by means of said third suction means (63), is ejected from said third chamber (30) passing through said second portion (12B) starting from an internal side (12B_{INT}) thereof toward an external side (12B_{ES}) thereof.
3. Air conditioning unit (1) according to claim 1 or 2, wherein said heat exchangers (11, 12, 12-1, 12-2) are of the finned pack type.
4. Air conditioning unit (1) according to any one of claims 1 to 3, wherein said refrigeration circuit (CF) comprises valve means (18, 18-1, 18-2) that allow the reversal of said refrigeration cycle.
5. Air conditioning unit (1) according to any one of claims 1 to 4, wherein said housing structure (50) extends mainly along a longitudinal direction (Y), along a transverse direction (X) orthogonal to said longitudinal direction (Y) and along a vertical direction (Z) orthogonal to said directions (X, Y), said third chamber (30) being longitudinally comprised between said first chamber (10) and said second chamber (20) and wherein said first chamber (10) and said third chamber (30) are separated by a first dividing wall (401) and wherein said second chamber (20) and said third chamber (30) are separated by a second dividing wall (402), wherein said dividing walls (401, 402) extend mainly along said transverse direction (X).
6. Air conditioning unit (1) according to claim 5, wherein

- said air conditioning unit (1) comprises a first longitudinal side (201) and a second longitudinal side (202) that extend along said longitudinal direction (Y) and along said vertical direction (Z), a first transverse side (301) and a second transverse side (302) that extend along said transverse direction (X) and along said vertical direction (Z), at least one lower wall and at least one upper wall opposite said at least one lower wall, wherein said sides (201, 202, 301, 302) and/or said walls, are defined by one or more parts of said housing structure (50), connected to one another so as to at least partially delimit said chambers (10, 20, 30).
7. Air conditioning unit (1) according to claim 5 or 6, wherein said first inlet (21A) for the first flow (F_1) of external air (A_E) is defined on said first longitudinal side (201), while said outlet (22) for the treated air (A_M) is defined on said second longitudinal side (202).
 8. Air conditioning unit according to claim 7, wherein said second inlet (21B) is defined on said first longitudinal side (201).
 9. Air conditioning unit (1) according to any one of claims 5 to 7, wherein said air conditioning unit (1) comprises a further inlet (21C) connectable with the indoor environment (400) to be conditioned for the entry of return air (A_R), said further inlet (21C) being defined by said housing structure (50) and being communicating with said inlet (21B) of said third chamber (30), wherein said inlet (21B) is defined through said second dividing wall (402).
 10. Air conditioning unit (1) according to claim 9, wherein said further inlet (21C) for said return air (A_R) is also communicating with said outlet (22) of said treated air (A_M).
 11. Air conditioning unit (1) according to any one of claims 1 to 10, wherein said first portion (12A) of said second heat exchanger (12) comprises a first part (12-L) and a second part (12-T) that extend orthogonally to each other, said parts (12-L, 12-T) defining two walls of said second chamber (20) orthogonal to each other.
 12. Air conditioning unit (1) according to any one of claims 1 to 11, wherein said air conditioning unit (1) comprises a third heat exchanger (15) operatively arranged inside said third chamber (30) and configured to carry out a heat exchange between the operating fluid circulating in said refrigeration circuit (CF) and said return air (A_R) before it is ejected through said second portion (12B) of said second heat exchanger (12).
 13. Air conditioning unit (1) according to any one of claims 1 to 12, wherein said air conditioning unit (1) comprises a baffle element (80) to deflect the flow ($F-A_R$) of return air (A_R) ejected from the third chamber (30) in the direction of said first portion (12A) of said second heat exchanger (12) and/or parallel thereto.
 14. Air conditioning unit (1) according to any one of claims 1 to 13, wherein said refrigeration machine (5) includes at least a first circuit (CF₁) and a second circuit (CF₂) each configured to carry out a refrigeration cycle with a respective operating fluid, wherein each refrigeration circuit (CF₁, CF₂) comprises:
 - a first heat exchanger (11-1, 11-2) of the air-liquid/gas type configured to carry out a heat exchange between said operating fluid and the treated air (A_M) aimed for said indoor environment (400);
 - a second heat exchanger (12-1, 12-2) of the air-liquid/gas type configured to carry out a heat exchange between said operating fluid and the air (A_E) coming from said outdoor environment (500);
 - a compressor (13-1, 13-2) to increase the pressure of said fluid to a value characteristic of condensation and expansion means (14-1, 14-2) to reduce the pressure of said operating fluid to a value characteristic of evaporation of said operating fluid,
 wherein for each of said refrigeration circuits (CF₁, CF₂), the corresponding first heat exchanger (11-1, 11-2) is housed in said first chamber (10) for conditioning said treated air (A_M) and the corresponding second heat exchanger (12-1, 12-2) at least partially delimits said second chamber (20) with a first portion (12-1A, 12-2A) thereof and said third chamber (30) with a second portion (12-1B, 12-2B) thereof.
 15. Air conditioning unit (1) according to claim 14, wherein said second heat exchanger (12-1) of said first circuit (CF₁) and said second heat exchanger (12-2) of said second circuit (CF₂) are arranged so as to define opposite sides of said second chamber (20) and of said third chamber (30).





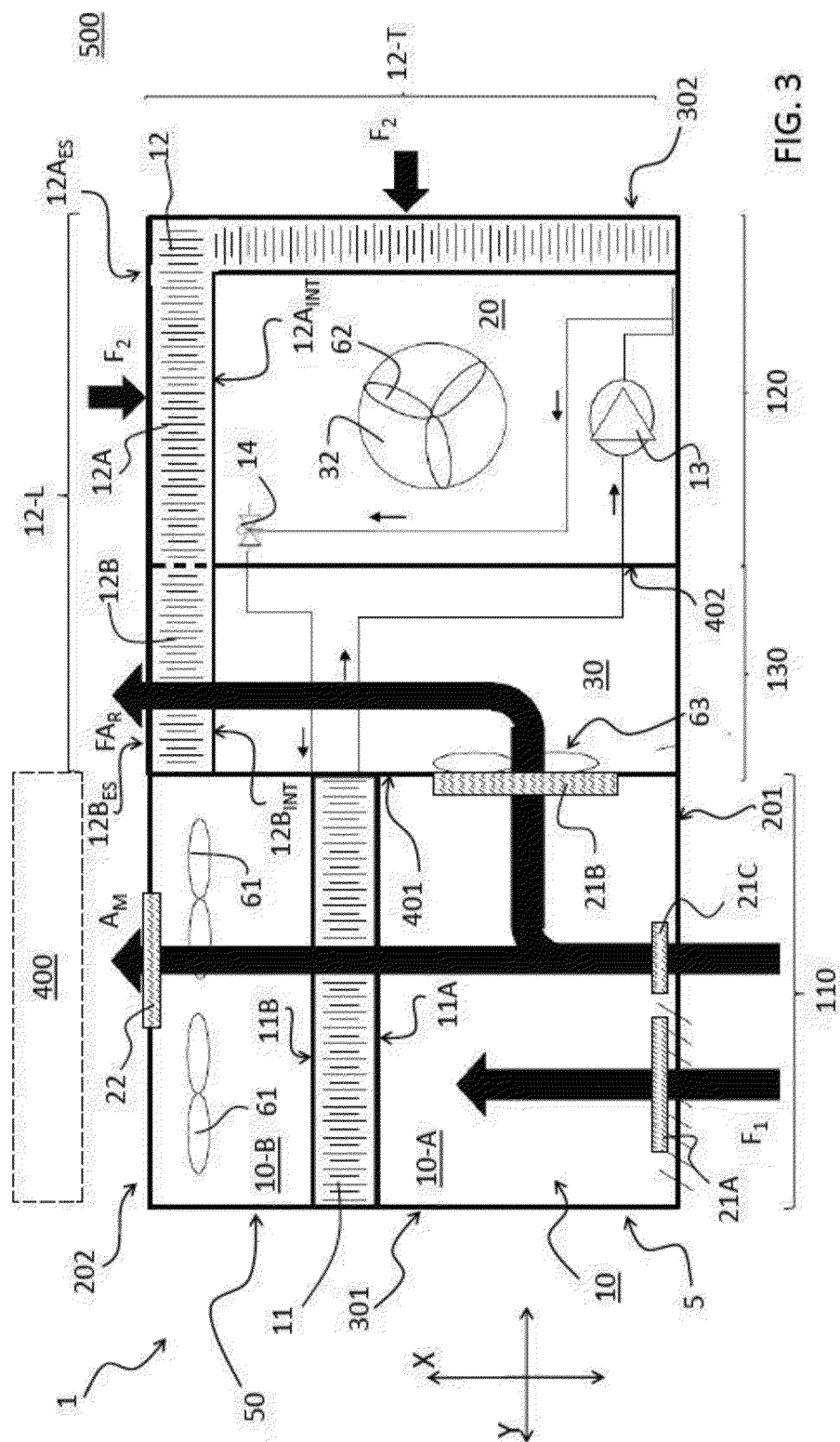


FIG. 3

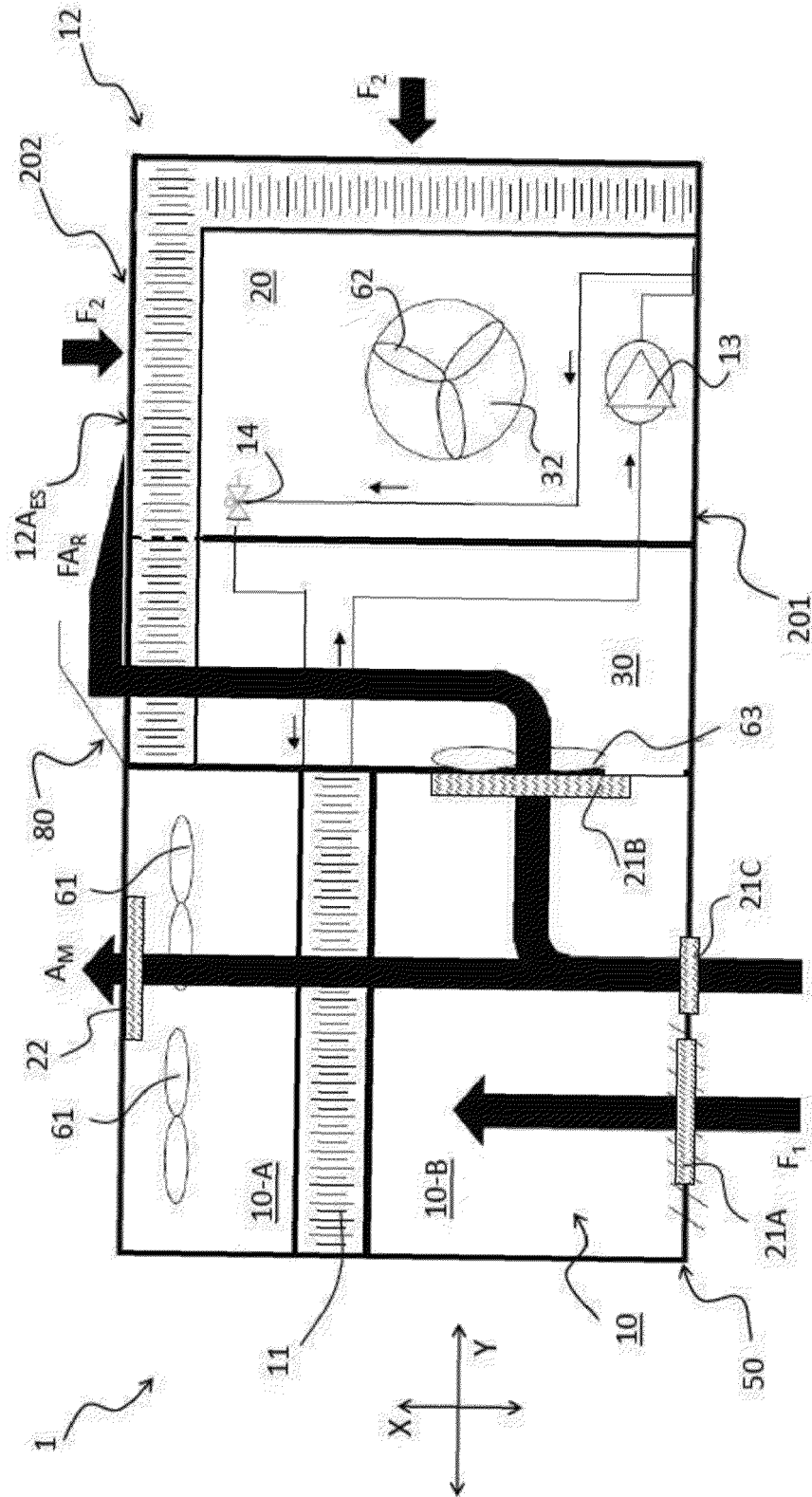


FIG. 4

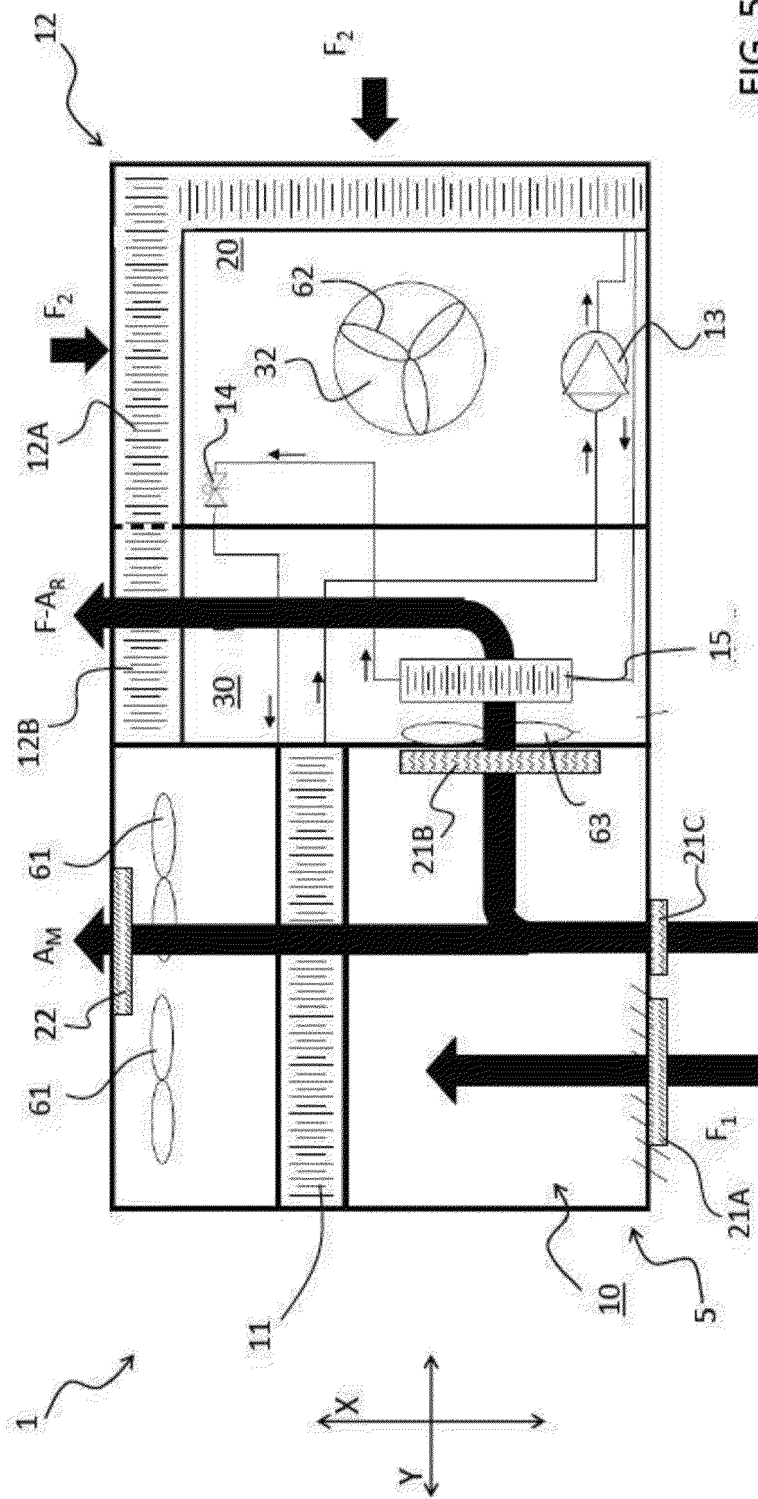


FIG. 5

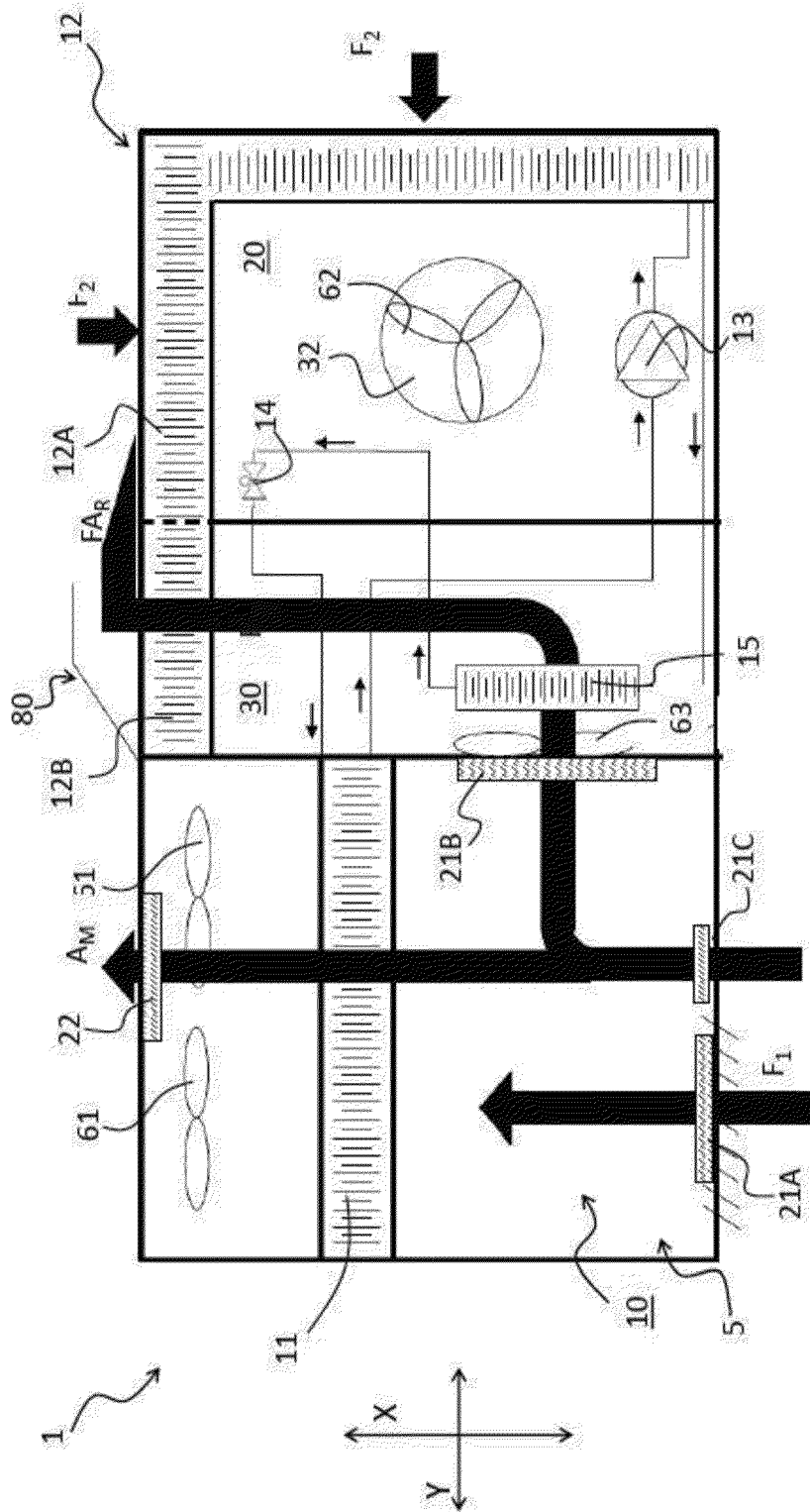


FIG. 6

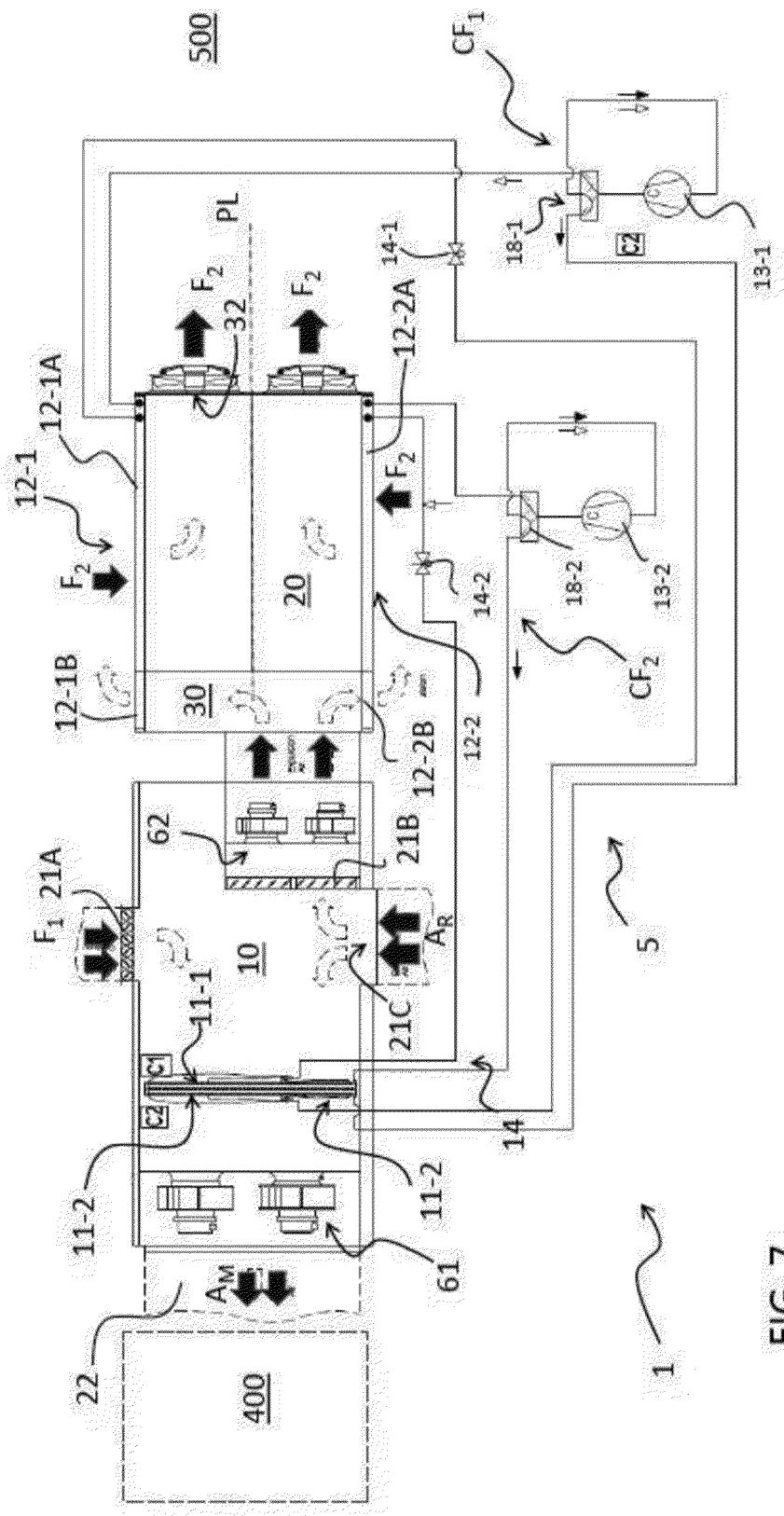


FIG. 7

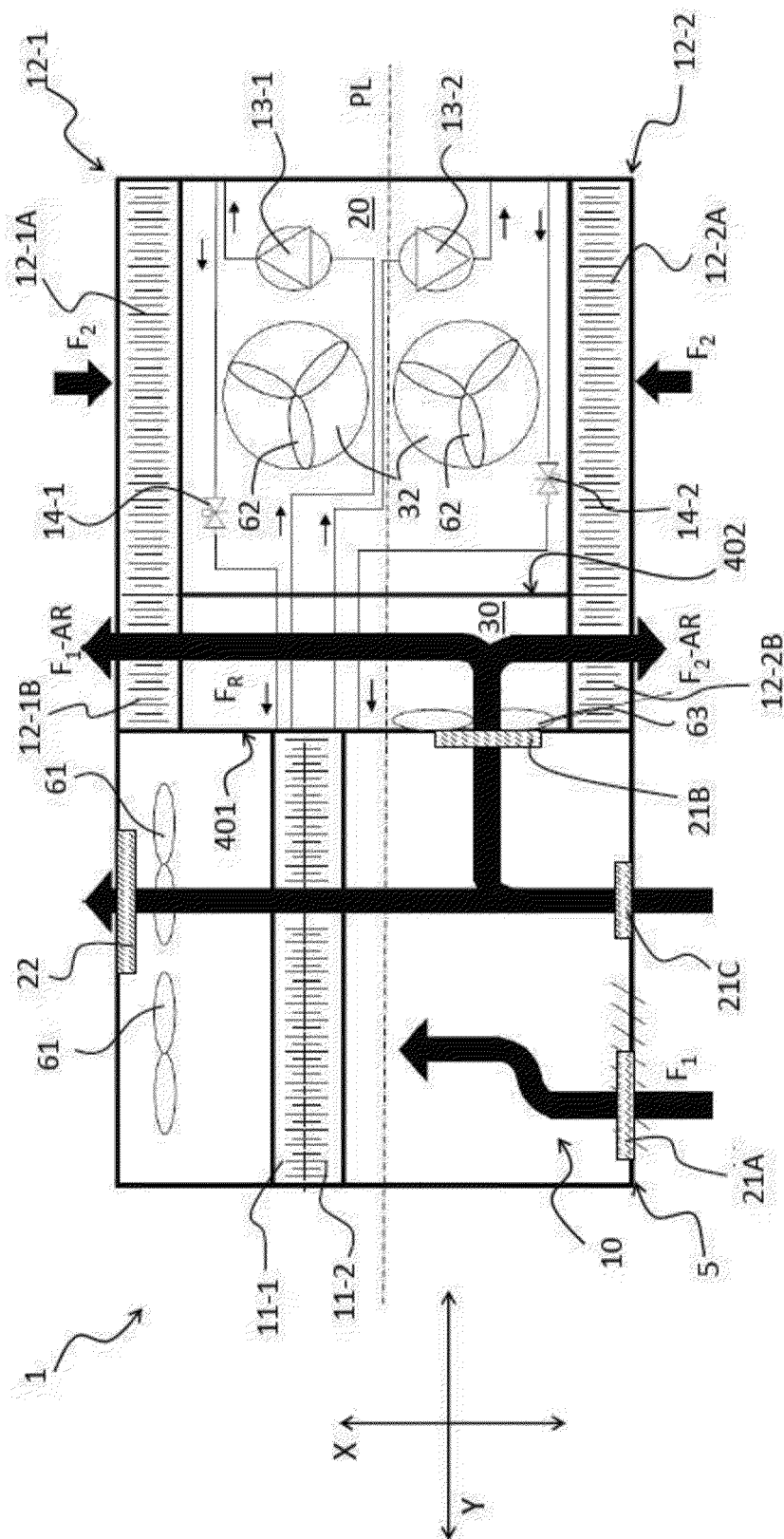
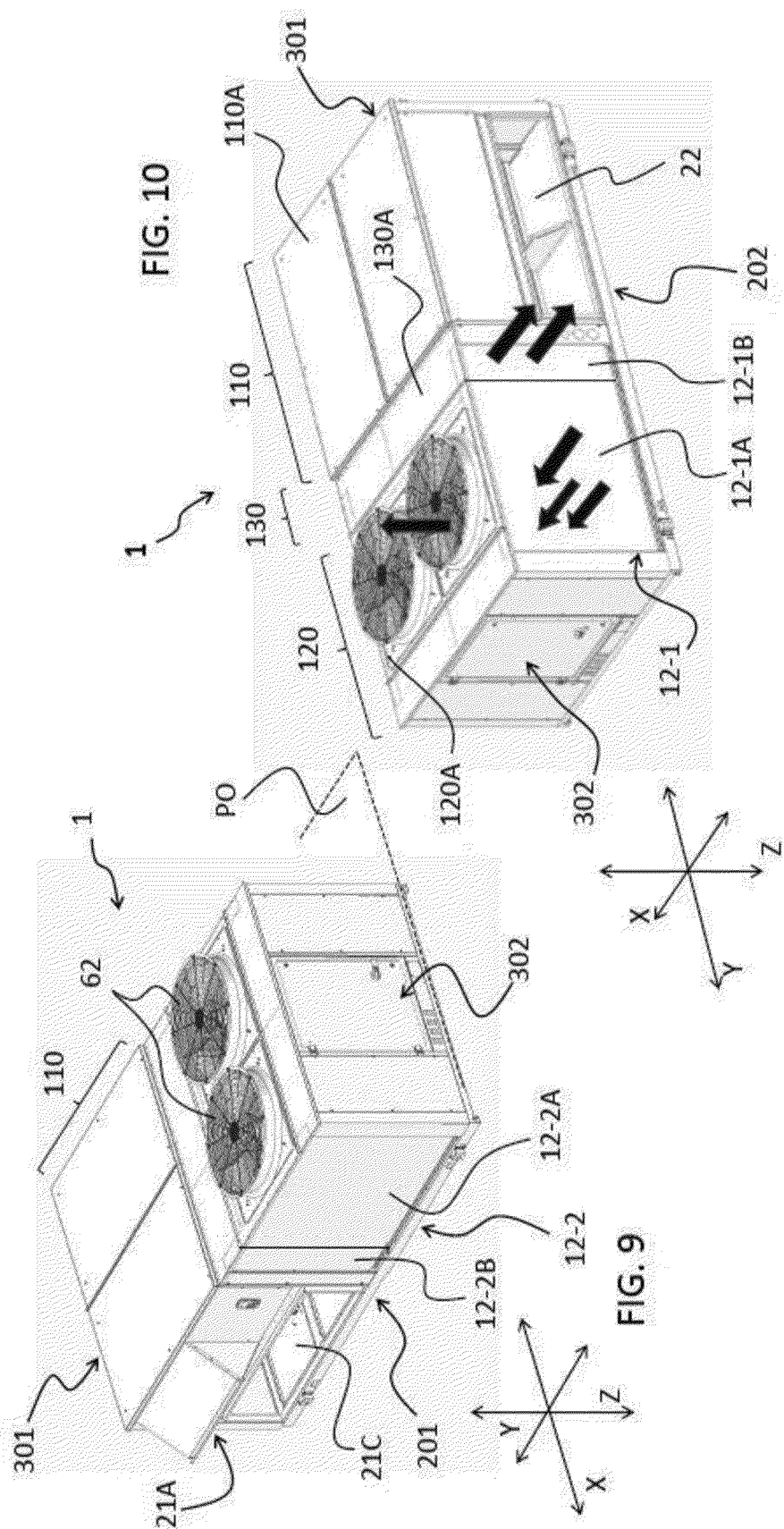
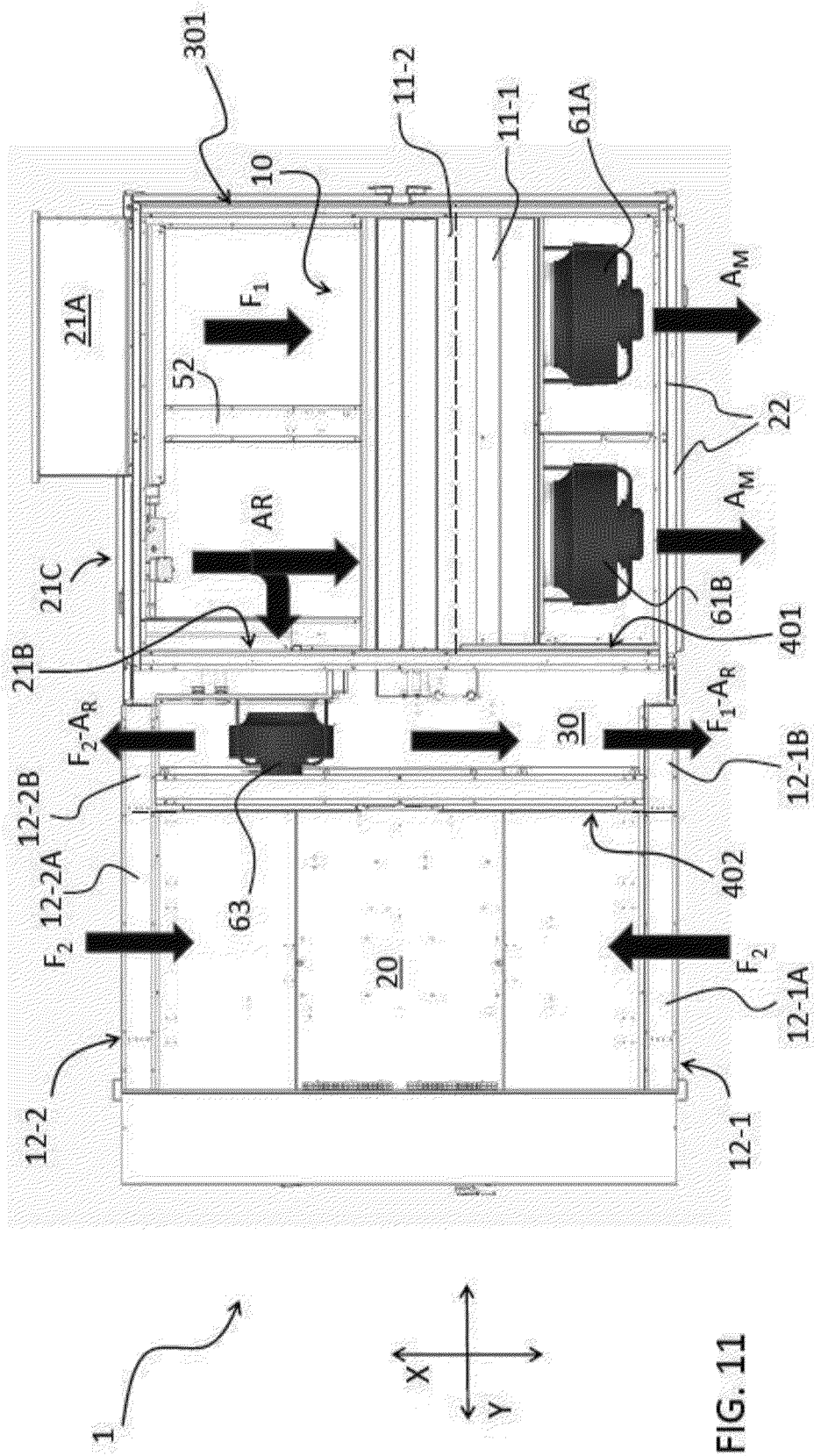


FIG. 8





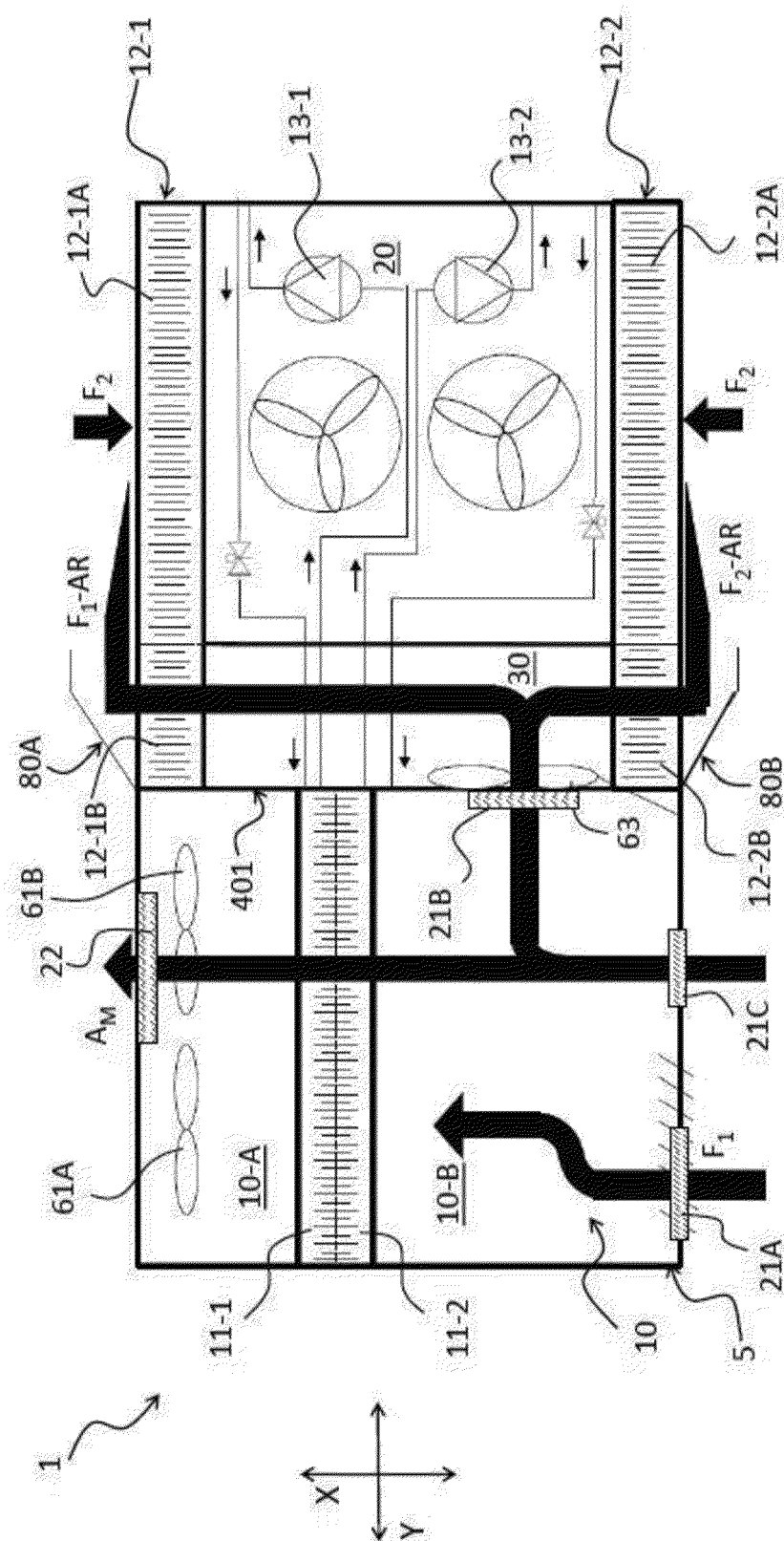
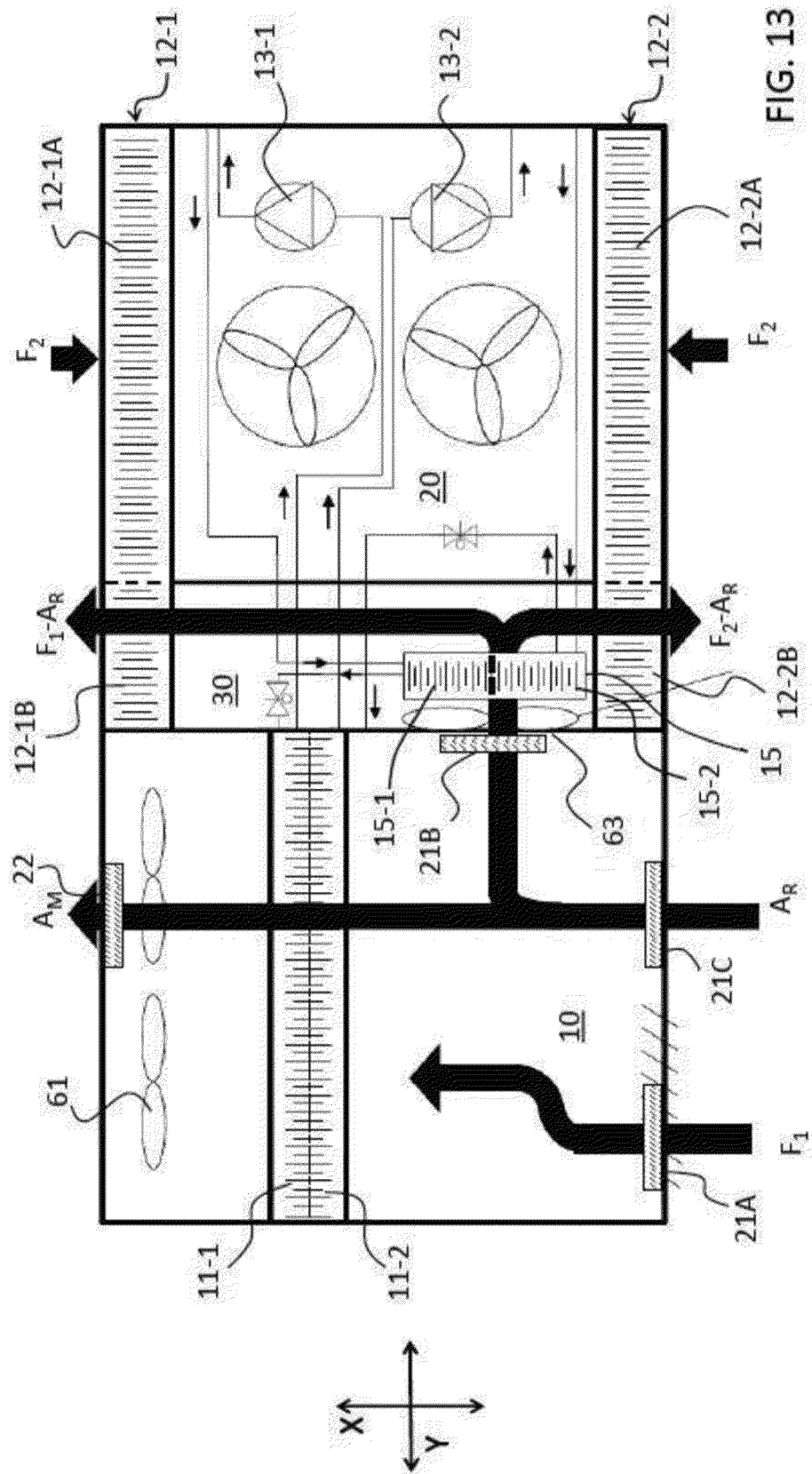


FIG. 12



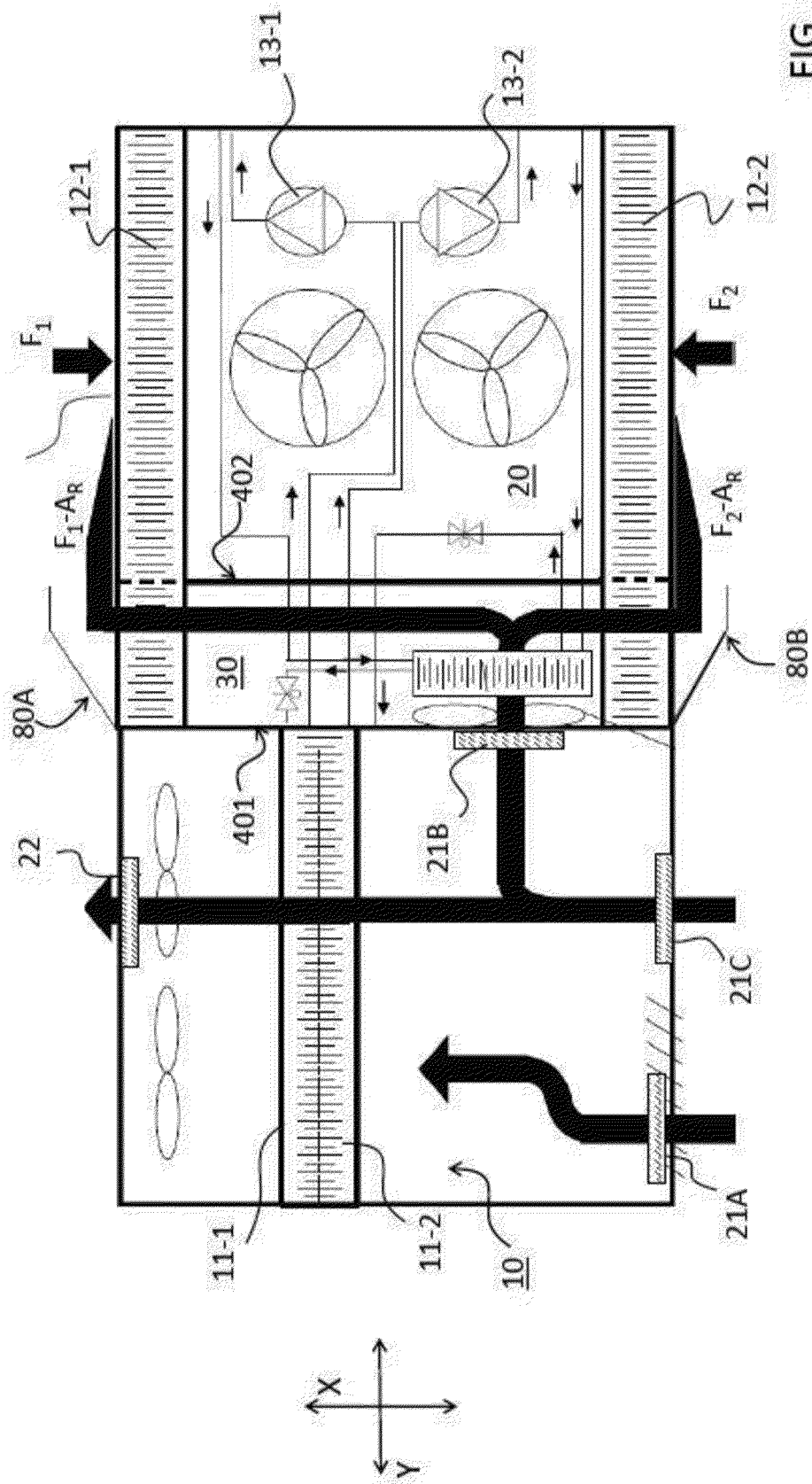


FIG. 14



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			F24F
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Place of search Munich		Date of completion of the search 16 November 2022	Examiner Schwaiger, Bernd
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