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(54) **COMBINED EQUIPMENT FOR THE CLIMATE CONTROL OF ENVIRONMENTS**

(57) Combined equipment for the climate control of environments, which comprises at least one heating plant with radiating strips provided with a containment box-shaped body (1), a burner (2) in which the combustion and the generation of combustion products take place, a circuit (5) of radiating tubes, which conveys a first carrier fluid (6) and is connected to the burner (2) to receive therein the high temperature combustion products susceptible of heating the first carrier fluid (6), a recirculation duct (7) housed in the containment box-shaped body (1), susceptible of closing the circuit (5) of radiating tubes. The combined equipment also comprises a heat pump heating plant, which is provided

with a second closed circuit (9) in which a second carrier fluid (10) circulates, an evaporator (11), which is housed inside the containment body (1) and is hydraulically connected to the second closed circuit (9) to heat the second carrier fluid (10). The containment box-shaped body (1) is provided with at least one first opening (12) connected by means of a heating duct (13) to the evaporator (11) susceptible of being traversed by a first air flow (14) coming from the outside environment (E) through the first opening (12) to heat, by means of thermal convection, said first air flow (14) directed towards said evaporator (11).

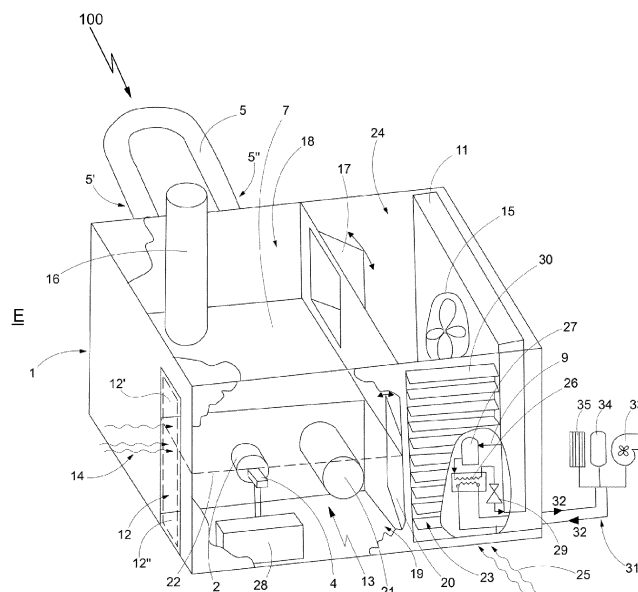


FIG. 1

Description

Field of application

[0001] The present invention regards combined equipment for the climate control of environments provided with a heating plant with radiating strips, according to the preamble of the respective main independent claim.

[0002] The present equipment is advantageously intended to be employed in industrial or commercial field to heat in particular large size buildings, both for a total heating and for heating partial areas of the building and for producing hot air or water for the purpose of also heating other environments.

State of the art

[0003] As is known, various types of equipment for the climate control of environments and in particular for heating have existed on the market for years. Such equipment is provided with a plant with radiating strips to be arranged slightly below the ceiling of buildings to be heated, in a manner so as to irradiate heat via irradiation towards things and people below, preferably with heat radiation in the infrared range.

[0004] Such plants with radiating strips of known type conventionally comprise closed circuit radiating ducts, which are connected to a burner, in which a fuel mixture composed of air and gas is made to burn.

[0005] Such mixture produces a flow of high temperature combustion products which is introduced in the closed circuit of the radiating ducts.

[0006] The aforesaid circuit of the plant is intercepted by a fan advantageously placed next to and upstream of the burner in a manner so as to subject the entire radiating circuit to a reduced pressure also susceptible of maintaining the plant in safe conditions.

[0007] The burnt gas flow produced by the burner is mixed in the closed circuit with a flow of combustion products previously introduced and in circulation, heating it so as to form a heating carrier fluid which is made to circulate in reduced pressure conditions by the action of the fan.

[0008] More in detail, the burners employed in such plants are conventionally provided with a combustion chamber, in which the comburent mixture, formed by air and gas, burns at a combustion head, generating a fume carrier fluid that is made to circulate inside radiating tubes together with the previously produced circulation fumes. The colder recirculation fumes are mixed with the hotter ones produced by the burner and together they are made to circulate by the fan, which maintains the entire circuit in reduced pressure conditions.

[0009] Therefore, the fan circulates in the circuit a flow rate of carrier fluid in part formed by the new much hotter burnt gases produced by the burner and in part by the cooler burnt recirculation gases which have already in part exchanged their heat with the radiating tubes during

the circulation thereof.

[0010] For the equilibrium of the masses at play, a part of the circulation fumes is expelled into the environment outside the building by means of a suitable expulsion duct (stack) usually placed upstream of the burner immediately downstream of the fan.

[0011] For example, it is known from patent WO 2011036645 to provide such heating plants with radiating strips with heat recovery devices placed to intercept the stack in order to expel, as in normal boilers, the lower temperature fumes, recovering part of the latent heat of condensation.

[0012] In recent years, in the industrial field of heating environments, there is a particularly strong need to increase thermal efficiency and also some laws require the at least partial use of renewable energy sources.

[0013] More clearly, the definition reported in the current legislation regarding renewable energy (*Legislative Decree 3 March 2011, No. 28 - Actuation of the directive 2009/28/CE regarding the promotion of the use of energy from renewable sources, bearing modification and subsequent abrogation of the directives 2001/77/CE and 2003/30/CE.*), reports that the "energy from renewable sources" is that energy coming from non-fossil renewable sources, i.e. wind energy, solar energy, aerothermal energy, geothermal energy, hydrothermal and oceanic energy, hydraulic energy, biomass, dump gases, residual gases from the purification and biogas processes.

[0014] In order to increase the energy efficiency of the equipment pieces for the climate control of environments, heating plants with radiating strips are known that are provided with heat recovery devices placed to intercept the fume discharge stack. Such devices transfer the heat recovered from the stack by means of a carrier fluid which transfers heat into the environment to be heated by means of a heat exchanger.

[0015] The equipment for the climate control of environments of known type, described in summary up to now, in practice does not lack drawbacks.

[0016] The main drawback lies in the fact that such equipment pieces of known type are not included among those listed as "supplied from renewable sources" since the supply of their burner up to now is only obtained from non-renewable energy sources, and in particular fuels deriving from oil are normally used, or more generally fossil hydrocarbons, such as methane gas, LPG or diesel.

[0017] A further drawback lies in the fact that such equipment pieces, even if attaining a greater efficiency with respect to the heating plants with radiating strips of conventional type, have not an efficiency sufficiently high to meet current standards in the industrial field of heating of environments.

[0018] In the field of equipment pieces for heating environments, equipment pieces provided with a heat pump heating plant have been known for some time. Such plants exploit aerothermal energy, which is listed among the renewable energy sources, contained in the air of the

outside environment in order to heat a carrier fluid at low temperature contained in closed circuit by means of an evaporator, normally positioned outside the environment to be heated inside a containment box-shaped body.

[0019] The carrier fluid thus heated by means of the heat absorbed from the air of the outside environment is compressed by a compressor, which creates a pressure difference adapted to force the carrier fluid inside the closed circuit, in particular towards a condenser, normally placed inside the environment to be heated. In this situation, the high temperature and pressure carrier fluid condenses and transfers, to the environment to be heated, the heat previously absorbed from the outside environment. The closed circuit finally connects the condenser and the evaporator by means of a thermal expansion valve, adapted to bring the carrier fluid (by now cooled) back to the operating pressure in order to once again be able to absorb heat from the outside environment.

[0020] The equipment pieces for the climate control of environments provided with a heat pump heating plant of the type described in summary up to now have in practice shown that they do not lack drawbacks.

[0021] A first drawback lies in the fact that the overall energy efficiency is strongly limited by the temperature difference between the outside environment and the environment to be heated. Therefore, in the winter seasons, or generally in the colder periods of the year, the afore-said temperature difference is such to have a significant negative effect on the total efficiency of the heat pump plant. More in detail, when the temperature of the outside environment is lowered below 7°C, the efficiency of the heat pump plant decreases drastically. In particular, if the temperature of the outside environment falls below 2°C, the evaporator risks freezing and/or icing. If the evaporator ices over, the entire heat pump heating plant stops operating until there is the complete unfreezing of the evaporator itself.

[0022] In this situation, unfreezing devices are known for allowing the evaporator to continue to work even at low temperatures, such as electrical heating elements placed at the evaporator itself, which by being heated due to ohmic effect increase the temperature of the latter and allow the operation thereof.

[0023] The main drawback of such unfreezing device for the evaporator lies in the fact that the electrical heating elements are highly energy-intensive and lower the overall efficiency of the climate control equipment.

[0024] Also known, in order to heat the evaporator in case of freezing, is an unfreezing method which provides for the use of the heat pump plant, by reversing its operating cycle, i.e. having the evaporator act as a condenser for several minutes, in order to transport a part of the heat of the internal environment to be heated to the evaporator itself, which increases its temperature until complete unfreezing has been achieved, in order to then once again reverse the cycle of the plant for the normal operation thereof.

[0025] The main drawback of the method of unfreezing

the evaporator of known type, described in summary above, lies in the fact that the reversal of the work cycle drastically lowers the overall efficiency of the climate control equipment, since in this situation it removes heat from the internal environment to be heated for several minutes; such heat must then be once again transferred with the subsequent reversal of the work cycle.

[0026] The patent EP 0099022 describes a heating equipment of known type which comprises a containment body in which a heat pump is housed, provided with an evaporator traversed by an air flow suctioned from the outside environment by means of a fan. In addition, inside the containment body, a burner is housed that is provided with an expulsion duct adapted to expel the discharge fumes into the air flow which intercepts the evaporator.

[0027] The equipment pieces of known type described up to now, in order to never leave the environment to be heated without the necessary heat supply, during construction require an over-sizing of the thermal flow rate to be installed with respect to the actual needs of the user, by using for example multiple evaporators, connected to each other in a pack and operating at pre-established interval.

Presentation of the invention

[0028] In such context, therefore, the main object of the present invention is that of overcoming the drawbacks of the above-described already known prior art, presenting equipment for the climate control of environments that is capable of improving the overall efficiency of the equipment pieces of known type and does not require an increase of thermal power to be installed beyond that required in order to thermally control the internal environment.

[0029] Further object of the present invention is that of presenting equipment for the climate control of environments which allows reaching high efficiencies by means of the at least partial use of a renewable energy source.

[0030] Further object of the present invention is that of presenting equipment for the climate control of environments which allows continuous operation that is safe and entirely reliable.

Brief description of the drawings

[0031] The technical characteristics of the finding, according to the task and the proposed objects, can be clearly seen in the contents of the below-reported claims and the advantages thereof will be more evident in the detailed description of several embodiments, according to the finding, illustrated as a non-limiting example in the enclosed drawing tables in which:

- fig. 1 illustrates a schematic perspective view of the equipment for the climate control of environments, object of the present invention, with some parts removed in order to better illustrate other parts;

- fig. 2 illustrates a plan schematic view of the equipment for the climate control of environments, object of the present invention, with some parts removed in order to better illustrate other parts;
- fig. 3 illustrates a front schematic view of the equipment for the climate control of environments, object of the present invention, with some parts removed in order to better illustrate other parts;
- fig. 4 illustrates a circuit diagram of the combined equipment for heating environments, object of the present invention, in a first embodiment thereof.
- fig. 5 illustrates a circuit diagram of the combined equipment for heating environments, object of the present invention, in a second embodiment thereof.

Detailed description of a preferred embodiment

[0032] With reference to the enclosed drawings, reference number 100 overall indicates equipment for the climate control of environments in accordance with a preferred embodiment of the present invention.

[0033] This is intended to be mainly employed in the climate control of the environments by means of irradiation and/or convection in industrial, commercial and private field.

[0034] The equipment for the climate control of environments 100, object of the present invention, comprises at least one heating plant with radiating strips and is provided with a containment box-shaped body 1.

[0035] Preferably, the containment box-shaped body 1 of the equipment 100, object of the invention, is positioned in an outside environment E with respect to the environment to be heated.

[0036] The heating plant with radiating strips comprises a burner 2 housed inside the containment box-shaped body 1.

[0037] The burner 2 comprises a combustion chamber 3, means 4 for supplying a fuel mixture C connected to the combustion chamber 3 in which the combustion of the fuel mixture C and the generation of combustion products take place.

[0038] The burner 2 can be of suction or blow type and in any one of the embodiments currently available on the market, *per se* known to the man skill in the art and therefore not described in detail hereinbelow, for example referred to as single-stage, double stage and/or modulating, and it is susceptible of burning gaseous or liquid fuel, based on the need and on design selections.

[0039] The heating plant with radiating strips also comprises a circuit 5 of radiating tubes, which conveys a first carrier fluid 6 and is connected to the burner 2 to receive therein the high temperature combustion products susceptible of heating the carrier fluid 6 itself.

[0040] In particular, the circuit 5 of radiating tubes is at least partially extended outside the containment box-shaped body 1, being advantageously intended to be arranged in the environment to be heated in order to transfer heat to the latter by means of irradiation.

[0041] The circuit 5 of radiating tubes is provided with an initial section 5' connected in fluid relation with the combustion chamber 3 of the burner 2 in order to receive the combustion products, and with a final section 5" connected in fluid relation with the burner 2 in order to allow at least part of the first carrier fluid 6 to return to the burner 2 and circulate inside the circuit 5 of radiating tubes.

[0042] In particular, the circuit 5 is extended for most of its extension (from the initial section 5' to the final section 5") outside of the containment box-shaped body 1.

[0043] The heating plant with radiating strips also comprises a recirculation duct 7 which is housed inside the containment box-shaped body 1 and is susceptible of placing the initial section 5' and the final section 5" of the circuit 5 of radiating tubes in connection with each other, forming a closed ring with the latter, in a manner such that at least one part of the first carrier fluid 6 which exits from the final section 5" returns into the initial section 5' of the circuit 5 itself.

[0044] The heating plant with radiating strips also comprises a first fan 8, which is provided with an impeller housed inside the recirculation duct 7 and functioning in suction, in particular in suction at the final section 5" of the circuit 5 of radiating tubes, in order to force the first carrier fluid 6 from the final section 5" to the initial section 5' of the circuit 5 of radiating tubes and hence to circulate the first carrier fluid 6 inside the circuit 5 of radiating tubes. The heating plant with radiating strips also comprises a fume expulsion duct 16 connected to the recirculation duct 7 and positioned downstream of the first fan 8, to expel at least one part of the aforesaid first carrier fluid 6.

[0045] Preferably, in accordance with the embodiments illustrated in figures 4 and 5, the fume expulsion duct 16 is positioned upstream of the burner 2 and downstream of the fan 8.

[0046] Preferably, the recirculation duct 7 which internally conveys the first carrier fluid 6, which is at higher pressure than atmospheric pressure since it is increased by the action of the fan 8, allows conveying at least one part of the first carrier fluid 6 itself towards the fume expulsion duct 16.

[0047] Preferably, in order to maintain constant the mass of the first carrier fluid 6 inside the circuit 5 of radiating tubes, the mass of first carrier fluid 6 that is expelled through the fume expulsion duct 16 is equivalent to the mass of fuel mixture C that is forced into the burner 2.

[0048] According to the idea underlying the present invention, the equipment 100 for the climate control of environments also comprises a heat pump heating plant.

[0049] Such heat pump heating plant is provided with a second closed circuit 9 in which a second carrier fluid 10 circulates and with an evaporator 11, which is housed inside the containment body 1 and is hydraulically connected to the second closed circuit 9 to heat the second carrier fluid 10.

[0050] More in detail, the containment box-shaped body 1 is provided with at least one first opening 12 con-

nected by means of a heating duct 13 to the evaporator 11 and is susceptible of being traversed by a first air flow 14 coming from the outside environment E through the first opening 12.

[0051] Advantageously, in accordance with a further embodiment, the first opening 12 can define two different (first and second) secondary inlet openings 12', 12'', each of which allowing the passage of the first air flow 14 inside the heating duct 13 along two different paths separate from each other. More in detail, a first path of the air flow 14 intercepts the fume expulsion duct 16, and a second path of the air flow 14 intercepts the supply means 4 of the burner 2.

[0052] The recirculation duct 7 is close to the heating duct 13 to heat, in particular by means of thermal convection, the first air flow 14 directed towards the evaporator 11.

[0053] Advantageously, the first air flow 14 is heated, in particular by means of convection, by touching the heating duct 13 and it transfers the heat thus obtained to the evaporator 11 of the heat pump heating plant, and such evaporator 11, during the entire operation of the equipment for the climate control of environments 100, is ensured a first air flow 14 constantly at a temperature higher than 7°C even in the coldest periods of the year.

[0054] The equipment 100, object of the invention, thus prevents the evaporator 11 from being externally iced, compromising the correct and effective operation of the heat pump heating plant, and simultaneously avoids the use of high energy-intensive unfreezing devices, such as electrical heating elements placed at the evaporator 11 itself, or reversals of the operating cycle of the heat pump plant.

[0055] Advantageously, in accordance with the preferred embodiment illustrated in the enclosed figures, the evaporator 11 of the heat pump heating plant comprises at least one second fan 15, which is adapted to suction the first air flow 14 from the outside environment E through the first opening 12 and is adapted to convey it inside the heating duct 13 in order to then externally hit the evaporator 11 itself.

[0056] Advantageously, the second fan 15 is placed at the evaporator 11, and is adapted to suction the first air flow 14 from the outside environment E through the first opening 12 and to convey it inside the heating duct 13, in order to then externally hit the evaporator 11 itself.

[0057] Advantageously, the second fan 15 is provided with an electric motor provided with an electronic controller with inverter in order to ensure a feedback control and a continuous variation of the number of revolutions and consequently a control and a continuous variation of the flow rate of the first air flow 14.

[0058] Preferably, the heating duct 13 of the containment box-shaped body 1 is intercepted by at least one first adjustable shutter 17 which is susceptible of varying the flow rate of the first air flow 14, directed towards the evaporator 11. The feedback control actuated by the electronic controller with inverter of the electric motor of

the second fan 15, which adjusts the flow rate of the first air flow 14 drawn from the outside environment E by means of the first opening 12, is linked to temperature and humidity values of the air of the environment E, detected by means of measuring means preferably provided outside the containment box-shaped body 1, in accordance with an embodiment of the present invention not illustrated in the enclosed figures. Such variation of flow rate of the first air flow 14 allows maintaining high efficiency of the heat pump heating plant.

[0059] Advantageously, the heating duct 13 comprises a first branch 18 which is traversed by the fume expulsion duct 16 and is intercepted by the first adjustable shutter 17. More in detail, the first branch 18 of the heating duct 13 is advantageously placed above said recirculation duct 7 and conveys to the evaporator 11 the first air flow 14 drawn from the outside environment E, in particular by means of the first secondary inlet opening 12' of the first opening 12.

[0060] Advantageously, the heating duct 13, and in particular the second branch 18 of the latter, is fluid-dynamically separate from the fume expulsion duct 16, in a manner such that the part of the first carrier fluid 6 which traverses the fume expulsion duct 16 is not mixed with the first air flow 14 which traverses the heating duct 13.

[0061] The temperature increase of the first air flow 14 coming from the outside environment E, if it traverses the first branch 18 of the heating duct 13, is about 20-30°C.

[0062] Preferably, the first adjustable shutter 17 which intercepts the first branch 18 of the heating duct 13 is movable by means of first actuator means.

[0063] Advantageously, in accordance with the embodiment illustrated in the enclosed figures, the heating duct 13 comprises a second branch 19, which is intercepted by a second adjustable shutter 20, is placed laterally side by side the recirculation duct 7 and conveys to the evaporator 11 the first air flow 14 drawn from the outside environment E preferably by means of the second secondary inlet opening 12'' of the first opening 12.

[0064] Preferably, the second adjustable shutter 20 which intercepts the second branch 19 of the heating duct 13 is movable by means of second actuator means.

[0065] Advantageously, the first and the second branch 18, 19 of the heating duct 13 are susceptible of being traversed both by the first air flow 14 coming from the outside environment E through the secondary inlet openings 12', 12'' of the first opening 12 made on the containment box-shaped body 1.

[0066] The first fan 8 of the heating plant with radiating strips of the equipment 100, object of the present invention, is preferably provided with an electric motor 21 housed inside the heating duct 13.

[0067] Preferably, the supply means 4 of the burner 2 of the heating plant with radiating strips are also housed inside said heating duct 13, advantageously side by side the electric motor 21 of the first fan 8.

[0068] Advantageously both the supply means 4 of the

burner 2, and the electric motor 21 which drives the first fan 8, are externally hit by the first air flow 14 which traverses the second branch 19 of the heating duct 13.

[0069] The temperature increase of the first air flow 14 coming from the outside environment E, if it traverses the second branch 19 of the heating duct 13, is about 10-20°C.

[0070] Advantageously, the heating duct 13 is at least partially delimited by the recirculation duct 7 by means of at least one common wall 22. Such common wall 22 is traversed by the supply means 4 of the burner 2 and by transmission means of the electric motor 21 which drives the first fan 8 which is provided with an impeller housed inside the recirculation duct 7.

[0071] Preferably, in accordance with the preferred embodiment illustrated in the enclosed figures, the containment box-shaped body 1 of the equipment object of the invention is provided with a second opening 23 connected by means of an air supply duct 24 to the evaporator 11 and susceptible of being traversed by a second air flow 25 coming from the outside environment E.

[0072] Advantageously, in accordance with the embodiment illustrated in the enclosed figures, the air supply duct 24 to the evaporator 11 susceptible of being traversed by the second air flow 25 coming from the outside environment E by means of the opening 23, is susceptible of being intercepted by the adjustable shutter 20 which also selectively intercepts the branch 19 of the heating duct 13.

[0073] Advantageously, the first opening 12 and the second opening 23 of the containment box-shaped body 1 are provided with respective gravity closing shutters 30, which are closed if the second fan 15 is turned off and therefore allow preventing heat dispersions by the heating duct 13 towards the outside environment E if it is not necessary to heat the evaporator 11 of the heat pump heating plant, for example if the temperature of the outside environment E exceeds 7°C.

[0074] In accordance with the two embodiments of the equipment 100, object of the present invention, respectively illustrated in the circuit diagrams of figures 4 and 5, the heat pump heating plant comprises a condenser 26 hydraulically connected to the evaporator 11 by means of the second closed circuit 9, a compressor 27 hydraulically connected to and interposed between the condenser 26 and the evaporator 11, which is adapted to force the second carrier fluid 10 from the evaporator 11 towards the condenser 26, conveying it inside the second closed circuit 9.

[0075] Preferably, the second carrier fluid 10, by intercepting the evaporator 11, absorbs heat from the first air flow 14 which is previously heated in the heating duct 13. In this manner, the second carrier fluid 10 is forced to pass from the liquid phase to the gaseous phase inside the evaporator 11, in a manner *per se* known by the man skilled in the art.

[0076] Advantageously, the heat pump heating plant also comprises a thermal expansion valve 29 hydraulically

connected and interposed between the condenser 26 and the evaporator 11 and is adapted to expand the second carrier fluid 10 coming from the condenser 26 by means of the second closed circuit 9.

[0077] Preferably, the second carrier fluid 10 is forced while in vapor phase (exiting from the evaporator 11) from the compressor 27 to the condenser 26, in which it transfers heat thus passing from the vapor phase to the liquid phase, in a manner *per se* known by the man skilled in the art.

[0078] Preferably, in accordance with the embodiments illustrated in figures 4 and 5, the second carrier fluid 10 at the outlet of the condenser 26 enters into the thermal expansion valve 29 where it undergoes a pressure drop and once again returns into the evaporator 11.

[0079] In accordance with one embodiment of the equipment 100, object of the present invention, illustrated in figures 1, 3 and 5, the condenser 26, the compressor 27 and the thermal expansion valve 29 are housed inside the containment box-shaped body 1 of the equipment for the climate control of environments 100.

[0080] More in detail, the condenser 26, the compressor 24 and the thermal expansion valve 27 are preferably housed in a closed compartment, thermally insulated and obtained inside the containment box-shaped body 1.

[0081] In accordance with the preferred embodiment illustrated in the enclosed figures, the condenser 26 of the heat pump heating plant is of plate type and is susceptible of exchanging heat by means of a third carrier fluid 32, which transports the heat thus obtained by means of a third closed circuit 31 to a secondary environment heating plant 33 of thermal ventilation type, with the object of heating air, and is advantageously positioned inside the environment to be heated, in accordance with the second embodiment of the circuit diagram illustrated in the enclosed figure 5.

[0082] Preferably, the secondary environment heating plant 33 comprises a storage tank 34 intercepted by the third closed circuit 31 and intended to store hot water, e.g. for sanitary use.

[0083] Preferably, the secondary environment heating plant 33 comprises a radiating heating system 35 intercepted by the third closed circuit 31 and intended to be employed for example in floor heating or in ceiling panel heating.

[0084] Otherwise, the condenser 26 of the heat pump heating plant is susceptible of exchanging heat with a third air flow 36, which is moved by a third fan mechanically associated with the condenser 26 itself and advantageously positioned inside the environment to be heated. Preferably, the combined equipment for the climate control of environments 100, object of the present invention, also comprises an electronic control unit 28 provided with temperature detecting means, which are adapted to detect temperature values of the evaporator 11 of the heat pump heating plant and temperature values of the first air flow 14 and to send a corresponding signal to the electronic control unit 28 containing such detected tem-

perature values.

[0085] Advantageously, the electronic control unit 28 is susceptible of controlling the first actuator means, e.g. hydraulic pistons, of the first adjustable shutter 17 placed to intercept the heating duct 13 in order to vary the flow rate of the first air flow 14 if predetermined temperature values are reached, measured by the temperature detecting means. Preferably, the flow rate of the first air flow 14 susceptible of traversing the first branch 18 of the heating duct 13 increases with the decrease of the temperature of the first air flow 14 drawn from the outside environment E preferably by means of the first secondary inlet opening 12' of the first opening 12, in order to maintain the temperature of the evaporator 11 constant.

[0086] Preferably, the electronic control unit 28 is susceptible of controlling the second actuator means of the second adjustable shutter 20 which is placed to intercept the second branch 19 of the heating duct 13 and of the air supply duct 24 and is susceptible of adjusting the first air flow 14 which traverses the second branch 19 of the heating duct 13 and the second air flow 25 which traverses the air supply duct 24. Preferably, the flow rate of the first air flow 14 in the second branch 19 of the heating duct 13 increases with the decrease of the temperature of the first air flow 14 drawn from the outside environment E preferably by means of the second secondary inlet opening 12" of the first opening 12, in order to maintain the temperature of the evaporator 11 constant.

[0087] If the temperature of the air of the outside environment E is low and in particular lower than 7°C, the flow rate of the second air flow 25 coming from the outside environment E by means of the second opening 23, suctioned in the air supply duct 24 and conveyed towards the evaporator 11, decreases with the decrease of the temperature of the second air flow 25 itself.

[0088] In particular, if the temperature of the air of the outside environment E is lower than 0°C, the electronic control unit 28 controls the first adjustable shutter 17 to open the first branch 18 of the heating duct 13, thus increasing the flow rate of the first air flow 14 which is heated in the heating duct 13 and simultaneously controls the second shutter 20 to open the second branch 19 of the heating duct 13 and to close the second opening 23, in a manner so as to substantially cancel the flow rate of the second air flow 25 coming from the outside environment E by means of the second opening 23, suctioned into the air supply duct 24 and conveyed to the evaporator 11.

[0089] The combined equipment for the climate control of environments thus conceived therefore attains the pre-established objects. In particular, such equipment allows a continuous and constant operation, without substantial losses of overall efficiency of the equipment.

[0090] In addition, the equipment, object of the present invention, thus conceived allows maintaining a substantially constant level of efficiency of the heat pump heating plant even during the coldest periods of the year, hence being advantageously employable in any setting, both

commercial and industrial.

Claims

1. Combined equipment for climate control of environments (100), which comprises:

- at least one heating plant with radiating strips provided with:

- a containment box-shaped body (1);
- a burner (2) housed in said containment box-shaped body (1) and provided with:

- one combustion chamber (3);
- means (4) for supplying a fuel mixture (C) connected to said combustion chamber (3) in which the combustion of said fuel mixture (C) and the generation of combustion products take place;

- a circuit (5) of radiating tubes, which is at least partially extended outside said box-shaped body (1), is susceptible of conveying a first carrier fluid (6) and is connected to said burner (2) to receive therein said high temperature combustion products susceptible of heating said first carrier fluid (6);

- a recirculation duct (7), which is housed in said containment box-shaped body (1), places an initial section (5') and a final section (5'') of said circuit (5) of radiating tubes in connection with each other, forming a closed ring with said circuit (5);

- a first fan (8), provided with an impeller housed in said recirculation duct (7) and functioning in suction and configured to force said first carrier fluid (6) from said final section (5'') to said initial section (5') and thus to circulate said first carrier fluid (6) inside said circuit (5) of radiating tubes;

- a fume expulsion duct (16) connected to said recirculation duct (7) downstream of said first fan (8), to expel at least one part of said first carrier fluid (6);

characterized in that it further comprises a heat pump heating plant, which is provided with:

- a second closed circuit (9) in which a second carrier fluid (10) is susceptible of circulating;

- an evaporator (11), which is housed within said containment body (1) and is hydraulically connected to said second closed circuit (9) to heat said second carrier fluid (10);

- said containment box-shaped body (1) being provided with at least one first opening (12) connected through a heating duct (13) to said evaporator (11) susceptible of being traversed by a first air flow (14) coming from the outside environment (E) through said first opening (12); said recirculation duct (7) being close to said heating duct (13) to heat said first air flow (14) directed towards said evaporator (11).
2. Combined equipment for climate control of environments (100) according to claim 1, **characterized in that** said evaporator (11) of said heat pump heating plant comprises at least one second fan (15) adapted to suction said first air flow (14) from the outside environment (E) through said first opening (12) and to force it into said heating duct (13).
 3. Combined equipment for climate control of environments (100) according to claim 1, **characterized in that** said heating duct (13) is intercepted by at least one first adjustable shutter (17) so as to vary the flow rate of the first air flow (14) directed towards said evaporator (11).
 4. Combined equipment for climate control of environments (100) according to claim 3, **characterized in that** said heating duct (13) comprises a first branch (18) traversed by said fume expulsion duct (16), intercepted by said first adjustable shutter (17) and placed above said recirculation duct (7); said first adjustable shutter (17) being able to be moved by first actuator means.
 5. Combined equipment for climate control of environments (100) according to claim 1, **characterized in that** said heating duct (13) comprises a second branch (19) intercepted by a second adjustable shutter (20) and placed laterally side by side said recirculation duct (7); said second adjustable shutter (20) being movable through second actuator means.
 6. Combined equipment for climate control of environments (100) according to claims 4 and 5, **characterized in that** said first branch (18) and second branch (19) of said heating duct (13) are both susceptible of being traversed by the first air flow (14) coming from the outside environment (E) through said first opening (12).
 7. Combined equipment for climate control of environments (100) according to claim 1, **characterized in that** said first fan (8) is provided with an electric motor (21) housed inside said heating duct (13); said supply means (4) of said burner (2) being also housed inside said heating duct (13).
 8. Combined equipment for climate control of environments (100) according to claim 1, **characterized in that** said heating duct (13) is at least in part delimited by said recirculation duct (7) through at least one common wall (22).
 9. Combined equipment for climate control of environments (100) according to claim 1, **characterized in that** said containment box-shaped body (1) is provided with a second opening (23) connected through an air supply duct (24) to said evaporator (11) susceptible of being traversed by a second air flow (25) coming from the outside environment (E).
 10. Combined equipment for climate control of environments (100) according to claim 9, **characterized in that** said first opening (12) and second opening (23) of said containment box-shaped body (1) are provided with respective gravity closing shutters (30).
 11. Combined equipment for climate control of environments (100) according to claim 1, **characterized in that** said heat pump heating plant comprises:
 - a condenser (26) hydraulically connected to said evaporator (11);
 - a compressor (27) hydraulically connected and interposed between said condenser (26) and said evaporator (11), adapted to force said second carrier fluid (10) from said evaporator (11) towards said condenser (26);
 - a thermal expansion valve (29) hydraulically connected and interposed between said condenser (26) and said evaporator (11), adapted to expand and to cool said second carrier fluid (10) coming from said condenser (26);
 said condenser (26), compressor (27) and thermal expansion valve (29) being housed inside said containment box-shaped body (1).
 12. Combined equipment for climate control of environments (100) according to claim 4, **characterized in that** it comprises an electronic control unit (28) provided with temperature detecting means adapted to detect temperature values of said evaporator (11) of said heat pump heating plant and temperature values of said first air flow (14) and to send a corresponding signal to said electronic control unit (28) containing the detected temperature values; said electronic control unit (28) being susceptible of controlling said first actuator means of said first adjustable shutter (17) to intercept said heating duct (13) so as to vary the flow rate of said first air flow (14) upon reaching predetermined temperature values measured by said temperature detecting means.
 13. Combined equipment for climate control of environments (100) according to claims 5, 9 and 12, **characterized in that** said electronic control unit (28) is

susceptible of controlling said second actuator means of said second adjustable shutter (20) which is placed to intercept said second branch (19) of said heating duct (13) and of said air supply duct (24) and is susceptible of adjusting said first air flow (14) which traverses said second branch (19) of said heating duct (13) and said second air flow (25) which traverses said air supply duct (24).

14. Combined equipment for the climate control of environments (100) according to claim 1, **characterized in that** said heating duct (13) is fluid-dynamically separate from said fume expulsion duct (16).

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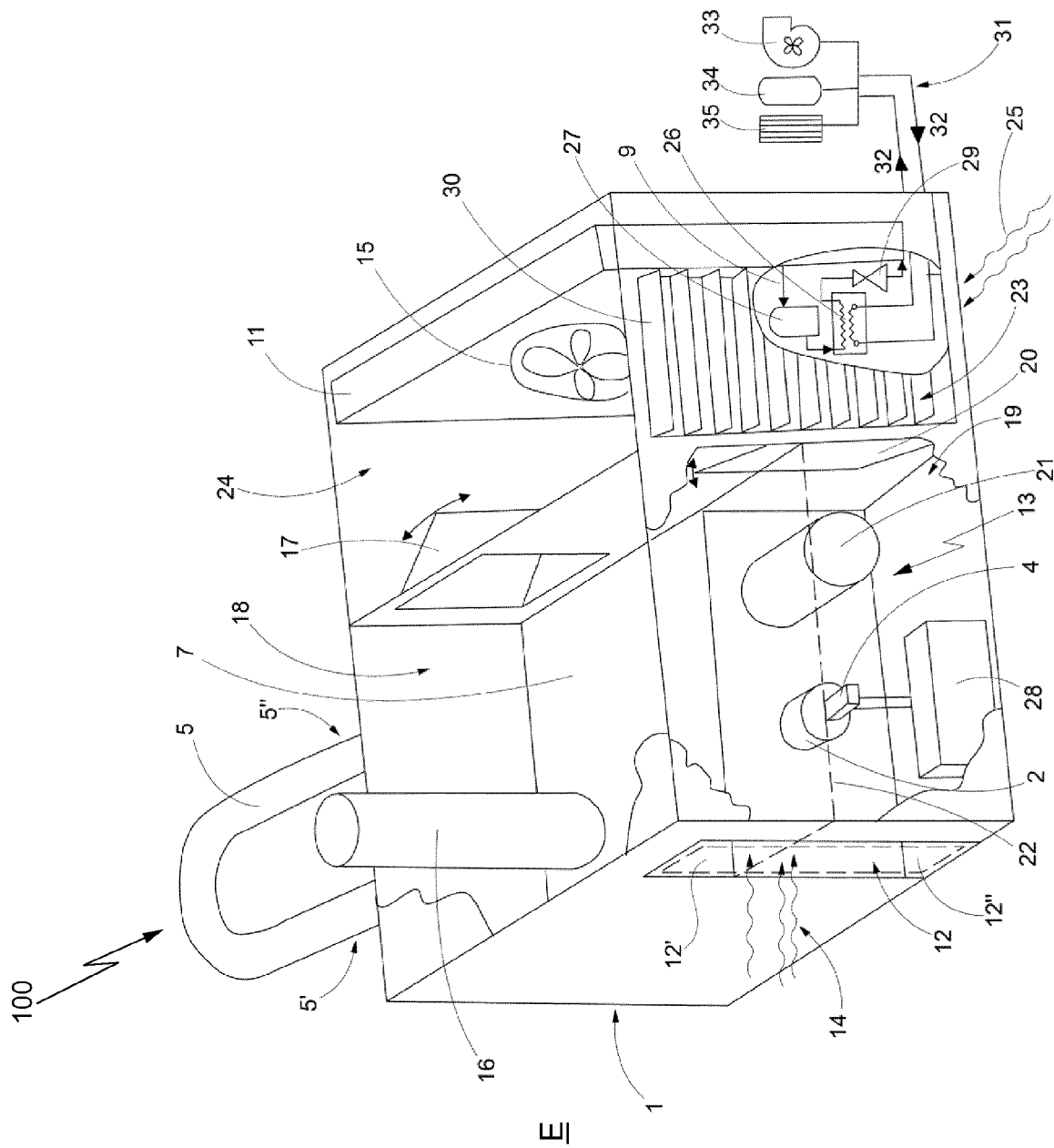


FIG. 1

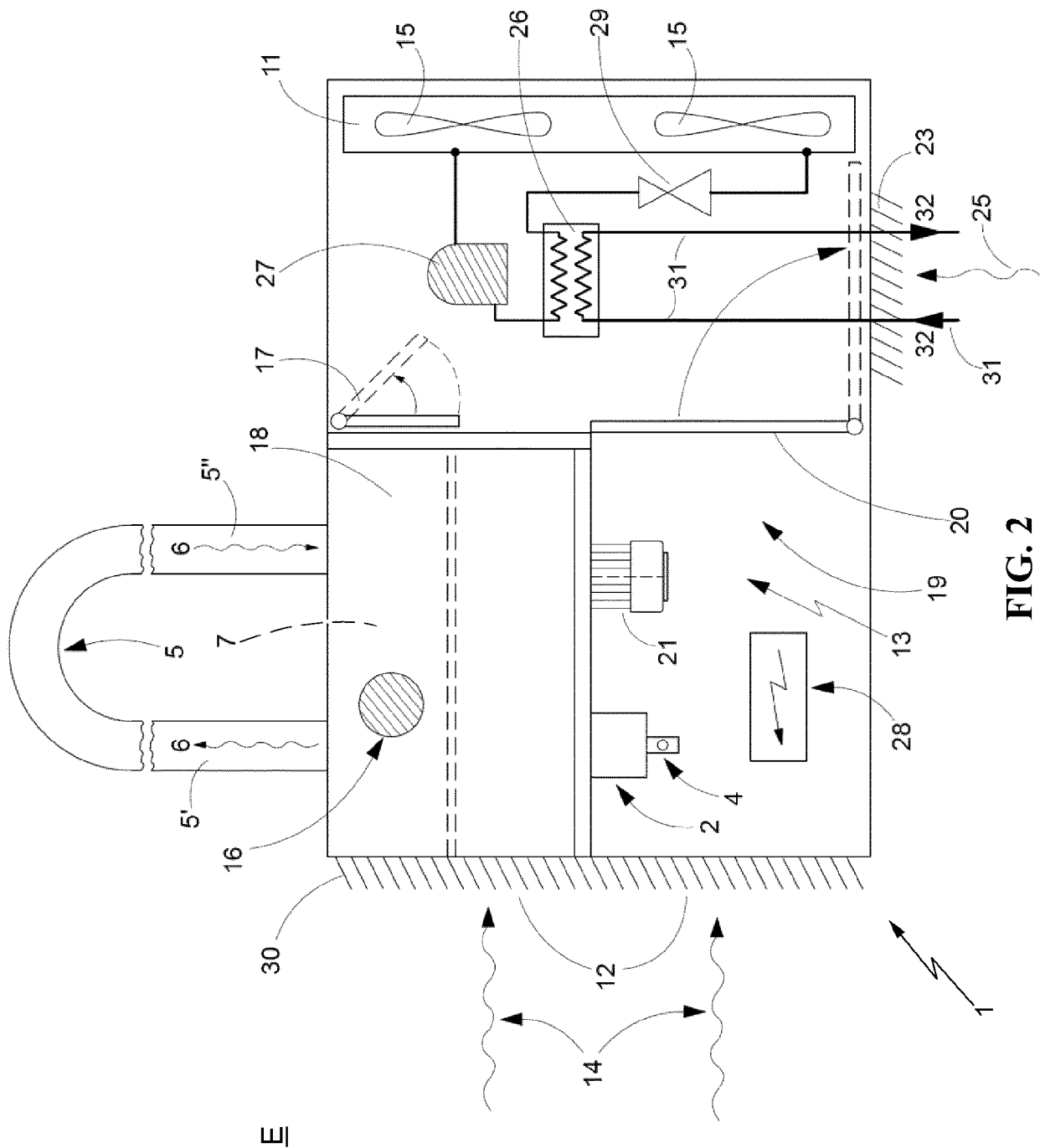


FIG. 2

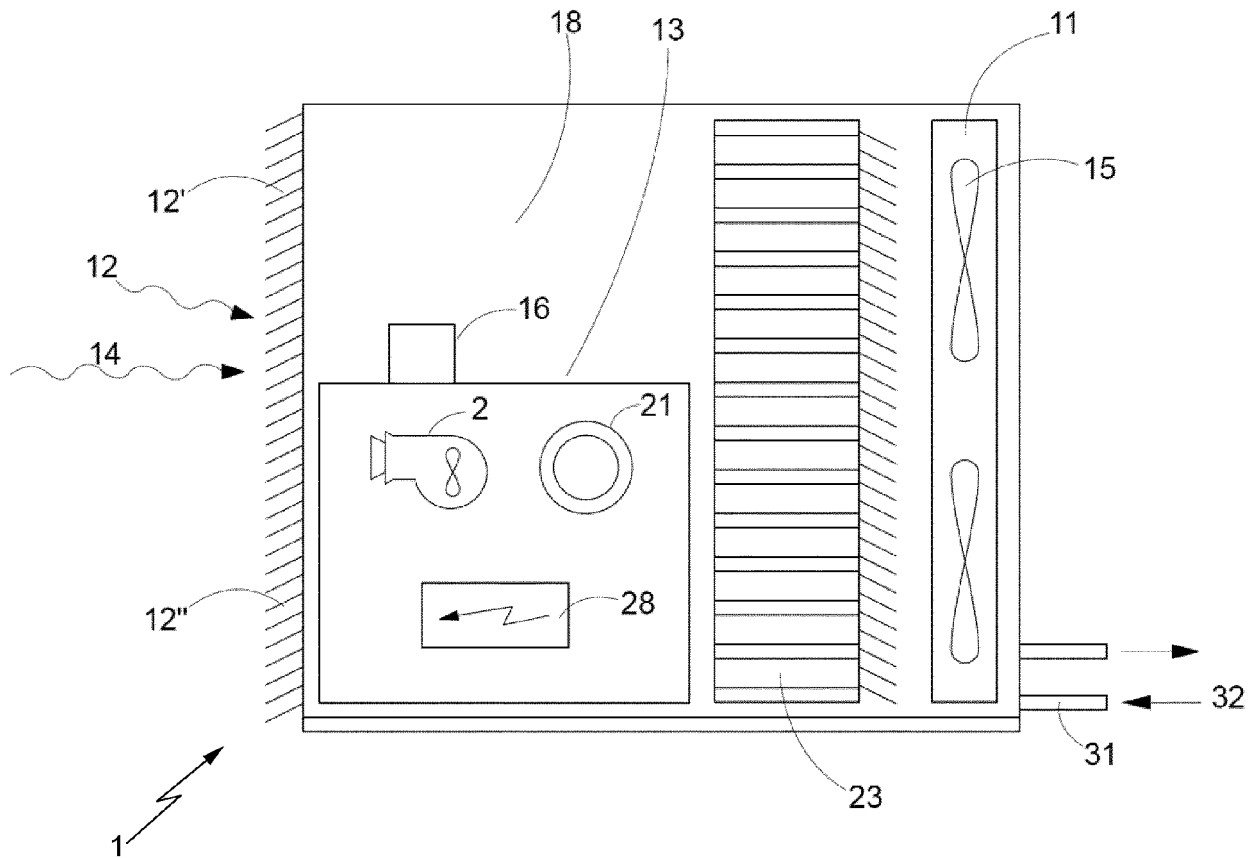


FIG. 3

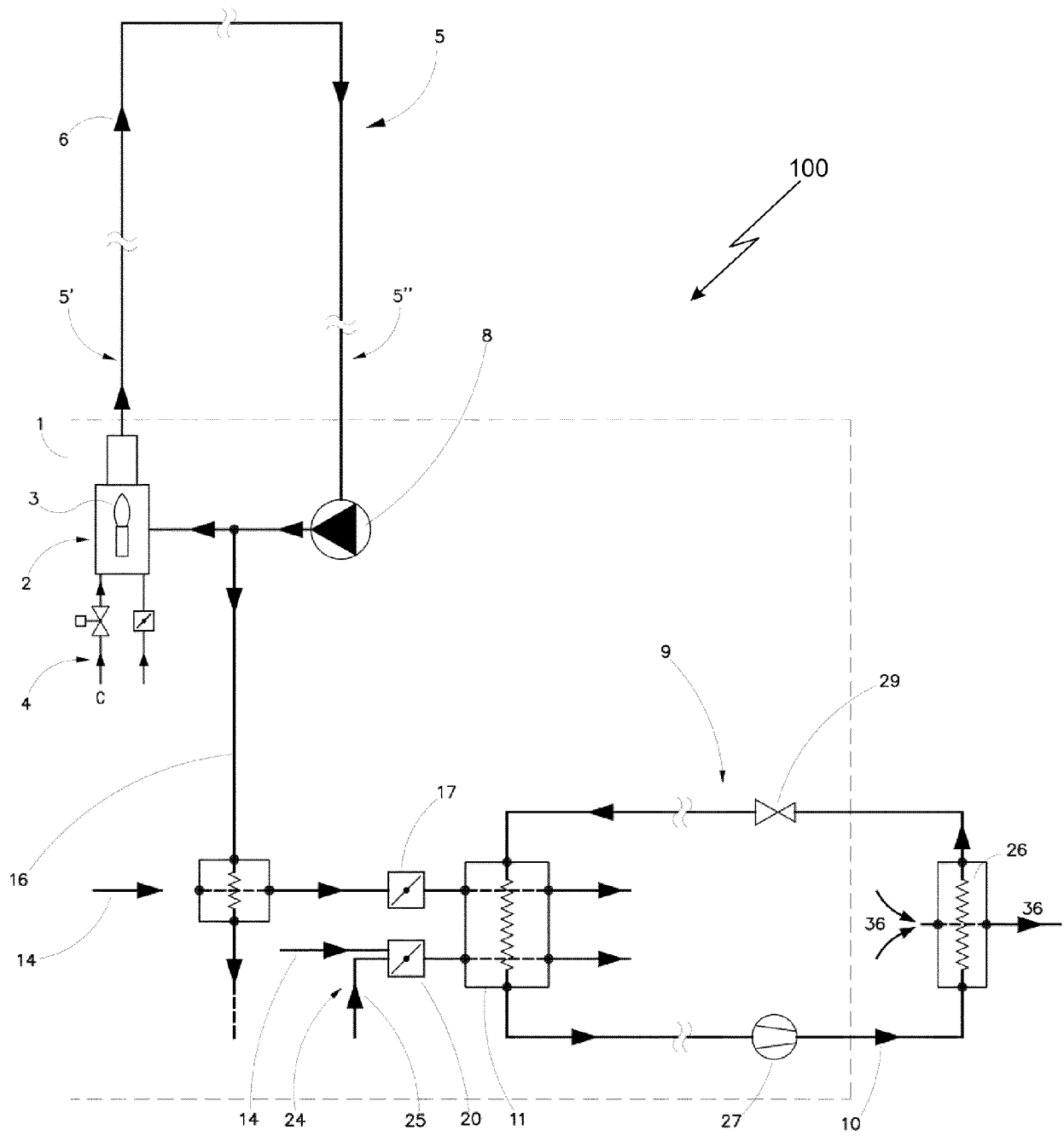


FIG. 4

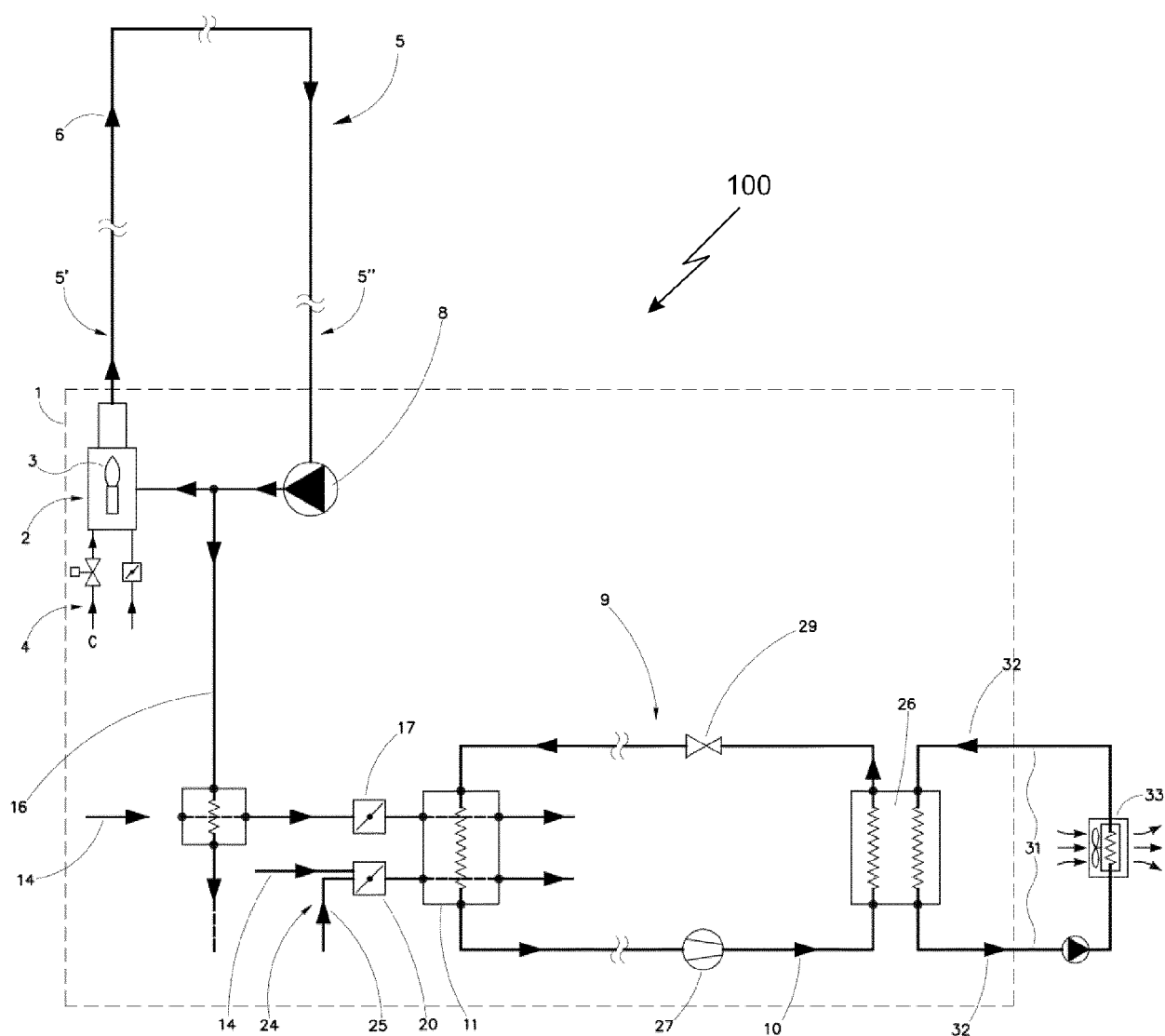


FIG. 5



EUROPEAN SEARCH REPORT

Application Number
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			F24D
Place of search		Date of completion of the search	Examiner
Munich		6 April 2018	Schwaiger, Bernd
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

06-04-2018

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