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(54) **CHIMNEY UNIT AND HEATING AND VENTILATION SYSTEM COMPRISING SAID CHIMNEY UNIT**

(57) A chimney unit (1) comprising a flue (8) and at least two flue inlets (6) allowing flow of gaseous medium into said flue (8), one flue inlet (6) being a direct outdoor air inlet (6a). At least one further flue inlet (6) is an indirect outdoor air inlet (6b) receiving outdoor air via a preheating structure (9), an exhaust gas inlet (6c) receiving exhaust gas from a heating unit (10), and/or a ventilation air inlet (6d) receiving ventilation air from a ventilation system (11). A heat exchanger (2) is arranged within said flue (8) and configured to transfer thermal energy between said gaseous medium (3) and a liquid medium (4) circulated in a circuit (18) for heat exchanging with a heat pump (7) in said building (15). A fan (5), facilitating flow of gaseous medium (3) across said heat exchanger (2), is arranged within said flue (8).

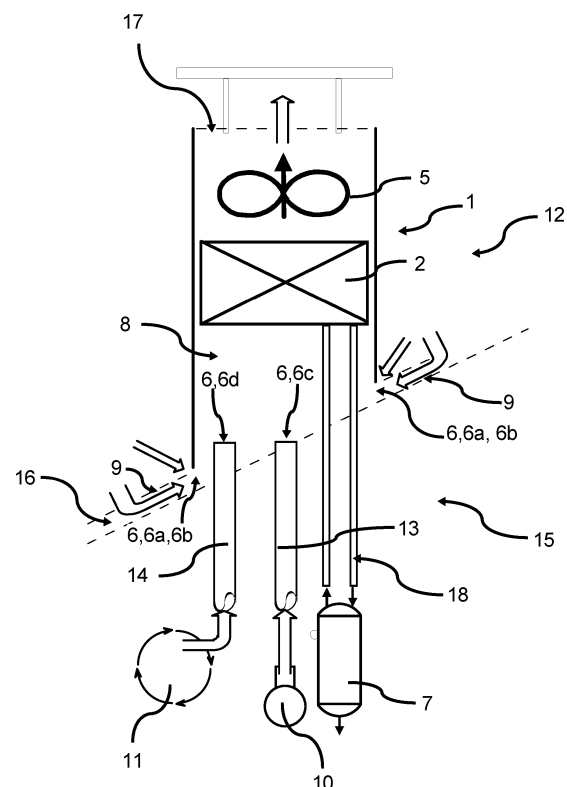


Fig. 1

Description

TECHNICAL FIELD

[0001] The disclosure relates to a chimney unit for installation on the roof of a building, as well as a heating and ventilation system comprising such a chimney unit.

BACKGROUND

[0002] Heat pumps are commonly used to heat or cool buildings by transferring thermal energy between a cooler fluid and a warmer fluid without using external power. The fluids used are usually air and/or water.

[0003] Conventional heat pumps are usually not sufficiently stable and high-performing to be considered an optimal heat source for a building. Hence, buildings are usually provided with additional heat sources such as boilers or electrical resistance heaters. Such heat sources are oftentimes fueled using fossil fuel, making the system less environmentally friendly than desired. Additionally, these systems usually do not utilize waste heat as much as they could, or at all, by allowing excess heat from indoor air or from other heat sources within the building to merely dissipate into the atmosphere.

[0004] Furthermore, heat pumps conventionally use outdoor air in a monoblock or split system requiring a relatively boxy outdoor unit with a fan, a solution that is both bulky and noisy, as well as difficult to install.

[0005] Hence, there is a need for solutions that are more reliable, have better performance, and are more environmentally friendly.

SUMMARY

[0006] It is an object to provide an improved chimney unit for installation on a roof of a building. The foregoing and other objects are achieved by the features of the independent claims. Further implementation forms are apparent from the dependent claims, the description, and the figures.

[0007] According to a first aspect, there is provided a chimney unit for installation on a roof of a building, the chimney unit comprising a flue having a flue outlet; at least two flue inlets configured to allow flow of gaseous medium into the flue, one of the flue inlets being a direct outdoor air inlet configured to receive outdoor air directly from an exterior of the building, and at least one further of the flue inlets being one of an indirect outdoor air inlet configured to receive outdoor air via a preheating structure of the building, an exhaust gas inlet configured to receive exhaust gas from a heating unit of the building, and a ventilation air inlet configured to receive ventilation air from a ventilation system of the building; a heat exchanger arranged within the flue, the heat exchanger being configured to transfer thermal energy between the gaseous medium and a liquid medium for circulating in a circuit for heat exchanging with a heat pump in the build-

ing; a fan arranged within the flue, the fan being configured to force flow of the gaseous medium towards the flue outlet and across the heat exchanger.

[0008] This solution allows a heat exchange arrangement that fits into an existing, conventional building element, shielding the components from the elements as well as hiding them from plain sight. The solution also utilizes waste heat from other building systems and can be configured to preheat air, e.g. colder outdoor air, without requiring additional components and without requiring external power, making the solution far more environmentally friendly than currently known solutions. Additionally, by arranging the heat exchanger and fan within a flue, noise levels to the surroundings will be reduced both due to the flue itself and due to the substantially vertical direction of the flow of gaseous media.

[0009] In a possible implementation form of the first aspect, the fan is vertically superimposed with the heat exchanger within the flue.

[0010] In a further possible implementation form of the first aspect, the liquid medium comprising water, thermal oil, or a water and glycol mixture, the liquid medium optionally being a nanofluid.

[0011] In a further possible implementation form of the first aspect, the chimney unit is configured to be preassembled at a manufacturing or building site.

[0012] In a further possible implementation form of the first aspect, the direct outdoor air inlet comprises a direct opening between an exterior of the building and the flue.

[0013] In a further possible implementation form of the first aspect, the preheating structure is configured to preheat outdoor air as the outdoor air travels from the exterior of the building into the flue.

[0014] In a further possible implementation form of the first aspect, the preheating structure is formed by a space between an outer roof covering and a roof support structure of the building, allowing outdoor air to be preheated by thermal radiation from the outer roof covering, without additional components or power usage.

[0015] In a further possible implementation form of the first aspect, the outer roof covering comprises partially overlapping roofing elements, optionally roof tiles.

[0016] According to a second aspect, there is provided a building heating and ventilation system comprising the chimney unit as described above, a heat pump, and a piping arrangement configured to circulate liquid medium.

[0017] In a possible implementation form of the second aspect, the building heating and ventilation system further comprises a heating unit and at least one first conduit connecting the heating unit to the exhaust gas outlet of the chimney unit.

[0018] In a further possible implementation form of the second aspect, wherein the heating unit is fueled by fossil fuel, biomass, and/or hydrogen.

[0019] In a further possible implementation form of the second aspect, the heating unit is a condensing boiler, a gas-fired heatpump, a CHP system or plant, or a fuel

cell.

[0020] In a further possible implementation form of the second aspect, the building heating and ventilation system further comprises photovoltaic-thermal hybrid solar panels, allowing additional heat sources to be combined.

[0021] In a further possible implementation form of the second aspect, the building heating and ventilation system further comprises a ventilation system and at least one second conduit connecting the ventilation system to the ventilation air outlet of the chimney unit. This allows the ventilation system, and indoor air, to contribute to increasing the thermal transfer efficiency of the entire system when transported through the second conduit to the flue and heat exchanger instead of being directly dissipated to the outdoors.

[0022] In a further possible implementation form of the second aspect, the chimney unit of the building heating and ventilation system is arranged on the roof, allowing gaseous media to travel naturally and the chimney to be used in a conventional manner.

[0023] According to a third aspect, there is provided a method of heating a building comprising a flue, the method comprising the steps of providing a heat exchanger within the flue, the heat exchanger being configured to transfer thermal energy between a gaseous medium and a liquid medium being circulated in a circuit for heat exchanging with a heat pump in the building; and supplying gaseous medium through at least two flue inlets, one of the flue inlets being a direct outdoor air inlet configured to receive outdoor air directly from an exterior of the building, and at least one further of the flue inlets being one of an indirect outdoor air inlet configured to receive outdoor air via a preheating structure of the building, an exhaust gas inlet configured to receive exhaust gas from a heating unit of the building, and a ventilation air inlet configured to receive ventilation air from a ventilation system of the building.

[0024] These and other aspects will be apparent from the embodiments described below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] In the following detailed portion of the present disclosure, the aspects, embodiments, and implementations will be explained in more detail with reference to the example embodiments shown in the drawings, in which:

Fig. 1 shows a schematic side view of a chimney unit and a building heating and ventilation system in accordance with an example of the embodiments of the disclosure, the chimney unit being arranged on the roof of the building;

Fig. 2 illustrates the fluid flow in the chimney unit and heating and ventilation system shown in Fig. 1.

DETAILED DESCRIPTION

[0026] Fig. 1 shows an embodiment of a chimney unit 1 for installation on a roof 16 of a building 15. The building 15 may be any type of building such as a self-sustained residential building, an apartment block, or an industrial or commercial building. The roof 16 may comprise any type of roofing material and may have any desired pitch, including no pitch, i.e., a so-called flat roof.

[0027] The chimney unit 1 may be preassembled at a manufacturing or building site, i.e. standardized and pre-fabricated, such that it can be easily and quickly installed on a building. However, the chimney unit 1 may also be assembled on-site, on the building, from its individual components.

[0028] The chimney unit 1 comprises a flue 8 having a flue outlet 17. The flue 8 may be at least partially divided into sub-flues or the chimney unit 1 may comprise several flues 8. A flue 8 is a chamber or duct through which smoke, hot gases, and other byproducts of combustion can be vented.

[0029] The chimney unit 1 may comprise structural walls or sides forming a chimney, the walls comprising any suitable material such as brick or metal. The structural walls or sides of the chimney may form the flue 8. The flue 8 may also be a separate pipe, such as a metal or plastic pipe, arranged within the chimney and enclosed by the structural walls or sides of the chimney.

[0030] The top of the chimney, or at least the flue outlet 17, may be provided with a chimney cap protecting the chimney unit 1 from rain, snow, and/or birds nesting. The chimney unit 1 is a ventilation unit which may be configured to allow gaseous media such as air to travel therethrough. In one embodiment, the chimney unit 1 is configured to allow smoke, combustion gases, and/or exhaust gases, generated by e.g. a heating unit, to travel therethrough, from the interior of the building towards the flue outlet 17, such that the exhaust gases are eventually dissipated into the great outdoors.

[0031] At least two flue inlets 6 are provided, each flue inlet being configured to allow a flow of gaseous medium into the flue 8. The gaseous medium can be indoor or outdoor air, or exhaust gases from an external heating unit 10. The flue inlets 6 are preferably provided towards the bottom of the flue 8, allowing gaseous media to enter the bottom of the flue 8 while exiting the flue at the very top of the flue 8 and chimney unit 1.

[0032] One of the flue inlets 6 is a direct outdoor air inlet 6a which is configured to receive outdoor air directly from the exterior of the building 15, i.e. without experiencing thermal energy transfer. The direct outdoor air inlet 6a may comprise a direct opening between the exterior of the building 15 and the flue 8.

[0033] Each additional flue inlet 6 may be an indirect outdoor air inlet 6b, an exhaust gas inlet 6c, or a ventilation air inlet 6d. Possible fluid flow paths of the chimney unit 1 are illustrated in Fig. 2.

[0034] The indirect outdoor air inlet 6b is configured to

receive outdoor air via a preheating structure 9 of the building 15. The preheating structure 9 may be configured to preheat outdoor air as the outdoor air travels from the exterior of the building 15 into the flue 8.

[0035] As illustrated in Fig. 2, the preheating structure 9 may be formed by a space between an outer roof covering and a roof support structure of the building 15, the outdoor air being preheated by thermal radiation from the outer roof covering. The outer roof covering may comprise partially overlapping roofing elements such as roof tiles. Additionally, the preheating structure 9 may be formed by a space within the roof support structure, e.g. when the outer roof covering is a material such as roofing felt which is applied directly onto a surface of the roof support structure.

[0036] The exhaust gas inlet 6c is configured to receive exhaust gas from a heating unit 10 of the building 15 which is described in more detail below.

[0037] The ventilation air inlet 6d is configured to receive ventilation air from a ventilation system 11 of the building 15 which is described in more detail below.

[0038] The chimney unit 1 also comprises a heat exchanger 2 arranged within the flue 8. The heat exchanger 2 is configured to transfer thermal energy between the gaseous medium 3 and a liquid medium 4 which is circulated in a circuit 18 for heat exchanging with a heat pump 7 in the building 15. The heat exchanger 2 may be a separate unit arranged within the flue 8 either during preassembly at a manufacturing or building site, or arranged within the flue 8 on site, e.g. when assembled within an already existing chimney. The heat exchanger 2 may be a heat exchanger specially manufactured for a specific chimney. The heat exchanger 2 may also be an off-the-shelf heat exchanger. The heat exchanger 2 may be any suitable type of heat exchanger. The heat exchanger 2 may be configured for any type of suitable flow, for example a combination of crossflow and counterflow.

[0039] The liquid medium may be any suitable fluid, in particular, it may comprise water, thermal oil, or be a mixture of water and an antifreeze liquid such as glycol. Furthermore, the liquid medium may be a nanofluid.

[0040] The chimney unit 1 furthermore comprises a fan 5 arranged within the flue 8. The fan 5 is configured to force the flow of the gaseous medium 3 towards the flue outlet 17 and across the heat exchanger 2. The fan 5 may be vertically superimposed with the heat exchanger 2 within the flue 8, i.e. arranged above the heat exchanger 2 as shown in Figs. 1 and 2, or below the heat exchanger 2 (not shown).

[0041] The present invention also relates to a building heating and ventilation system 12 comprising the above-described chimney unit 1, a heat pump 7, and a piping arrangement configured to circulate liquid medium 4. The chimney unit 1 of the building heating and ventilation system 12 may be arranged on the roof 16 of the building 15, as shown in Figs. 1 and 2.

[0042] The building heating and ventilation system 12

may further comprise a heating unit 10, as mentioned above, and at least one first conduit 13 connecting the heating unit 10 to the exhaust gas outlet 6c of the chimney unit 1. A pump may be used to create flow of liquid medium through the first conduit 13, between and across the heating unit 10 and the heat exchanger 2.

[0043] The heating unit 10 may be any suitable unit for energy conversion such as a condensing boiler, a gas-fired heat pump, a CHP (combined heat and power) system or plant, or a fuel cell. In other words, the energy converting process may be combustion-based or based on thermochemical reactions. The heating unit 10 may be fueled by any suitable fuel such as fossil fuel, biomass, and/or hydrogen. The building heating and ventilation system 12 may comprise several heating units 10 fueled by different fuels, providing a hybrid arrangement.

[0044] The building heating and ventilation system 12 may further comprise a ventilation system 11 and at least one second conduit 14 connecting the ventilation system 11 to the ventilation air outlet 6d of the chimney unit 1. Ventilation air from indoors usually has a different temperature than outdoor air, contributing to an increase in thermal transfer efficiency of the entire system when transported through the second conduit 14 to the flue 8 and heat exchanger 2 instead of being directly dissipated to the outdoors.

[0045] The building heating and ventilation system 12 may also comprise photovoltaic-thermal hybrid solar panels (PVT panels). The PVT panels may be connected to liquid media circuit 16 by means of two T-valves or other connections (not shown) connecting to the above-mentioned piping arrangement. This allows the heat source of the PVT panels to be combined with the heat source of the chimney unit 1.

[0046] The present invention also relates to a method of heating a building 15 comprising a flue 8. The method comprises a number of steps, the first step being to provide a heat exchanger 2 within the flue 8, the heat exchanger 2 being configured to transfer thermal energy between gaseous medium 3 and liquid medium 4, liquid medium 4 being circulated in circuit 18 for heat exchanging with a heat pump 7 in the building 15.

[0047] The method furthermore comprises the step of supplying gaseous media through at least two flue inlets 6. One of the flue inlets 6 is a direct outdoor air inlet 6a configured to receive outdoor air directly from an exterior of the building 15. At least one further of the flue inlets 6 is one of an indirect outdoor air inlet 6b configured to receive outdoor air via a preheating structure 9 of the building 15, an exhaust gas inlet 6c configured to receive exhaust gas from a heating unit 10 of the building 15, and a ventilation air inlet 6d configured to receive ventilation air from a ventilation system 11 of the building 15.

[0048] The method may furthermore comprise the step of activating a fan 5, which creates a flow of gaseous medium across the heat exchanger 2.

[0049] The various aspects and implementations have been described in conjunction with various embodiments

herein. However, other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed subject-matter, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

[0050] The reference signs used in the claims shall not be construed as limiting the scope. Unless otherwise indicated, the drawings are intended to be read (e.g., cross-hatching, arrangement of parts, proportion, degree, etc.) together with the specification, and are to be considered a portion of the entire written description of this disclosure. As used in the description, the terms "horizontal", "vertical", "left", "right", "up" and "down", as well as adjectival and adverbial derivatives thereof (e.g., "horizontally", "rightwardly", "upwardly", etc.), simply refer to the orientation of the illustrated structure as the particular drawing figure faces the reader. Similarly, the terms "inwardly" and "outwardly" generally refer to the orientation of a surface relative to its axis of elongation, or axis of rotation, as appropriate.

Claims

1. A chimney unit (1) for installation on a roof (16) of a building (15), said chimney unit (1) comprising:

- a flue (8) having a flue outlet (17),
- at least two flue inlets (6) configured to allow flow of gaseous medium into said flue (8),

- one of said flue inlets (6) being a direct outdoor air inlet (6a) configured to receive outdoor air directly from an exterior of said building (15), and

- at least one further of said flue inlets (6) being one of

- an indirect outdoor air inlet (6b) configured to receive outdoor air via a preheating structure (9) of said building (15),

- an exhaust gas inlet (6c) configured to receive exhaust gas from a heating unit (10) of said building (15), and

- a ventilation air inlet (6d) configured to receive ventilation air from a ventilation system (11) of said building (15);

- a heat exchanger (2) arranged within said flue (8), said heat exchanger (2) being configured to transfer thermal energy between said gaseous medium (3) and a liquid medium (4) for circulating in a circuit (18) for heat exchanging with a heat pump (7) in said building (15);

- a fan (5) arranged within said flue (8), said fan (5) being configured to force flow of said gaseous medium (3) towards said flue outlet (17) and across said heat exchanger (2) .

2. The chimney unit (1) according to claim 1, wherein said fan (5) is vertically superimposed with said heat exchanger (2) within said flue (8).

3. The chimney unit (1) according to claim 1 or 2, wherein said liquid medium comprises water, thermal oil, or a water and glycol mixture, the liquid medium optionally being a nanofluid.

4. The chimney unit (1) according to any one of claims 1 to 3, wherein said chimney unit (1) is configured to be preassembled at a manufacturing or building site.

5. The chimney unit (1) according to any one of the previous claims, wherein said direct outdoor air inlet (6a) comprises a direct opening between an exterior of said building (15) and said flue (8).

6. The chimney unit (1) according to any one of the previous claims, wherein said preheating structure (9) is configured to preheat outdoor air as said outdoor air travels from said exterior of said building (15) into said flue (8).

7. The chimney unit (1) according to claim 6, wherein said preheating structure (9) is formed by a space between an outer roof covering and a roof support structure of said building (15)

8. The chimney unit (1) according to claim 6 or 7, wherein said outer roof covering comprises partially overlapping roofing elements, optionally roof tiles.

9. A building heating and ventilation system (12) comprising

- the chimney unit (1) according to any one of claims 1 to 8;
- a heat pump (7);
- a piping arrangement configured to circulate liquid medium (4) .

10. The building heating and ventilation system (12) according to claim 9, further comprising a heating unit (10) and at least one first conduit (13) connecting said heating unit (10) to the exhaust gas outlet (6c) of said chimney unit (1).

11. The building heating and ventilation system (12) according to claim 10, wherein said heating unit (10) is fueled by fossil fuel, biomass, and/or hydrogen.

12. The building heating and ventilation system (12) according to claim 10 or 11, wherein said heating unit (10) is a condensing boiler, a gas fired heatpump, or a fuel cell. 5
13. The building heating and ventilation system (12) according to any one of claims 9 to 12, further comprising a ventilation system (11) and at least one second conduit (14) connecting said ventilation system (11) to the ventilation air outlet (6d) of said chimney unit (1). 10
14. A building (15) comprising a roof (16) and the building heating and ventilation system (12) according to any one of claims 9 to 13, wherein the chimney unit (1) of said building heating and ventilation system (12) is arranged on said roof (16). 15
15. A method of heating a building (15) comprising a flue (8), 20
said method comprising the steps of:
- providing a heat exchanger (2) within said flue (8), said heat exchanger (2) being configured to transfer thermal energy between a gaseous medium (3) and a liquid medium (4) being circulated in a circuit (18) for heat exchanging with a heat pump (7) in said building (15); and 25
 - supplying gaseous medium through at least two flue inlets (6), 30
- one of said flue inlets (6) being a direct outdoor air inlet (6a) configured to receive outdoor air directly from an exterior of said building (15), and 35
 - at least one further of said flue inlets (6) being one of
 - an indirect outdoor air inlet (6b) configured to receive outdoor air via a preheating structure (9) of said building (15), 40
 - an exhaust gas inlet (6c) configured to receive exhaust gas from a heating unit (10) of said building (15), and
 - a ventilation air inlet (6d) configured to receive ventilation air from a ventilation system (11) of said building (15). 45

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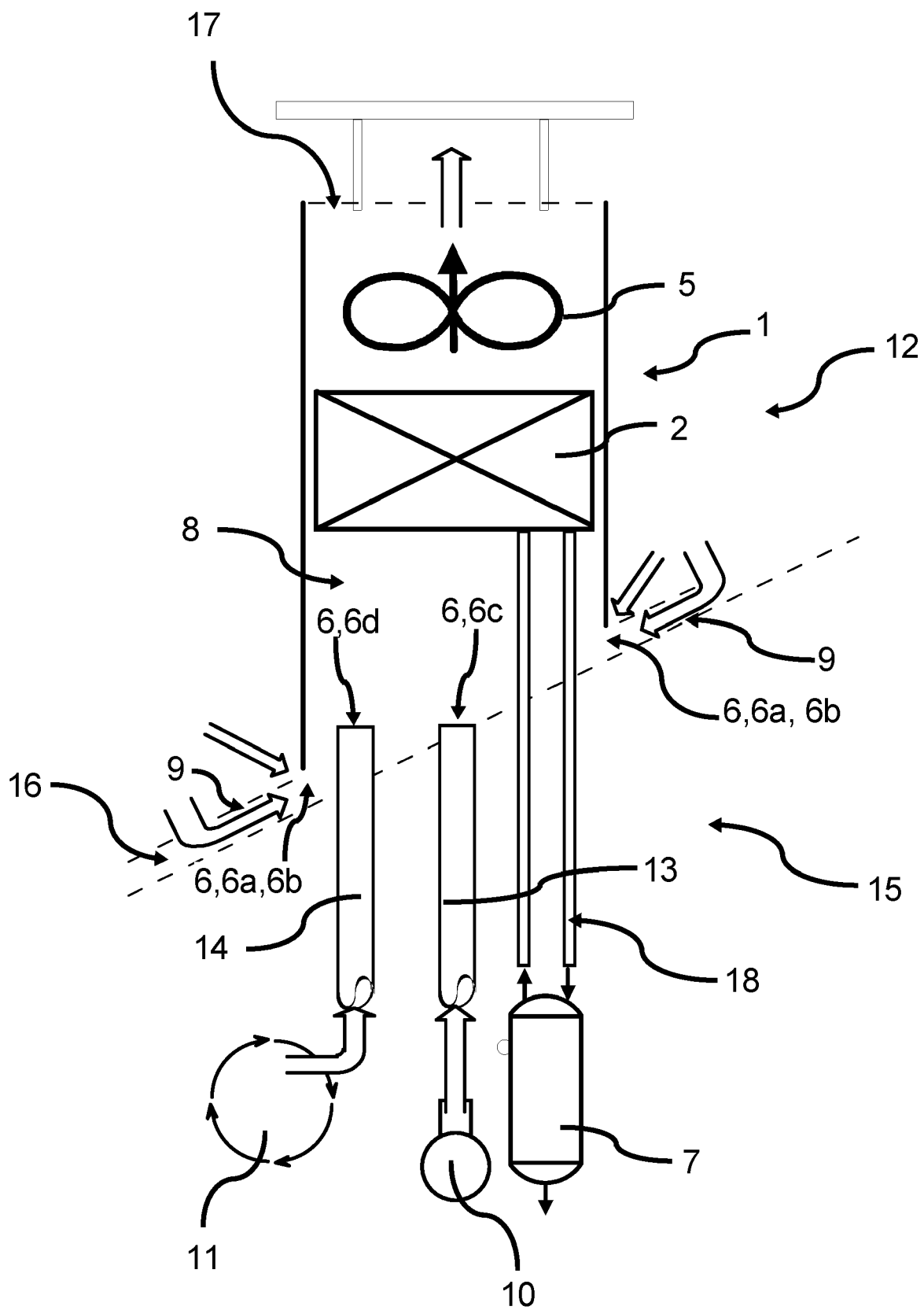


Fig. 1

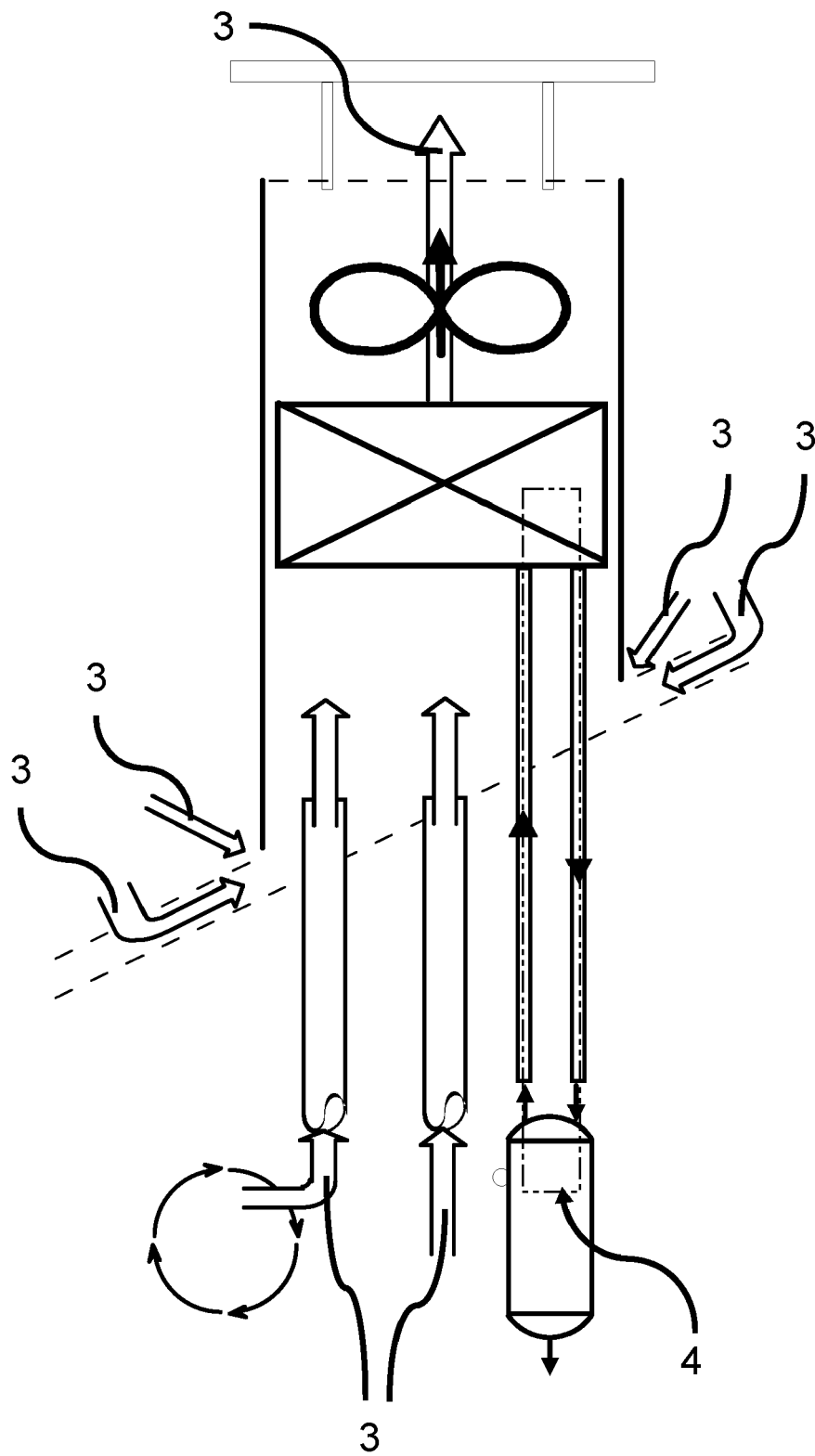


Fig. 2



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Application Number

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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