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(54) AIR CONDITIONING SYSTEM AND OPERATING METHOD THEREOF

(57) An air conditioning system (1) is described that is structured to be installed in a building (2) which comprises at least one internal compartment (3) and a hydraulic system (4) comprising at least two ducts which extend into the building between said internal compartment and an external location to said building (2). The air conditioning system comprises a heat pump unit which is arranged in the external location, is hydraulically connected to the two ducts, and is configured to carry out a heat exchange between the water circulating in the ducts and the ambient air in the external location. The system further comprises a heat-pump fan coil unit which is arranged in the compartment, is hydraulically connected to the two ducts, and is configured to carry out a heat exchange between the water circulating in the ducts and the ambient air in the internal compartment. The system further comprises a control system which controls the heat pump unit in order to maintain the temperature of the water circulating in the ducts in a predetermined temperature range.

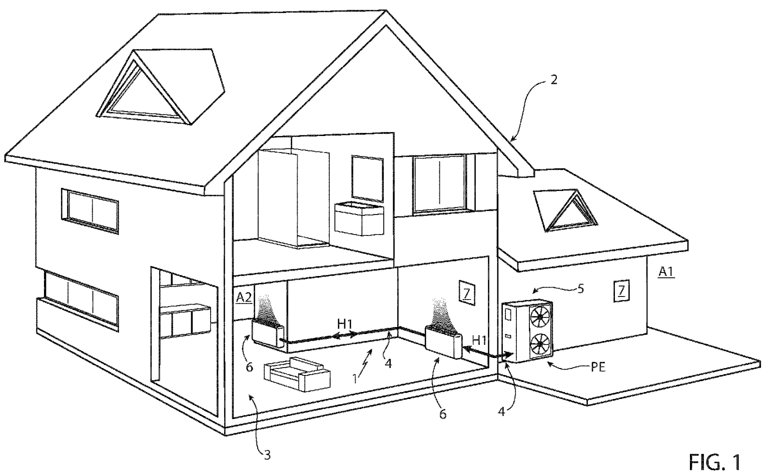

FIG. 1

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims priority from Italian patent application no. 102023000002934 filed on February 21, 2023, the entire disclosure of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present invention relates to an air conditioning system and to an operating method thereof.

PRIOR ART

[0003] It is known in the thermal-engineering sector that it is necessary to adapt traditional domestic heating systems in order to satisfy European directives that set stringent limitations on the emission of air pollutants produced by said systems. Indeed, among the various limitations, European directives stipulate the ban of the use of burner boilers in heating systems as of the year 2035.

[0004] Satisfying this condition will thus require drastic intervention in current heating systems so as to replace current burner boilers with new boilers equipped with technologies capable of satisfying the aforementioned limitations. Such an adaptation thus requires the elimination of traditional burner boilers and the use of other technologies that have less of an impact in terms of air emissions.

[0005] The realization of this condition thus requires the performance of complex interventions for the reconversion and adaptation of current heating systems since these are configured to operate specifically using the aforementioned boilers with traditional burner technology.

[0006] Internal analyses/studies conducted by the Applicant have shown that thermal heat-pump apparatuses represent a technology that is potentially compatible with numerous heating systems present in current homes, i.e. that use burner boilers.

[0007] The replacement of a burner boiler in a traditional system provided, for example, with water radiators and/or fan convectors, with a thermal apparatus with an air-water heat pump represents a complex operation subject to multiple technical problems.

[0008] A first technical problem is the fact that the use of the thermal heat-pump apparatus in a traditional hydraulic system requires the performance of costly and complex operations for the adaptation of the same.

[0009] The various adaptations involve the use of a tank, the addition of sectioning valves, and other hydraulic components, which heavily affect the overall cost of an intervention in the system.

[0010] A second technical problem is the fact that some additional hydraulic components, such as the tank, have significant dimensions that in some cases are incompatible with the available space in a home.

[0011] A third technical problem is the fact that the use of a heat pump in a traditional system provided with uninsulated ducts is inappropriate because it exposes the ducts to the formation of condensation water which, in addition to causing damage to the ducts over time, also leads to consequences on the walls and floors of the home, such as the formation of stains, mould, fungi, etc.

[0012] A fourth technical problem is the fact that the aforementioned adaptation interventions require the performance of masonry work, which entails expenses and inconvenience for the users.

DESCRIPTION OF THE INVENTION

[0013] The object of the present invention is thus to provide an air conditioning system that allows solving the aforementioned technical problems.

[0014] According to the present invention, an air conditioning system and a method for operating the same are provided as set forth in the appended claims.

BRIEF DESCRIPTION OF THE FIGURES

[0015] The present invention will now be described with reference to the accompanying drawings, which illustrate a non-limiting example embodiment thereof, wherein:

- Figure 1 schematically shows an air conditioning system provided according to the present invention;
- Figure 2 is a block diagram of the air conditioning system provided according to the present invention;
- Figure 3 is a block diagram of the air conditioning system provided according to the present invention during the cooling function,
- Figure 4 is a block diagram of the air conditioning system provided according to the present invention during the cooling and humidity control function,
- Figure 5 is a block diagram of the air conditioning system provided according to the present invention during the heating function,
- Figure 6 schematically shows a heat-pump fan coil unit, with parts removed for clarity, of the air conditioning system shown in the preceding figures.

PREFERRED EMBODIMENTS OF THE INVENTION

[0016] In the attached figure, the reference number 1 indicates schematically, as a whole, an air conditioning system 1 that is structured to be installed in a building 2. The air conditioning system 1 is configured to air-condition, i.e., heat, cool, dehumidify at least one internal space or compartment 3 of the building 2 based on an air-conditioning temperature of the internal compartment 3 set by a user.

[0017] In the example shown in Figure 1, the building 2 comprises a hydraulic system 4 through which water

H1 circulates. The hydraulic system 4 is formed by a plurality of pipes or ducts, at least two in the schematic example of Figure 2, which extend in the building between the internal compartment 3 and an external location PE outside the building 2. The external location PE is positioned so as to be in contact with the ambient air present outside the building.

[0018] According to the preferred embodiment of the present invention shown in Figures 1 and 2, the air conditioning system 1 comprises a heat pump unit 5 arranged in the external location PE of the building 2 so as to be in contact with the ambient air present outside the building 2, and one or more heat-pump fan coil devices or units 6 arranged in one or more internal compartments 3 of the building 2 and a control system 7 which is configured to selectively control the operation of the heat pump unit 5 and the heat-pump fan coil unit(s) 6.

[0019] In order to increase the expository clarity of the present description, explicit reference will be made in the following discussion, without any resulting loss in generality, to a single heat-pump fan coil unit 6, which is arranged in an internal compartment 3 of the building 2 and is hydraulically connected by means of two hydraulic terminals 6a and 6b to respective ducts 4a, 4b for delivery and return of the hydraulic system 4 (Figure 2) in order to receive and supply water H1 from and to said hydraulic system 4. It is understood, however, that the air conditioning system 1 can comprise a plurality of heat-pump fan coil units 6 arranged in one or more internal compartments 3.

[0020] With reference to the schematic embodiment shown in Figure 2, the heat pump unit 5 is provided with a heat pump circuit 8 hydraulically connected to the two ducts 4a,4b of the hydraulic system 4 in the external location PE.

[0021] The heat pump circuit 8 comprises a refrigerant fluid F1 (first refrigerant fluid) and is configured to carry out a heat exchange between the ambient air A1 present outside the building and the water H1 circulating in the two ducts 4a, 4b by means of the refrigerant fluid F1.

[0022] The heat-pump fan coil unit 6 comprises a heat pump circuit 9 and is hydraulically connected to the two ducts 4a, 4b of the hydraulic system 4 inside the internal compartment 3.

[0023] The heat pump circuit 9 comprises a refrigerant fluid F2 (second refrigerant fluid) and is configured to carry out a heat exchange between the water H1 circulating in the two ducts 4a, 4b and the air A2 present in the internal compartment 3, by means of the refrigerant fluid F2.

[0024] The control system 7 is configured to control the heat pump circuit 9 in order to control the heat exchange between the water H1 circulating in the two ducts 4a,4b and the air A2 present in the internal compartment 3 in order to condition the air A2 based on the air-conditioning temperature of the internal compartment 3 set by the user.

[0025] According to the present invention, the control system 7 is further conveniently configured to control the heat pump circuit 8 of the heat pump unit 5 in order to maintain the temperature of the water H1 circulating in the two ducts 4a,4b of the hydraulic system 4 in a first predetermined temperature range comprised between about 20°C and about 30°C, preferably 24-25°C.

[0026] The Applicant has found that maintaining the temperature of the water H1 in the predetermined temperature range achieves the technical effect of eliminating the formation of condensation water in the ducts 4a,4b of the hydraulic system 4. This effect solves the technical problem related to the damage of the ducts, and to the formation of stains, mould, fungi in the walls of the building due to condensation.

[0027] According to the present invention, the control system 7 is configured to control the heat pump circuit 8 of the heat pump unit 5 in order that the temperature of the water H1 circulating in the two ducts 4a,4b of the hydraulic system 4 does not have a value that is not comprised by the first predetermined temperature range. In other words, the control system 7 is configured to control the heat pump circuit 8 of the heat pump unit 5 in order that the temperature of the water H1 circulating in the two ducts 4a,4b of the hydraulic system 4 is not lower than about 20°C and not higher than about 30°C.

[0028] With reference to Figure 2, the heat-pump fan coil unit 6 further comprises a fan device 25 and a heat exchanger device 10 which is hydraulically connected to the heat pump circuit 9 so as to be passed through by the refrigerant fluid F2 and to the two ducts 4a, 4b so as to be passed through by the water H1, and is internally structured to carry out a heat exchange between the refrigerant fluid F2 and the water H1.

[0029] The use of the heat exchanger device 10 has the technical effect of mitigating the thermal jump required by the air conditioning of the internal compartment 3 by introducing an intermediate heat-exchange level that allows the heat pump circuit 8 to operate with a high efficiency while simultaneously allowing the heat-pump fan coil unit 6 to provide the level of comfort required in the internal compartment 3 by the user.

[0030] For example, the heat exchanger device 10 can conveniently comprise a plate heat exchanger. The plates can be made of stainless steel, copper, aluminum or the like. The plate heat exchanger comprises an outer casing containing a series of preferably parallel plates which are superimposed while conveniently allowing the formation of a series of passage channels for the fluids between said plates. The cavity created between two adjacent plates constitutes the channel in which the fluid flows. The hot and cold fluids flow through the exchanger with alternating channels so that one plate is always in contact on one side with the hot fluid and on the other side with the cold fluid. In the example shown in Figure 2, the heat exchanger device 10 comprises at least four hydraulic terminals 10a, 10b, 10c and 10d and at least two internal cavities 10e 10f separated by at least one heat transfer plate 10g. A cavity 10e is hydraulically connected to the heat pump circuit 9 by means of the two terminals 10a and 10b so as to be passed through by the refrigerant fluid F2, and the other cavity 10f is hydraulically connected to the two ducts of the hydraulic circuit 4 by means of the two terminals 10c and 10d so as to be passed through by the water H1. The plate heat exchanger is extremely advantageous inasmuch as it has small dimensions.

[0031] With reference to the example embodiment shown in Figure 2, the heat pump circuit 9 comprises an exchanger device 11, an exchanger device 12, and a compressor device 13. Preferably, the compressor device 13 can conveniently comprise a variable-speed refrigeration compressor.

[0032] Conveniently, the exchanger device 11 and the exchanger device 12 can comprise respective exchanger modules, which can consist of, for example, finned pack coils, and are arranged adjacent to each other.

[0033] Preferably, in use, the exchanger device 11 is designed to be controlled so as to generate heat, i.e. is heated by the refrigerant fluid F2 so as to transfer heat into the internal compartment 3 to heat it.

[0034] Preferably, the exchanger device 11 is designed to be controlled, in use, so as to generate cold, i.e. is structured so as to remove heat from the internal compartment 3 so as to chill/cool the same.

[0035] Preferably, the exchanger devices 11 and 12 have a parallelepiped box-like shape and can be arranged adjacent to each other so as to face each other.

[0036] In the example illustrated in Figure 2, the exchanger device 11 can be arranged toward the outside of the heat-pump fan coil unit 6, i.e. toward the internal compartment 3, while the exchanger device 12 can be arranged toward the inside of the heat-pump fan coil unit 6, i.e. next to the inner face of the exchanger device 11.

[0037] According to the example embodiment shown in Figure 2, the exchanger device 11 has a first terminal hydraulically connected to the outlet terminal of the compressor device 13 through a hydraulic branch 14, and an opposite second terminal connected to a terminal 10a of the heat exchanger device 10 through a hydraulic branch 15. The hydraulic branch 15 can be hydraulically connected to a tank 28 designed to receive and/or supply the refrigerant fluid F2 to the heat pump circuit 9.

[0038] In the illustrated example, the exchanger device 12 has a first terminal hydraulically connected to the inlet terminal of the compressor device 13 through a hydraulic branch 16, and the second terminal connected to the hydraulic branch 15 through a hydraulic branch 17.

[0039] In the illustrated example, the heat pump circuit 9 further comprises a hydraulic branch 18 which connects the outlet terminal of the compressor device 13 to a terminal 10b of the heat exchanger device 10, and a hydraulic branch 19 which hydraulically connects the inlet terminal of the compressor device 13 to the terminal 10b of the heat-sink exchanger device 10.

[0040] The heat pump circuit 9 further comprises an electrically operated valve 20 arranged on the hydraulic branch 14. Conveniently, the electrically operated valve 20 can comprise a two-way modulating solenoid valve.

[0041] The heat pump circuit 9 further comprises: an electrically operated valve 22 arranged on the hydraulic branch 16 and an electrically operated valve 23 arranged on the hydraulic branch 18, and an electrically operated valve 24 arranged on the hydraulic branch 19.

[0042] In the illustrated example, the fan device 25 is preferably arranged facing the exchanger devices 11 and 12.

[0043] As for the heat pump circuit 8, it is preferably of a water-air type and comprises two terminals 8a and 8b hydraulically connected to the ducts 4a and 4b of the hydraulic circuit 4 to receive/supply the water H1. In the example shown in Figure 2, the heat pump circuit 8 comprises a heat exchanger device 30, a compressor device 31, a heat exchanger device 32 and a ventilation device 33.

[0044] The heat exchanger device 30 is hydraulically connected to the compressor device 31 so as to be passed through by the refrigerant fluid F1 and to the heat exchanger device 32 in order to supply it with the refrigerant fluid F1. The heat exchanger device 30 can cooperate with the ventilation device 33 in order to carry out the heat exchange between the refrigerant fluid F1 and the air A1. In the example shown in Figure 2, the heat exchanger device 32 has two terminals connected to the hydraulic terminals 8a and 8b and is structured so as to be passed through by the water H1 and the refrigerant fluid F1 and so as to effect the heat exchange between the water H1 and the refrigerant fluid F1.

[0045] With reference to Figure 2, the heat-pump fan coil unit 6 further preferably comprises an electrically operated four-way diverter valve 26 designed to operate in two operating positions. In a first operating position shown in Figures 3 and 4, the diverter valve 26 hydraulically connects the terminal 10c to the terminal 6b and the terminal 10d with the terminal 6a. In a second operating position shown in Figure 5, the diverter valve 26 hydraulically connects the terminal 10c to the terminal 6a and the terminal 10d to the terminal 6b.

[0046] The control system 7 can comprise one or more electrical devices 7a and/or electronic devices 7b configured to implement control programs or control algorithms in order to control the operation of the heat-pump fan coil unit 6 and the heat pump unit 5.

[0047] Preferably, the electrical devices 7a and/or the electronic devices 7b can be configured to communicate with one another and/or with user control devices/control panels) and/or with measurement devices, for example by means of wired and/or wireless communication systems.

[0048] With reference to an example embodiment shown in Figure 6, the heat-pump fan coil unit 6 can comprise an outer box-like casing or frame 34 inside which are arranged: the heat exchanger device 10, the heat pump circuit 9, and the fan device 25. Electrical devices 7a, and/or electronic devices 7b, and/or temperature-measuring sensors 33 and/or humidity-measuring sensors 35 can also be conveniently arranged in the box-like frame 34.

[0049] The operation of the air conditioning system 1 will be described in the following. In particular, three different operational functions will be described: a cooling function shown in Figure 3, a relative humidity control function in Figure 4, and a heating function shown in Figure 5.

[0050] In Figures 3, 4 and 5, the dashed line shows the path of the refrigerant fluid F2 in the heat pump circuit 9 in the course of the performance of the functions.

[0051] With reference to Figure 3, when the user issues a command to implement the cooling function and sets a temperature, the control system 7 commands the closing of the valves 20 and 24, and the opening of the valves 21, 22 and 23. The control system 7 further controls the diverter valve 26 so as to bring it into the first operating condition. The control system 7 further controls the heat pump unit 5 in order to maintain the water H1 circulating in the hydraulic system in the first predetermined temperature range.

[0052] The control system 7 further controls the heat pump circuit 9 so that the refrigerant fluid F2 in the gaseous state is supplied by the exchanger device 12 to the compressor device 13 through the hydraulic branch 16. The compressor device 13 compresses the refrigerant fluid F2 in the gaseous state and supplies it into the heat exchanger device 10 through the hydraulic branch 18. In the heat exchanger device 10, the refrigerant fluid F2 is subjected to the heat exchange with the water H1 to which it transfers heat. The refrigerant fluid F2 chilled in the heat exchanger device 10 is then pushed through the hydraulic branch 15 to the exchanger device 12 in which it carries out the heat exchange with the air A2 by absorbing heat from the same in order to chill it before being sucked in by the compressor device 13, thus starting the cycle again.

[0053] During the performance of the cooling, the control system 7 can measure the temperature inside the internal compartment 3, for example by means of measuring sensors 33 and control the heat pump circuit 9 based on the difference between the measured temperature and the set temperature. In this cycle, the closing of the valve 20 excludes the exchanger device 11 from the circuit. During the performance of the cooling function, the control system 7 can also activate the fan device 25 as a function of, for example, user commands and/or the difference between the measured temperature and the set temperature.

[0054] With reference to Figure 4, the control system 7 can also implement the relative humidity control function in which it controls the opening of the valve 20 so as to drain a predetermined flow rate of refrigerant fluid F2 in the compressed gaseous state, and thus hot, supplied at the outlet of the compressor device 13 and feeds it to the exchanger device 11.

[0055] Thanks to the controlled opening of the modulating valve 20, a reduction in the thermal discomfort of the user is advantageously achieved in the initial step of activating the cooling. In particular, the condensation heat that is conveyed into the exchanger device 13 by means of the modulating valve 20 attenuates the thermal jump perceived by the user in the first step of emitting cold air, which thus reduces his or her feeling of discomfort.

[0056] It is understood that, in this step, the control system 7 regulates the speed of the compressor device 13 based on the required heat load, in order to lower the evaporation temperature in the exchanger device 12 and thus extract humidity from the air A2.

[0057] With reference to Figure 5, when the user issues a command to implement the heating function and to regulate the temperature, the control system 7 commands the opening of the valves 20 and 24 and the closing of the valves 21, 23 and 22. The control system 7 further controls the diverter valve 26 so as to bring it into the second operating condition. The control system 7 further controls the heat pump unit 5 in order to maintain the water H1 circulating in the hydraulic system in the first predetermined temperature range.

[0058] The control system 7 further controls the heat pump circuit 9 so that the gaseous refrigerant fluid F2 compressed by the exchanger device 11 is supplied to the exchanger device 11 through the hydraulic branch 14. In the heat exchanger device 11, the refrigerant fluid F2 is subjected to the heat exchange with the air A2 in the internal compartment 3 to which it transfers heat. The refrigerant fluid F2 chilled in the heat exchanger device 11 is then pushed through the hydraulic branch 15 into the heat exchanger device 10 in which it carries out the heat exchange with the water H1 by absorbing heat from the same to chill it before being sucked back in by the compressor device 13, thus starting the cooling cycle again. During this function, the control system 7 can measure the temperature inside the internal compartment 3, for example by means of the measuring sensors 33 and control the heat pump circuit 9 based on the difference between the measured temperature and the set temperature. In this cycle, the closing of the valves 21 and 22 excludes the exchanger device 12 from the cycle. During the performance of the heating function, the control system 7 can also activate the fan device 25 as a function of, for example, user commands and/or the difference between the measured temperature and the set temperature.

[0059] The air conditioning system described above has the advantage that it makes it possible to replace, in an easy and economical manner, the burner boiler with a heat pump unit and traditional radiators or fan coils with the heat-pump fan coil units described above without the need to perform complex adaptation operations and install bulky tanks or additional hydraulic components. Moreover, as pointed out above, thanks to the action of maintaining the temperature of the water in the hydraulic system in the predetermined range, problems of condensation water forming in systems with uninsulated pipes are avoided, which eliminates the drawbacks resulting from damage to ducts, the formation of stains, mould, fungi etc.

[0060] Finally, the air conditioning system is easy and quick to install and does not require the performance of masonry work, which thus obviates expenses and discomfort for the users.

Claims

1. Air conditioning system (1) structured to be installed in a building (2) which comprises at least one internal compartment (3) and a hydraulic system (4) comprising at least two ducts (4a, 4b) for delivery and return, which extend into the building (2) between said internal compartment (3) and an external location (PE) to said building (2) and are passed through by water (H1),
the air conditioning system (1) comprises:

   a first heat pump unit (5) which is arranged in the external location (PE) and is provided with a first heat pump circuit (8) comprising a first refrigerant fluid (F1); the first heat pump unit (5) is hydraulically connected to said two ducts (4a, 4b) and is configured in order to carry out a heat exchange between the water (H1) circulating in said ducts (4a, 4b) and the ambient air (A1) in said external location (PE) by means of said first refrigerant fluid (F1),
   at least one heat-pump fan coil unit (6) which is arranged in said internal compartment (3), is hydraulically connected to said two ducts (4a, 4b) and is configured in order to carry out a heat exchange between the water (H1) circulating in said ducts (4a, 4b) and the air (A2) present in said internal compartment (3),
   a control system (7) which is configured to control said first heat pump unit (5) in order to maintain the temperature of the water (H1) circulating in said ducts (4a, 4b) in a first predetermined temperature range comprised between about 20°C and about 30°C.

2. Air conditioning system according to claim 1, wherein said one heat-pump fan coil unit (6) is provided with a second heat pump circuit (9) in which a second refrigerant fluid (F2) circulates and which is hydraulically connected to said ducts (4a, 4b) to carry out a heat exchange between the water (H1) circulating in said two ducts (4a, 4b) and the air (A2) present in said internal compartment (3) by means of said second refrigerant fluid (F2),
said electronic control system (7) is configured to control said second heat pump circuit (9) to carry out a heat exchange between the water (H1) circulating in said two ducts (4a, 4b) and the air (A2) present in said internal compartment (3) by means of said second refrigerant fluid (F2) .

3. Air conditioning system according to claim 2, wherein said one heat-pump fan coil unit (9) comprises a plate heat exchanger device (10) comprising one or more internal heat exchanger plates and is hydraulically connected to said second heat pump circuit (9) and to said ducts (4a, 4b); the plate heat exchanger device (10) is structured to be passed through by said second refrigerant fluid (F2) and by said water (H1), and is structured to carry out a heat exchange between the second refrigerant fluid (F2) and said water (H1) through said internal plates.

4. The air conditioning system according to claim 3, wherein said second heat pump circuit (9) comprises a compressor device (13) and two heat exchanger devices (11, 12) which are connected to each other and to said plate heat exchanger device (10) by means of a series of hydraulic branches and a series of electrically operated valves, which are arranged on said hydraulic branches.

5. Air conditioning system according to claim 4, wherein said electronic control system (7) is configured to control, during a cooling function of said internal compartment (3), said compressor device (13) and said valves in order to cause the second refrigerant fluid (F2) compressed by said compressor device (13) to pass in sequence through said plate heat exchanger device (10) so as to transfer heat to said water (H1), and one of the said heat exchanger devices (11,12) in order to absorb heat from the air (A2) present in said internal compartment (3).

6. Air conditioning system according to claims 4 or 5, wherein said electronic control system (7) is configured to control, during a function of cooling and dehumidifying said internal compartment (3), said compressor device (13) and said valves to cause said second refrigerant fluid (F2) compressed by said compressor device (13) to pass in sequence through said plate heat exchanger device (10) so as to transfer heat to said water (H1) circulating in said ducts (4a, 4b), a heat exchanger device (12) in order to absorb heat from the air (A2) of the internal compartment (3) and the other heat exchanger device (11) to heat it at least partially.

7. Air conditioning system according to any one of claims from 4 to 6, wherein said electronic control system (7) is configured to control, during a heating function of said internal compartment (3), said compressor device (13) and said valves to cause said second refrigerant fluid (F2) compressed by said compressor device (13) to pass in sequence through

said heat exchanger device (12) so as to transfer heat to the air (A2) present in the internal compartment (3), and to said plate heat exchanger device (10) to absorb heat from said water (H1) circulating in said ducts (4a,vb).

8. Air conditioning system according to any one of claims from 4 to 7, wherein said heat pump circuit (9) comprises an electrically operated modulating valve (20) arranged on a circuit branch (14), which hydraulically connects the delivery of the device compressor (13) to a heat exchanger device (11).

9. Air conditioning system according to any one of claims 4 to 8, wherein said heat exchanger devices (11,12) comprise respective finned pack coils arranged adjacent and facing each other.

10. Air conditioning system according to any one of the preceding claims, wherein said electronic control system (7) is configured to control said first heat pump circuit (8) of said first heat pump unit (5) in order that the temperature of the water circulating in said ducts (4a, 4b) is not lower than about 20°C and not higher than about 30°C.

11. Operating method of an air conditioning system (1) structured to be installed in a building (2) which comprises at least one internal compartment (3) and a hydraulic system (4) comprising at least two ducts (4a, 4b) for delivery and return of the water (H1), which extend into the building between said internal compartment (3) and an external location (PE) to said building (2),
the air conditioning system comprises:

a first heat pump unit (5) which is arranged in the external location (PE) and is provided with a first heat pump circuit (8) comprising a first refrigerant fluid (F1); the first heat pump unit (5) is hydraulically connected to said two ducts (4a, 4b) and is configured to carry out a heat exchange between the water (H1) circulating in said ducts (4a, 4b) and the ambient air (A1) in said external location (PE) by means of said first refrigerant fluid (F1),
at least one heat-pump fan coil unit (6) which is arranged in said internal compartment (3), is hydraulically connected to said two ducts (4a, 4b) and is configured to carry out a heat exchange between the water (H1) circulating in said ducts (4a, 4b) and the air (A2) present in said internal compartment (3),
the method comprises the step of controlling said first heat pump unit (5) in order to maintain the temperature of the water (H1) circulating in said ducts (4a, 4b) in a first predetermined temperature range between about 20°C and about 30°C.

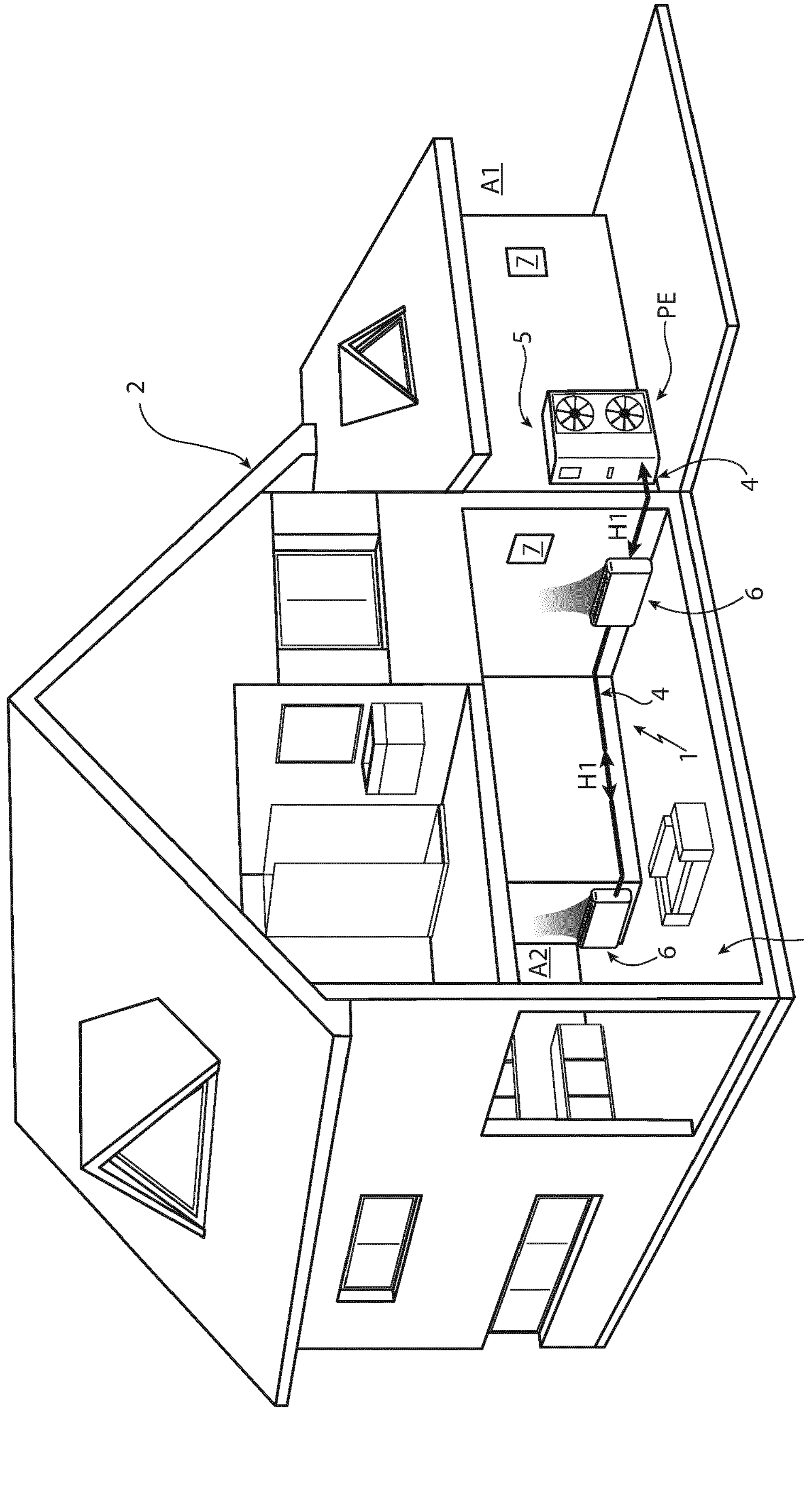

FIG. 1

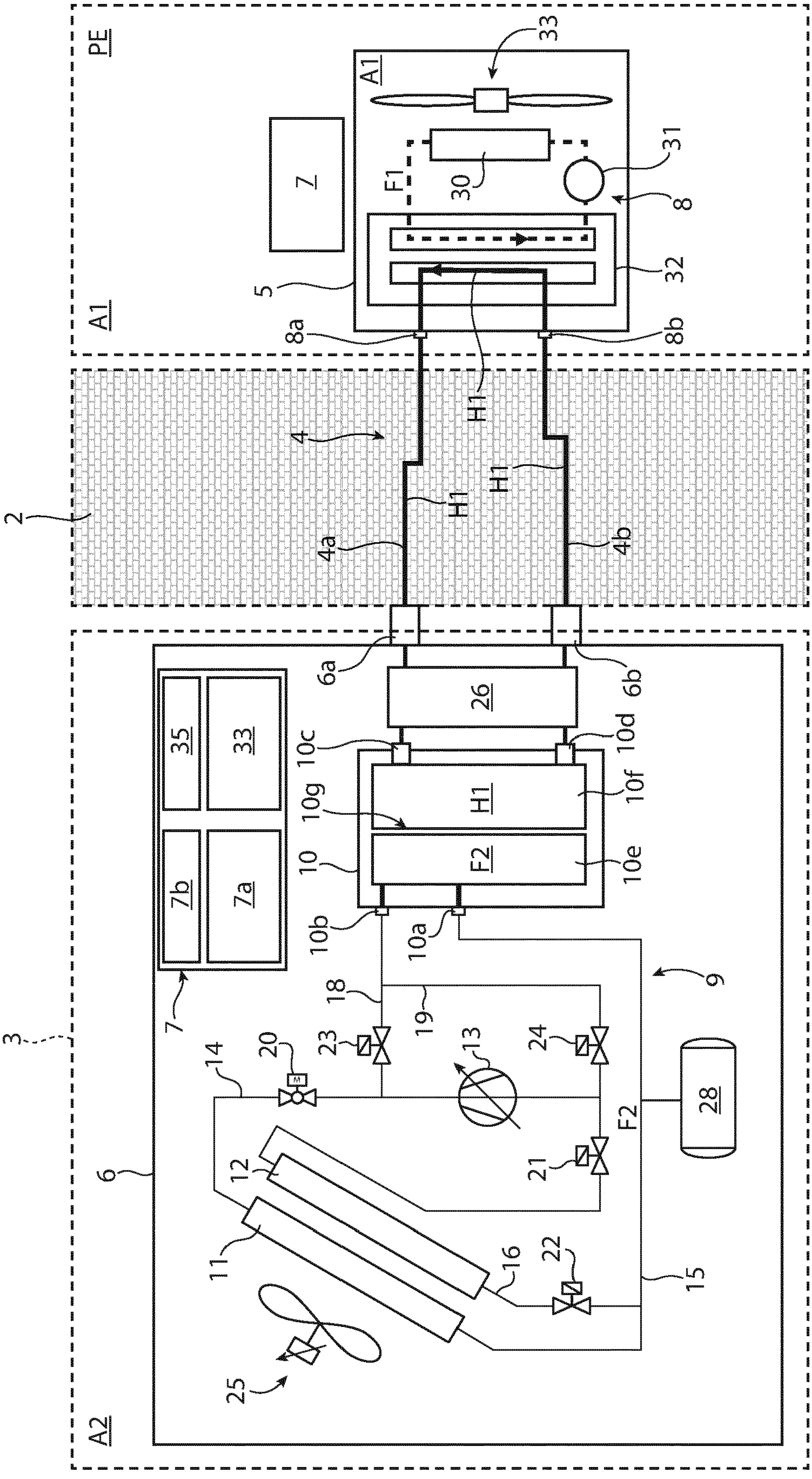
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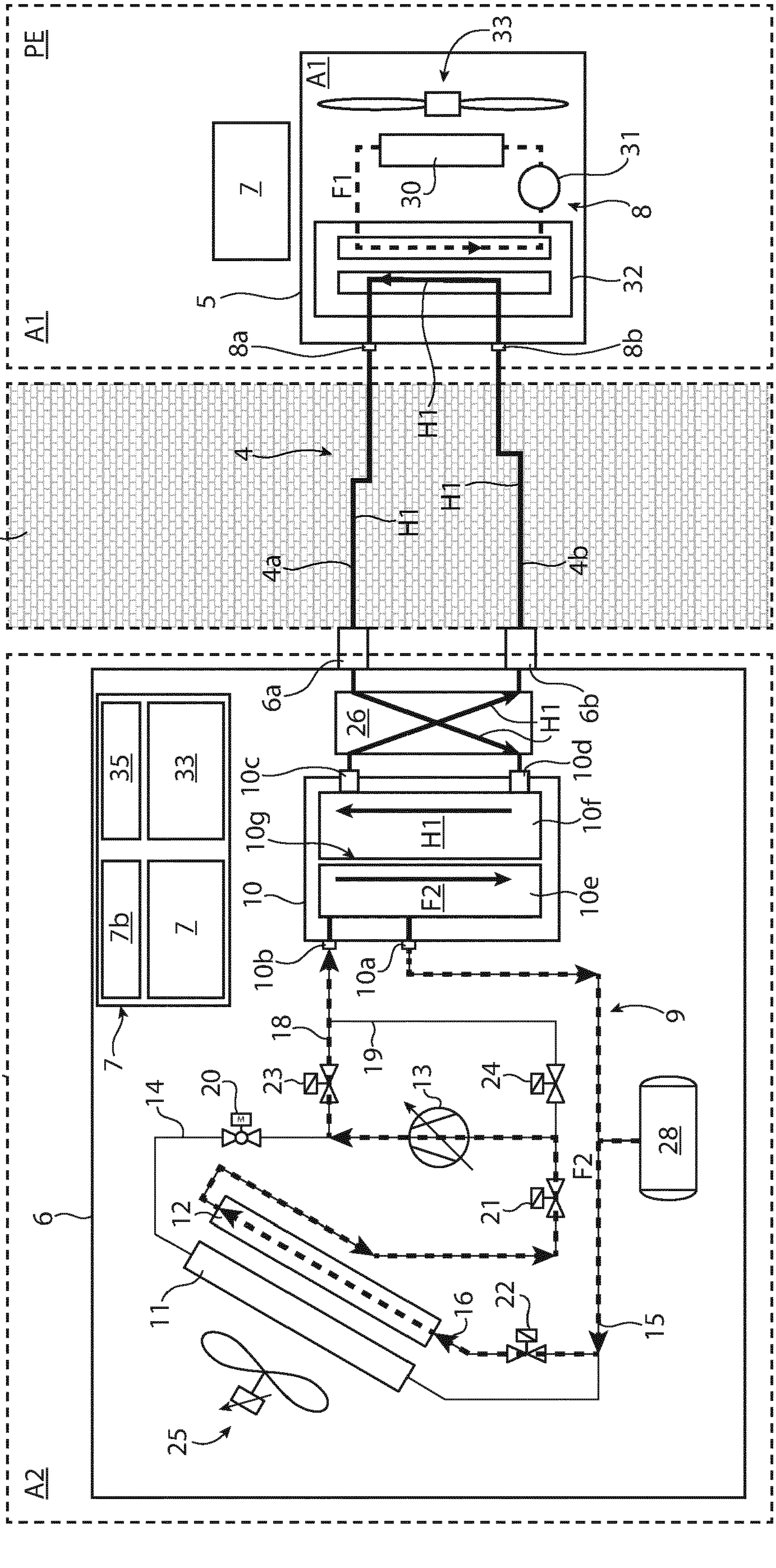
FIG. 2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10b
10a
9
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F2
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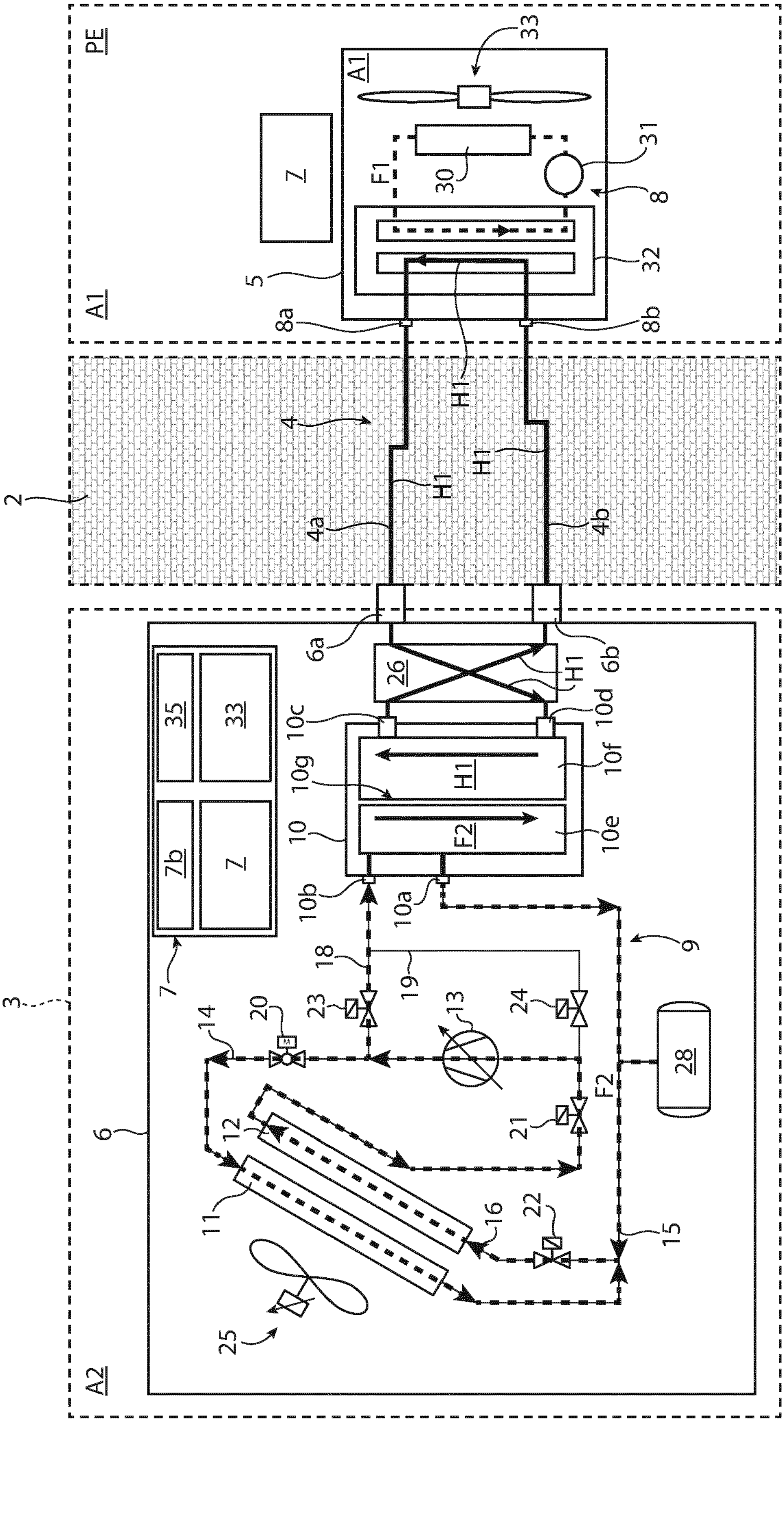
A2

FIG. 3



PE
A1
Z
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F1
30
31
8
32
33
8a
8b
H1
2
4
4a
4b
6a
6b
26
10c
10d
10g
10f
10
10e
F2
35
33
7b
Z
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10b
10a
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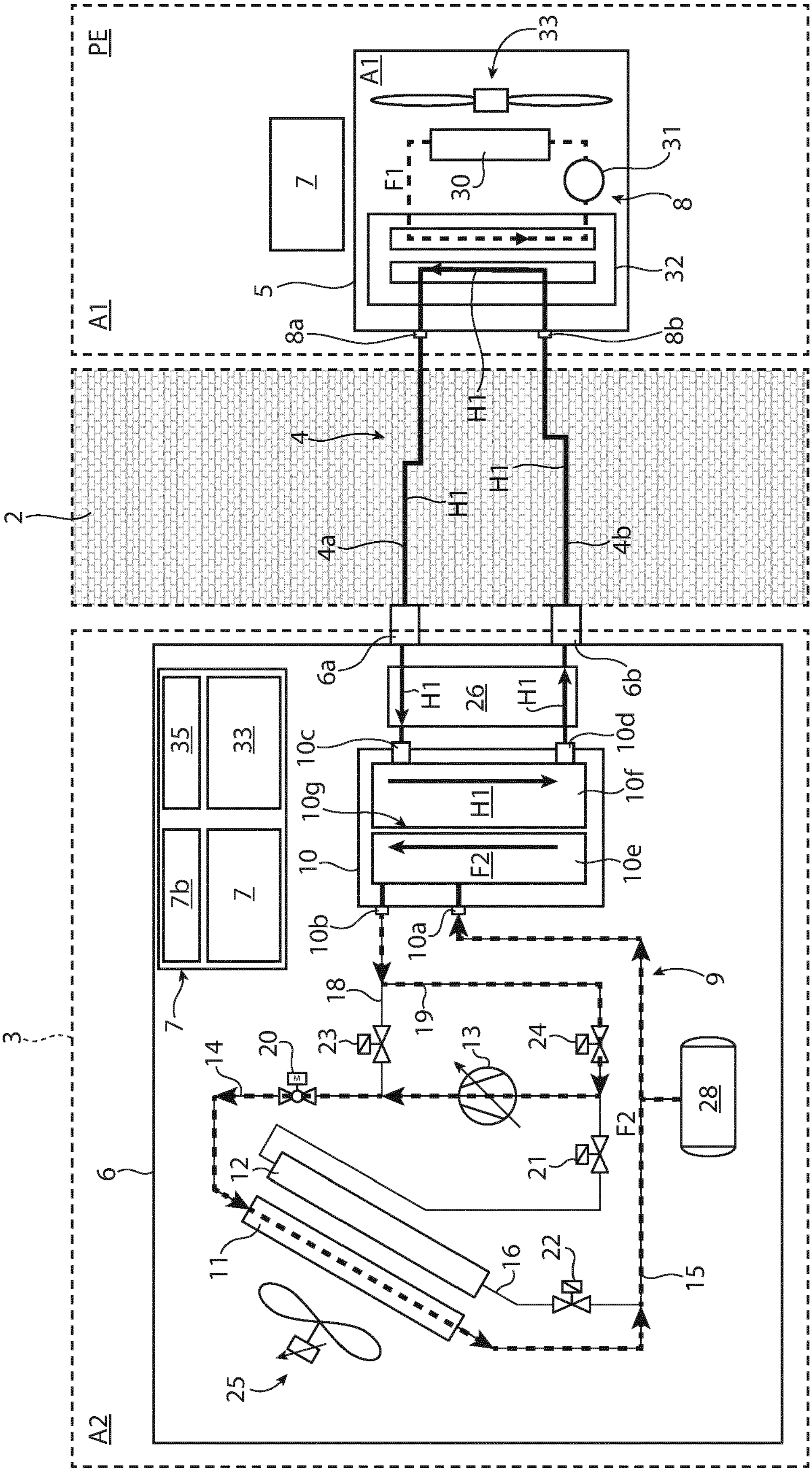
A2

FIG. 4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A2
Z
F1
F2
H1
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FIG. 5

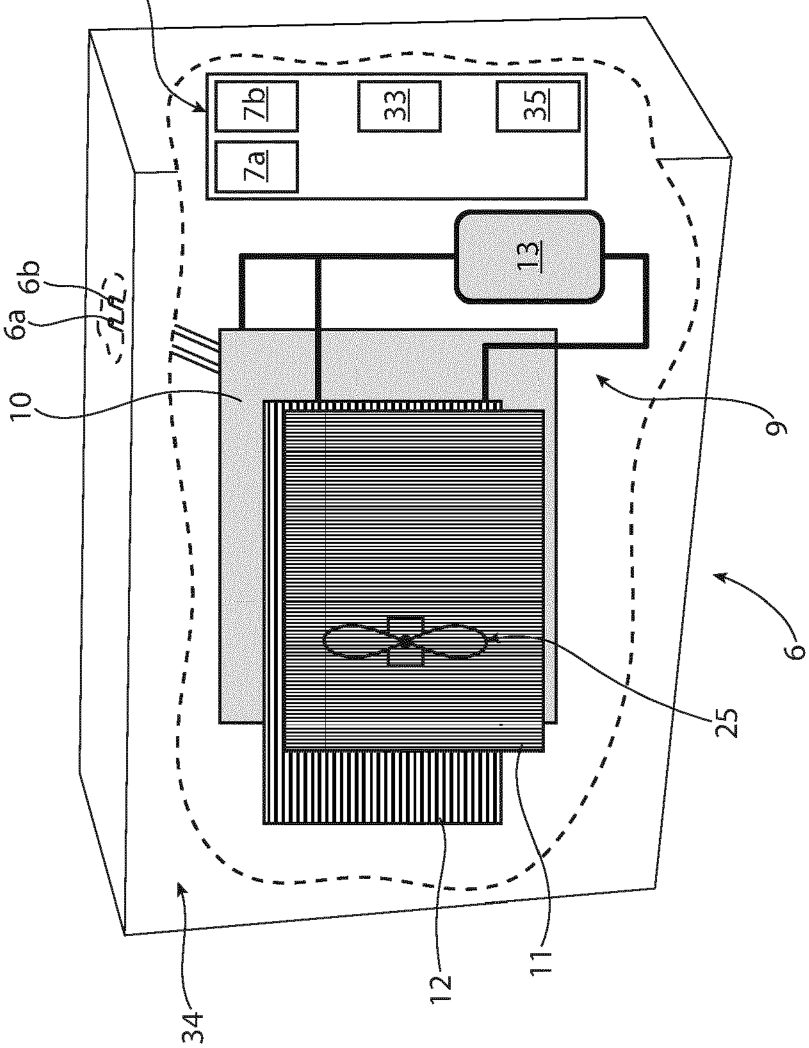

FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
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Place of search	Date of completion of the search	Examiner
Munich	14 May 2024	Mattias Grenbäck

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