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(54) Building engineering module

(57) Building engineering module (1), which can be fitted onto the outside wall (2) of buildings comprising a number of storeys, such as e.g. of residential buildings, industrial buildings or commercial buildings, and which building engineering module (1) comprises piping/cables for ventilation and sewerage and water supply/electricity supply and heating/cooling and/or data transfer, and which building engineering module (1) can be connected to connecting piping/connecting cabling (8) in a trench (6) in the bottom part, or in connection with the bottom part, of the building and/or on the basement floor of the and/or in utility rooms. The building engineering module is arranged to manage the apartment-specific or space-specific ventilation of the building, and the building engineering module (1) comprises one or more heat pumps configured for each of the different storeys of the building for utilizing the thermal energy in the exhaust air of the building or for cooling the supply air. In addition, the building engineering module (1) is of the box-structure type when installed on the wall of a building.

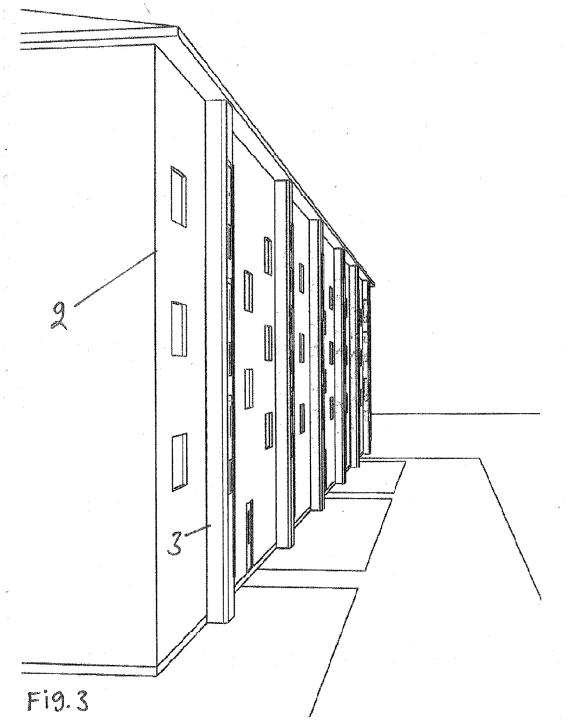

Fig.3

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Description

Background of the invention

[0001] The object of the invention is a building engineering module as defined in the preamble of claim 1, which module can be used in connection with different buildings for disposing building engineering in the module and which module can be further fitted onto the outer wall of a house or building.

Prior art

[0002] Some various building engineering modules are known in the art, in which modules building engineering, such as piping and cabling, are disposed.

[0003] One solution is presented in publication JP8042123A, which describes a modular structure for fixing to the outer wall of an apartment building, inside which structure the piping needed for water distribution and gas distribution can be disposed.

[0004] The building engineering modules in prior-art solutions do not comprise all the means needed in building engineering, and on the other hand the solutions according to prior art cannot be very easily scaled or applied to different buildings.

[0005] The aim of this invention is to achieve a new type of building engineering module, which module comprises the means needed in building engineering and with which module the drawbacks of prior-art solutions can be eliminated or reduced, and to achieve an easily installable and functional solution for a comprehensive building engineering module with site-specific, and even with apartment-specific, requirements.

Brief description of the invention

[0006] The building engineering module according to the invention is characterized by what is presented in the characterization part of claim 1. The solutions according to the different embodiments are also characterized by what is presented in the dependent claims. The solution according to the invention now being presented has some significant advantages compared to prior-art solutions.

[0007] With the invention now presented a new type of building engineering module is achieved, with which the problems of solutions known in the art are eliminated because it can be applied (scaled) to many different buildings. In addition, the solution according to the invention is simple and inexpensive to fabricate and to install onto the wall of a house. Listed below are some of the advantages of the building engineering module according to the invention and of its different embodiments.

- The building engineering module creates entirely new opportunities for enhancing operating efficiency and cutting costs in both newbuilding and renovation construction while simultaneously improving quality.
- Production of prefabricated modular building engineering is more efficient than on-site construction of them, which lowers the price of building engineering.
- A prefabricated module is always made in optimal conditions. The quality both of newbuilding and of renovation construction is easier to monitor than before.
- The building engineering module can be fixed directly to the outer wall of a residential living space or other space needing heating and building engineering. Consequently, the building engineering comprised in a module do not require separate servicing space or installation space inside the building. Only the necessary space-specific regulation devices and terminal devices are installed in the space behind the outer wall.
- A small installation crew installs a module, in which case the number of workers working on the site decreases.
- Prefabricated modular building engineering reduce the work phases requiring specialist professional skills and specialist professional competence at the site itself.
- A box-structure type of building engineering module that forms an enclosed space forms a structure protected from the weather for the piping, wires and ventilation unit devices to be connected to the building engineering. The module can be installed either on an outer wall of the building, in a recess in an outer wall, on balcony structures or on other outer structures of the building.
- The box-type structure of the module can be fabricated from fire-resistant material and compartmentalized with fire seals in the desired manner, in which case it forms a structure that improves fire safety.
- Replacement of the devices of a module is easy and rapid. The modular structure enables apartment-specific or space-specific modification work and upgrades to systems and to devices without affecting the indoor spaces of the building.
- Reduction of living nuisances caused in an apartment during repairs.
- A centralized and apartment-specific fire alarm system can be installed in apartments, which system can, if necessary, be spread into the other apartments of the building and to an alarm center.

- A new emergency exit to the apartments in apartment blocks can be formed by means of a module. Also to those apartments which it is difficult for the fire department to access with external escape stairs, e.g. owing to the height of the building or to the shape of the terrain surrounding the building.

- Servicing of the apparatus of a module occurs from outside via a service hatch and does not require a visit inside in an apartment or in another space of the building.

- Renewable energy can be used in the heating and in the cooling of apartments.

- By means of the heat pump and the heat recovery system, the heating requirement of an apartment or of another space in the building essentially decreases.

- By means of windmills and solar panels to be installed on the roof of properties, the need to purchase electrical energy used by a module decreases and in the best case is completely eliminated.

- By means of the ground-source heat module to be installed in the bottom part of a building engineering module tower, the hot household water needed by a property can be produced.

[0008] Optimal ventilation and heat recovery reduces the energy requirement of a building.

Brief description of the figures

[0009] In the following, the invention will be described in more detail by the aid of examples with reference to the drawings 1 - 6, wherein

- Figs. 1 and 2 present the installation of a building engineering module according to the invention onto a wall 2 of the building.

- Figs. 3 and 4 present different perspectives of a building engineering module when it is installed on the wall 2.

- Figs. 5 and 6 present a service elevator 4 fitted onto a building engineering module.

- Figs. 7a-7c present diagrams of a ventilation unit that comprises a heat pump and is fitted into a building engineering module, in different operating situations of the unit.

Detailed description of the invention

[0010] Figs. 1 and 2 present the installation of a building engineering module according to the invention onto an outer wall 2 of a building. The building engineering module 1 can be fitted onto the outside wall 2 of buildings comprising one or more storeys (and one or more apartments or other spaces), such as e.g. of residential buildings, industrial buildings or commercial buildings. The building engineering module 1 is self-supporting. The building engineering module 1 comprises piping/cables 7 for ventilation and/or sewerage and water supply/electricity supply and/or heating/cooling and/or data transfer, and additionally the building engineering module comprises a heat pump, such as a ground-source heat pump, and/or an air-conditioning device and/or heat recovery from exhaust air, which is/are installed at the point of each different storey. The structure and operating principle of the heat pump 10 fitted into the building engineering module are described in more detail in Figs.7a-7c.

[0011] The building engineering module 1 is connected to connecting piping/connecting cabling 8 in a trench 6 in the bottom part, or in connection with the bottom part, of the building. A building engineering module can be installed as a single piece or as a number of pieces onto the wall of the building. The building engineering module 1 is of the box-structure type when installed on the wall of a building, as is presented in Fig. 3. Figs. 1 and 2 present a building engineering module when fitted to a three-storey house, but the number of storeys is in no way limited, but instead there can be anything from one storey upwards, and furthermore there can be a number of building engineering modules side-by-side, as is described in Fig. 2.

[0012] Figs. 3 and 4 present different perspectives of a building engineering module installed on a wall 2, and the building engineering module is of the box-structure type, being enclosed in a box structure 3 (the whole of the box structure 3 is itself a part of the building engineering module). The box structure 3 forms a structure protected from the weather for the piping, wires and ventilation unit devices to be connected to the building engineering. The box-type structure 3 can be fabricated from fire-resistant material and compartmentalized with fire seals in the desired manner.

[0013] Figs. 5 and 6 present a service elevator 4 fitted into a building engineering module, with which elevator e.g. servicing procedures can be performed via a service hatch 5 in the building engineering module. The building engineering module comprises at least one service hatch at the point of each storey of the building. The elevator can, of course, also be used for transporting freight or people, and the elevator can be fitted into a groove 5', which is in the enclosure/box structure 3 of the building engineering module. The hoisting motor of the elevator is fixed to the elevator car. The elevator can alternatively be implemented in such a way that the elevator car comprises support wheels, which are against the enclosure of the building engineering module. A rotatable wheel is fixed to the roof piece of the enclosure, around which

wheel the hoisting cables of the elevator are arranged.

[0014] The basic function in the building engineering module 1 according to the invention is a ventilation unit 9 with a heat pump 10 functioning as the core of it, which heat pump, depending on the need, either heats or cools an apartment or some other space of the building. Some other space of the building refers to e.g. a unitary storage space or office space. The heat pump utilizes the thermal energy obtainable from the exhaust air as well as the thermal energy obtainable from the outdoor air in an optimal manner, heating if necessary the circulating air and/or replacement air to be supplied to the inside. The building engineering module 1 comprises one or more heat pumps configured for each of the different storeys of the building. Heat pumps are installed at the point of each storey. The operating principle of the ventilation unit and of the heat pump is described in more detail in Figs. 7a-7c.

[0015] The building engineering module 1 comprises a ventilation unit 9 provided with a heat pump 10. The ventilation unit is disposed in an enclosure 3. With the heat pump 10 the supply air (replacement air) being supplied to the building can be heated with the exhaust air of the building or can be cooled. With the ventilation unit 9 the ventilation can be performed for each specific apartment or for each specific space. Also the temperature regulation can be performed for each specific apartment or for each specific space. The heat pump comprises a closed coolant circuit 11, to which a heat exchanger 12 is connected for transferring heat between the exhaust air and the coolant of the coolant circuit 11. The heat exchanger 12 functions either as an evaporator (heat is transferred from the exhaust air into the coolant) or as a condenser (heat is transferred from the coolant into the exhaust air), depending on the operating mode of the ventilation unit 9.

[0016] In addition, a second heat exchanger 13 is connected to the coolant circuit 11 for transferring heat between the coolant and the supply air being conducted into the building. The second heat exchanger 13 functions either as a condenser (heat is transferred from the coolant into the supply air) or as an evaporator (heat is transferred from the supply air into the coolant), depending on the operating mode of the ventilation unit 9. A compressor 14 is connected to the coolant circuit 11 for raising the pressure of the coolant flowing between the heat exchanger and the second heat exchanger. The compressor 14 is connected between the heat exchanger 12 of the coolant circuit 11 and the second heat exchanger 13.

[0017] In addition, an expansion valve 15 is connected to the coolant circuit 11 between the second heat exchanger and the first heat exchanger. The pressure of the coolant flowing between the second heat exchanger 13 and the heat exchanger 12 is reduced with the expansion valve 15.

[0018] The ventilation unit 9 comprises a supply duct 16 for conducting supply air from outside to inside the building. A supply air fan 24 is connected to the supply duct 16 for conducting the supply air from outside to inside the building. The second heat exchanger 13 of the heat pump is connected to the supply duct 16 at a point after the supply air fan 24 in the flow direction of the air.

[0019] The ventilation unit 9 also comprises an exhaust duct 17 for conducting exhaust air out from the inside space of the building. An exhaust air fan 25 is connected to the exhaust duct 17 for conducting the supply air out from inside the building. The heat exchanger 12 of the heat pump is connected to the exhaust duct 17 at a point after the exhaust air fan 25 in the flow direction of the air.

[0020] The ventilation unit 9 comprises an air heat exchanger 19 for transferring heat from the exhaust air to the supply air. The heat transfer of the air heat exchanger 18 is based on convection, i.e. the air currents do not intermix in the air heat exchanger 19. The air heat exchanger 19 can be e.g. a cross-flow heat exchanger. The air heat exchanger 19 is connected to the supply duct 16 at a point before the second heat exchanger 13 of the heat pump in the flow direction of the air. The air heat exchanger 19 is connected to the exhaust duct 17 at a point before the heat exchanger 12 of the heat pump in the flow direction of the air.

[0021] The ventilation unit 9 is provided with a three-way valve, a damper or another corresponding guide device 18, with which the exhaust air can be guided to flow through the air heat exchanger 19 or past the air heat exchanger 19.

[0022] The ventilation unit 9 comprises a circulating circuit 20 for outdoor air, to which the heat exchanger 12 of the heat pump is connected. A circulating fan 21 for the outdoor air is connected to the circulating circuit for outdoor air. The outdoor air in the circulating circuit 20 for outdoor air can be circulated through the heat exchanger 12.

[0023] The ventilation unit 9 also comprises a circulating circuit 22 for indoor air, to which the second heat exchanger 13 of the heat pump is connected. A circulating fan 23 for indoor air is connected to the circulating circuit for indoor air. The indoor air in the circulating circuit 22 for indoor air can be circulated through the second heat exchanger 13.

[0024] In Fig. 7a the ventilation unit 9 warms the inside space of the building. The air heat pump 10 functions as a so-called exhaust air heat pump, which transfers heat from the exhaust air of the building into the supply air. The supply air fan 24 sucks air from outside into the supply duct 16. The exhaust air fan 25 sucks exhaust air from inside the building into the exhaust duct 17. The guide device 18 is in a position in which exhaust air flows through the air heat exchanger 19. Also supply air flows through the air heat exchanger 19, in which case the exhaust air warms the supply air.

[0025] After the air heat exchanger 19 the supply air flows into the second heat exchanger 13 of the air heat pump. After the air heat exchanger 19 the exhaust air flows into the heat exchanger 12 of the heat pump, in

which the heat in exhaust air is transferred to the coolant of the coolant circuit 11. The coolant evaporates in the heat exchanger 12. After this the pressure of the coolant is increased with the compressor 14. The compressor 14 pushes the coolant vapor into the second heat exchanger 13, in which the coolant vapor surrenders heat into the supply air. At the same time the coolant cools and condenses back into a liquid. The coolant flows out of the second heat exchanger 13, after which it flows into the expansion valve 15, in which the pressure and the temperature of the coolant decrease. After this the coolant flows back into the heat exchanger 12, and the process is repeated. The exhaust air flows from the heat exchanger 12 into the outdoor air. The supply air flows from the second heat exchanger 13 to inside the building.

[0026] If necessary the outdoor air can be circulated in the circulating circuit 20 for outdoor air to the heat exchanger 12 of the heat pump, in which heat exchanger the heat in the outdoor air is transferred into the coolant circuit 11. Air from the heat exchanger 12 flows back into the outdoor air. If necessary, the indoor air of the building can be circulated in the circulating circuit 22 for indoor air to the second heat exchanger 13 of the heat pump, in which heat exchanger the indoor air warms up. The indoor air from the second heat exchanger flows back to inside the building.

[0027] In Fig. 7b, the ventilation unit 9 functions as a passive heat exchanger. In this case the heat pump 10 is not in use. The guide device 18 is in a position in which exhaust air flows through the air heat exchanger 19. Also supply air flows through the air heat exchanger 19, in which case the exhaust air warms the supply air. After the air heat exchanger 19 the supply air flows to inside the building and the exhaust air to outside.

[0028] In Fig. 7c, the ventilation unit 9 cools the supply air being conducted to inside the building. This is achieved by changing the process of the heat pump 10 to be the reverse compared to the operating situation of Fig. 7a. In this case the supply air flows into the second heat exchanger 13 of the heat pump, in which the heat in exhaust air is transferred to the coolant of the coolant circuit 11. The coolant evaporates in the second heat exchanger 13. After this the pressure of the coolant is increased with the compressor 14. The compressor 14 pushes the coolant vapor into the heat exchanger 12, in which the coolant vapor surrenders heat into the exhaust air. At the same time the coolant cools and condenses back into a liquid. The coolant flows out of the heat exchanger 12, after which it flows into the expansion valve 15, in which the pressure and the temperature of the coolant decrease. After this the coolant flows back into the second heat exchanger 13, and the process is repeated. The exhaust air flows from the heat exchanger 12 into the outdoor air. The supply air flows from the second heat exchanger 13 to inside the building. The guide device 18 is in a position in which exhaust air bypasses the air heat exchanger 19. The condensation of the coolant in the heat exchanger 12 can be boosted by circulating the outdoor air in the circulating circuit 20 for outdoor air.

[0029] In addition, the building engineering module 1 comprises a regulation unit, with which the operation of the ventilation unit 9, such as the amount of ventilation and the temperature of the supply air, can be adjusted. The regulation unit can be controlled e.g. from inside the building.

[0030] The building engineering module 1 comprises an own ventilation unit 9 for each floor of the building or a floor-specific ventilation unit. The building engineering module 1 comprises an own ventilation unit 9 for each apartment or space. In this case the ventilation of the building can be arranged specifically for each apartment or for each space.

[0031] In summertime the temperature of the air to be blown inside can be reduced by means of the heat pump, in which case the indoor temperature of the apartment is brought to a comfortable level. If necessary, the heating of the air can be increased with a separate water-circulating heater or electric heater or e.g. with a solar panel.

[0032] The building engineering module manages the apartment-specific ventilation according to the current provisions and guarantees fresh, clean air for each room in an apartment with the feeling of a draft. If necessary, the ventilation is easy to boost. When an apartment is empty, the apparatus is adjusted to the minimum level while ensuring that there is adequate basic ventilation for the apartment. The assembly comprised in a building engineering module can be tailored according to need for a specific housing company and/or even a specific apartment. It is also easy to add to the functions of a building engineering module as needs increase.

[0033] The following systems can also be fitted into a building engineering module:

- the electricity supply and electricity distribution board for the apartments
- sewers and household water pipes
- remotely-readable water metering and electricity metering
- a ground-source heat circuit for heating household water and for additional heating
- telecommunications connections to the apartments and an apartment-specific wireless network
- a smoke alarm system
- separate cooker hood ducting
- central vacuum cleaning system
- waste chutes
- rainwater pipes
- a control panel, from which the apparatus is adjusted and the electricity consumption of the apparatus can be read on the same panel
- apartment-specific water meter
- apartment-specific weather station, which displays historical data, weather information, weather forecasting and weather history.

[0034] It is obvious to the person skilled in the art that

the different embodiments of the invention are not either limited solely to the examples described above, and that they may for these reasons be varied within the scope of the claims presented below.

[0035] One or more means for producing energy, such as a solar panel or windmill can be fitted into a building engineering module. Different monitoring means/alarm means, such as sensors or meters, such as e.g. smoke meters/smoke alarms, can also be fitted into a building engineering module. An emergency exit ladder is fixed/fitted to the building engineering module. Some or all of the different parts of a building engineering module are fabricated from recycled material, such as recycled plastic or recycled metal.

Claims

1. Building engineering module (1), which can be arranged onto the outside wall (2) of buildings comprising a number of storeys, such as of residential buildings, industrial buildings or commercial buildings, and which building engineering module (1) comprises piping/cables for ventilation and sewerage and water supply and/or electricity supply and/or heating/cooling and/or data transfer, and which building engineering module (1) can be connected to connecting piping/connecting cabling (8) in a trench (6) in the bottom part, or in connection with the bottom part, of the building and/or on the basement floor of the building and/or in utility rooms, **characterized in that** the building engineering module is arranged to manage the apartment-specific or space-specific ventilation of the building, **in that** the building engineering module (1) comprises one or more heat pumps arranged for each of the different storeys of the building for utilizing thermal energy in exhaust air of the building or for cooling supply air, and **in that** the building engineering module (1) is of the box-structure type when installed on the wall of a building.

2. Building engineering module according to claim 1, **characterized in that** the building engineering module (1) comprises a ventilation unit (9) for conducting supply air into the building and for removing exhaust air from the building, which ventilation unit (9) comprises a heat pump (10) for transferring heat from the exhaust air to the supply air of the building or for cooling the supply air.

3. Building engineering module according to claim 2, **characterized in that** and it comprises at least one ventilation unit (9) for each space or apartment of the building.

4. Building engineering module according to claim 2, **characterized in that** the ventilation unit (9) comprises an air heat exchanger (19) for transferring heat from the exhaust air to the supply air of the building.

5. Building engineering module according to claim 4, **characterized in that** an air heat exchanger (19) is disposed at a point before the heat pump (10) in the flow direction of the supply air.

6. Building engineering module according to claim 4 or 5, **characterized in that** an air heat exchanger (19) is disposed at a point before the heat pump (10) in the flow direction of the exhaust air.

7. Building engineering module according to claim 1, **characterized in that** there are a number of building engineering modules side-by-side or consecutively continuous on the wall of the building.

8. Building engineering module according to claim 1, **characterized in that** the building engineering module can be scaled for buildings of different sizes or of different models.

9. Building engineering module according to claim 1, **characterized in that** the building engineering module comprises at the point of the different storeys at least one service hatch (5) for servicing the building engineering module.

10. Building engineering module according to claim 1, **characterized in that** one or more means for producing energy, such as a solar panel or windmill, is fitted, or can be fitted, to the building engineering module.

11. Building engineering module according to claim 1, **characterized in that** a service elevator (4) is fitted to the building engineering module.

12. Building engineering module according to claim 1, **characterized in that** different monitoring means/alarm means, such as sensors or meters, such as e.g. smoke meters/smoke alarms, are fitted into the building engineering module.

13. Building engineering module according to claim 1, **characterized in that** some or all of the different parts of the building engineering module are fabricated from recycled material, such as recycled plastic or recycled metal.

14. Building engineering module according to claim 1, **characterized in that** an emergency exit ladder is fixed/fitted to the building engineering module.

15. Building comprising a number of storeys, **characterized in that** it comprises a building engineering mod-

ule (1) according to any of the preceding claims, which module is installed in the outer wall of the building.

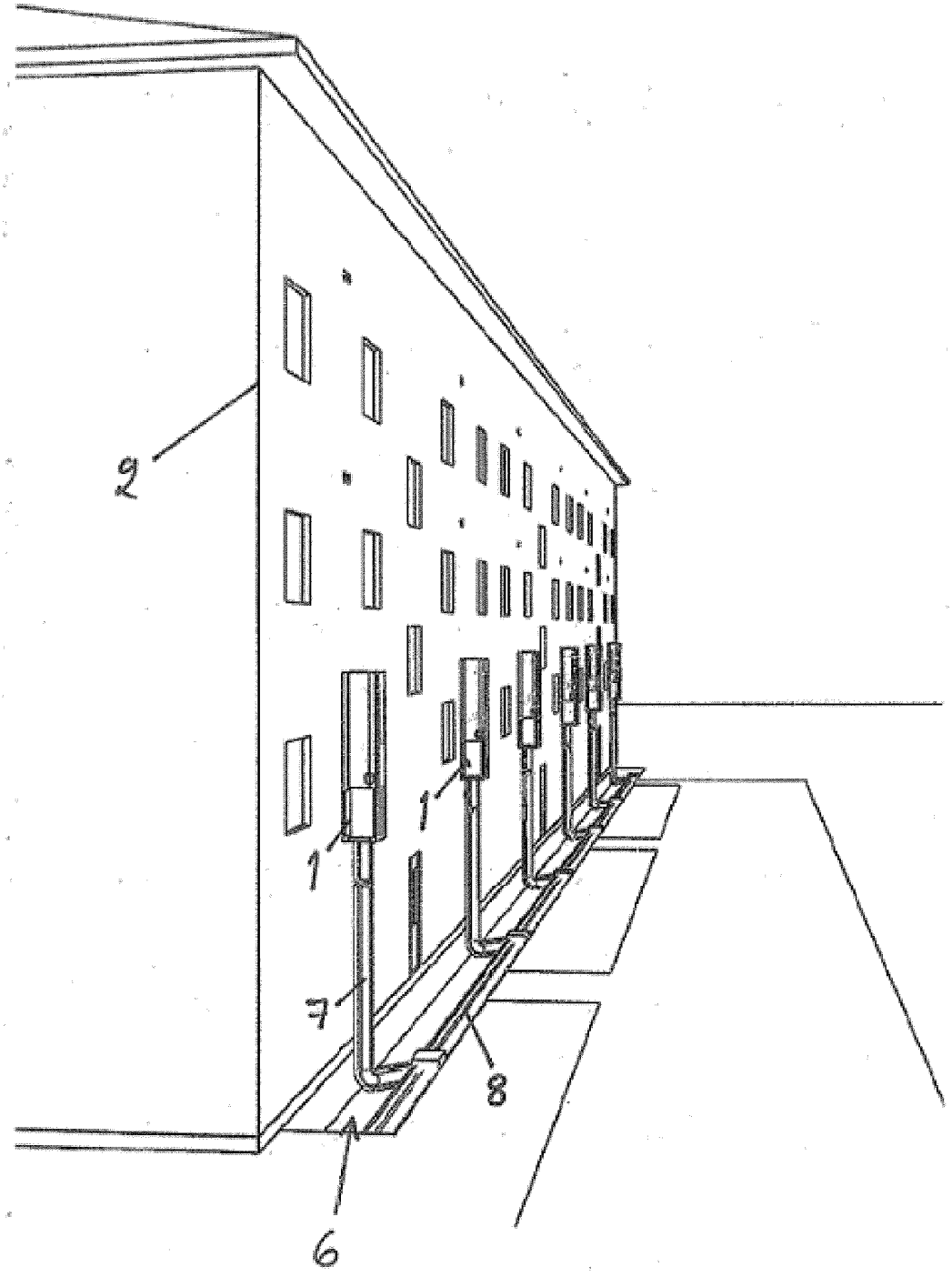


Fig.1

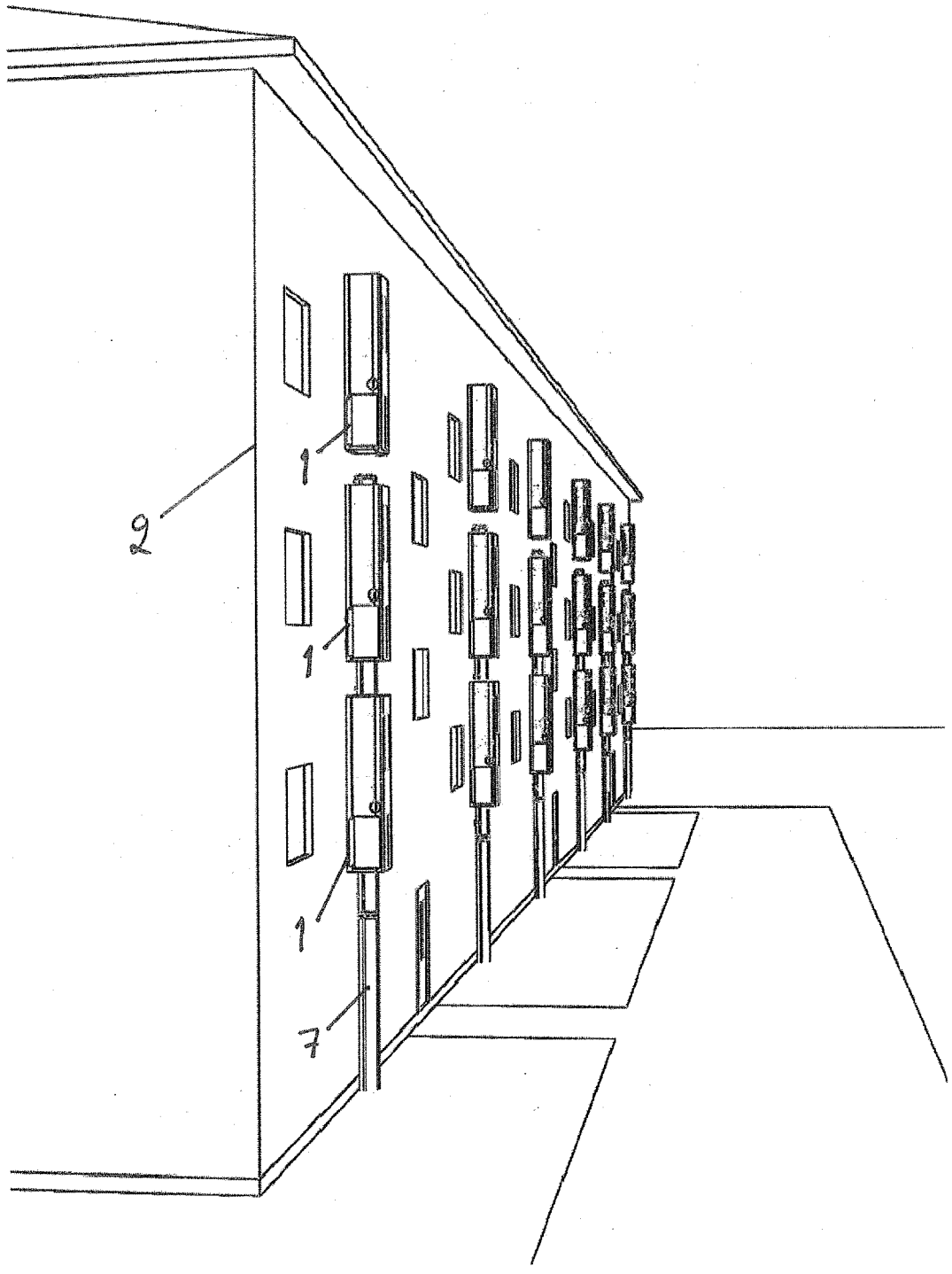


Fig.2

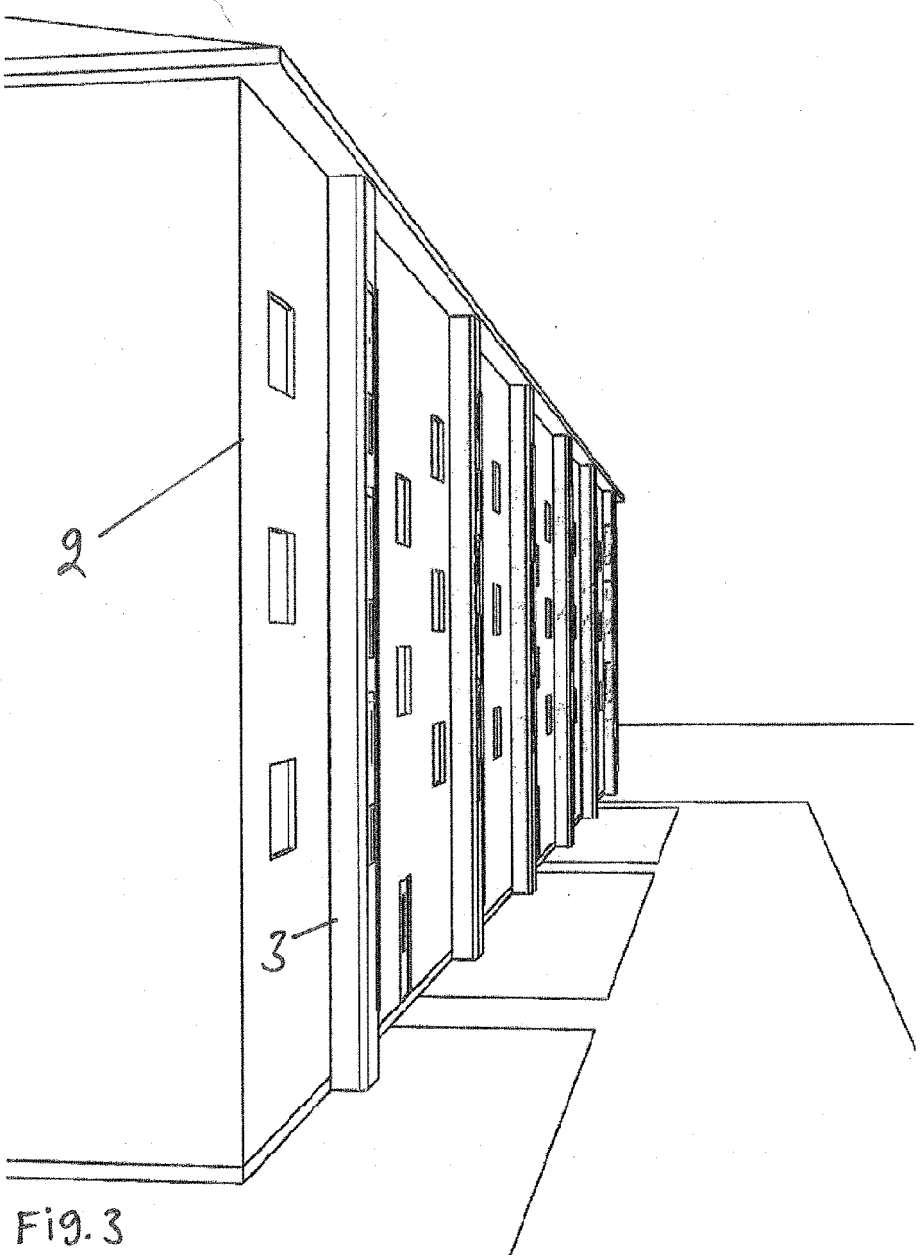


Fig.3

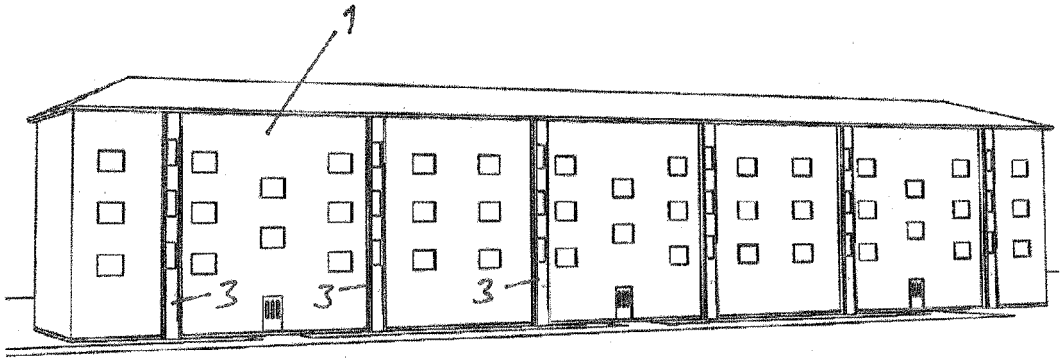


Fig.4

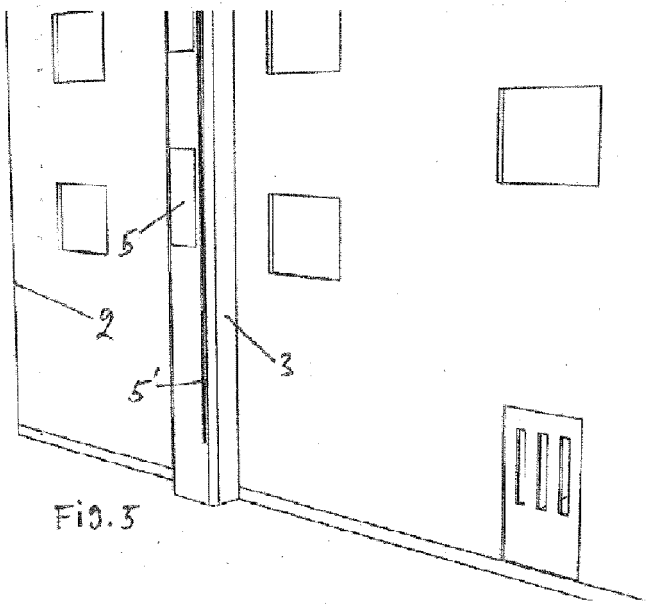


Fig. 5

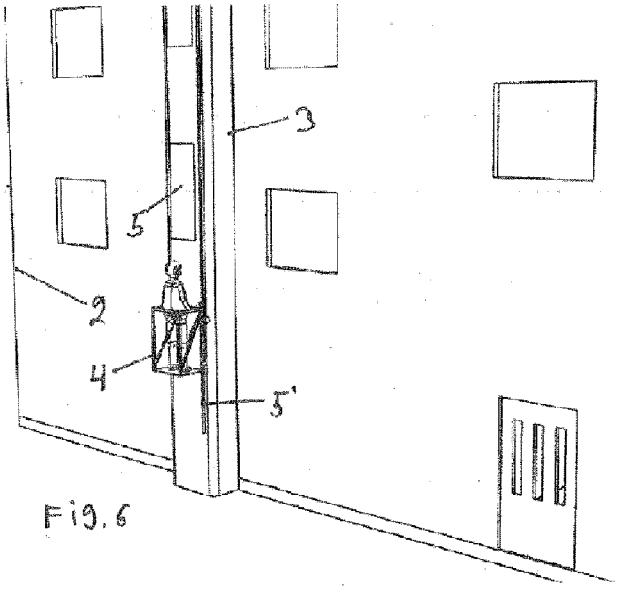
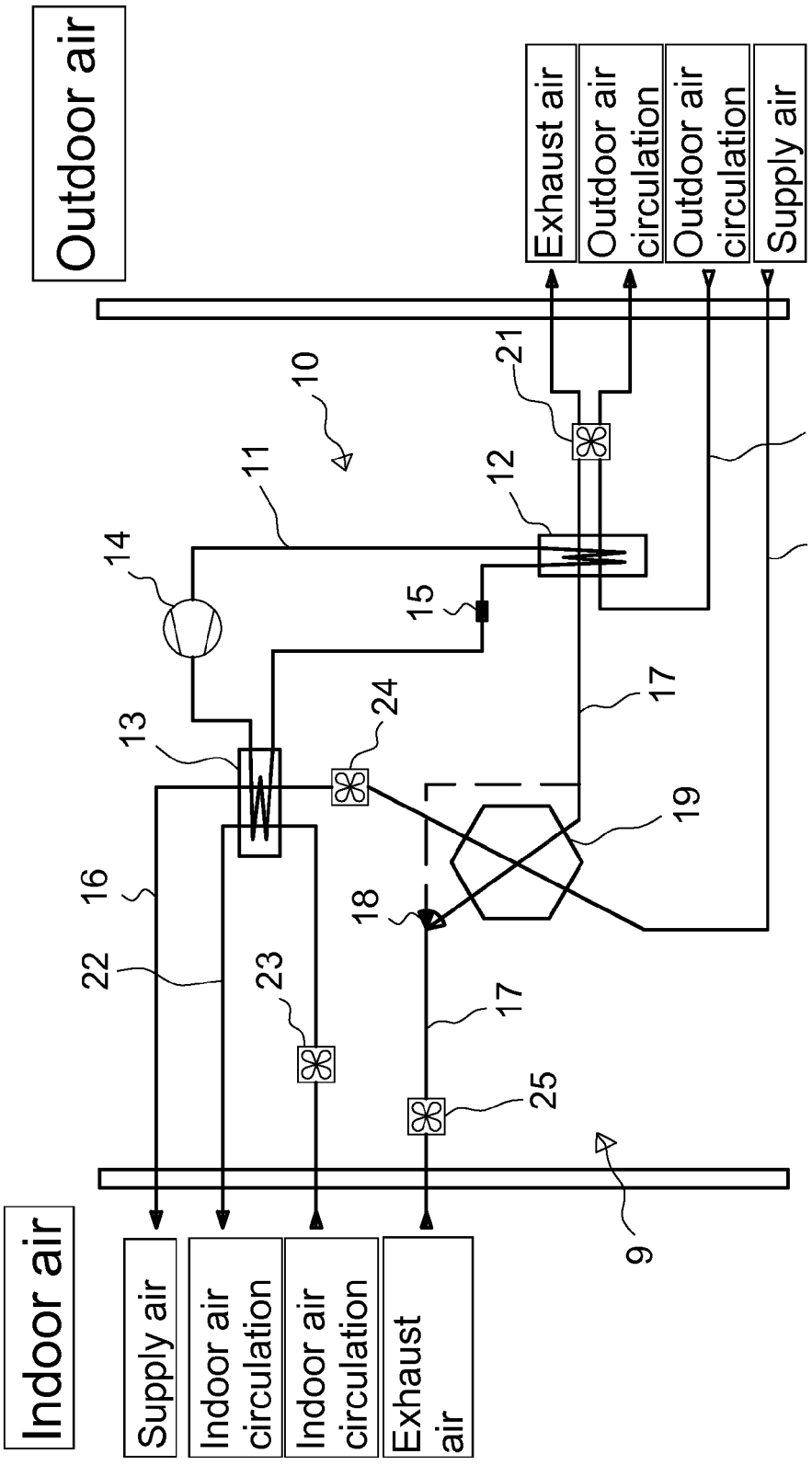


Fig. 6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Indoor air
Supply air
Indoor air circulation
Indoor air circulation
Exhaust air

Fig.7a

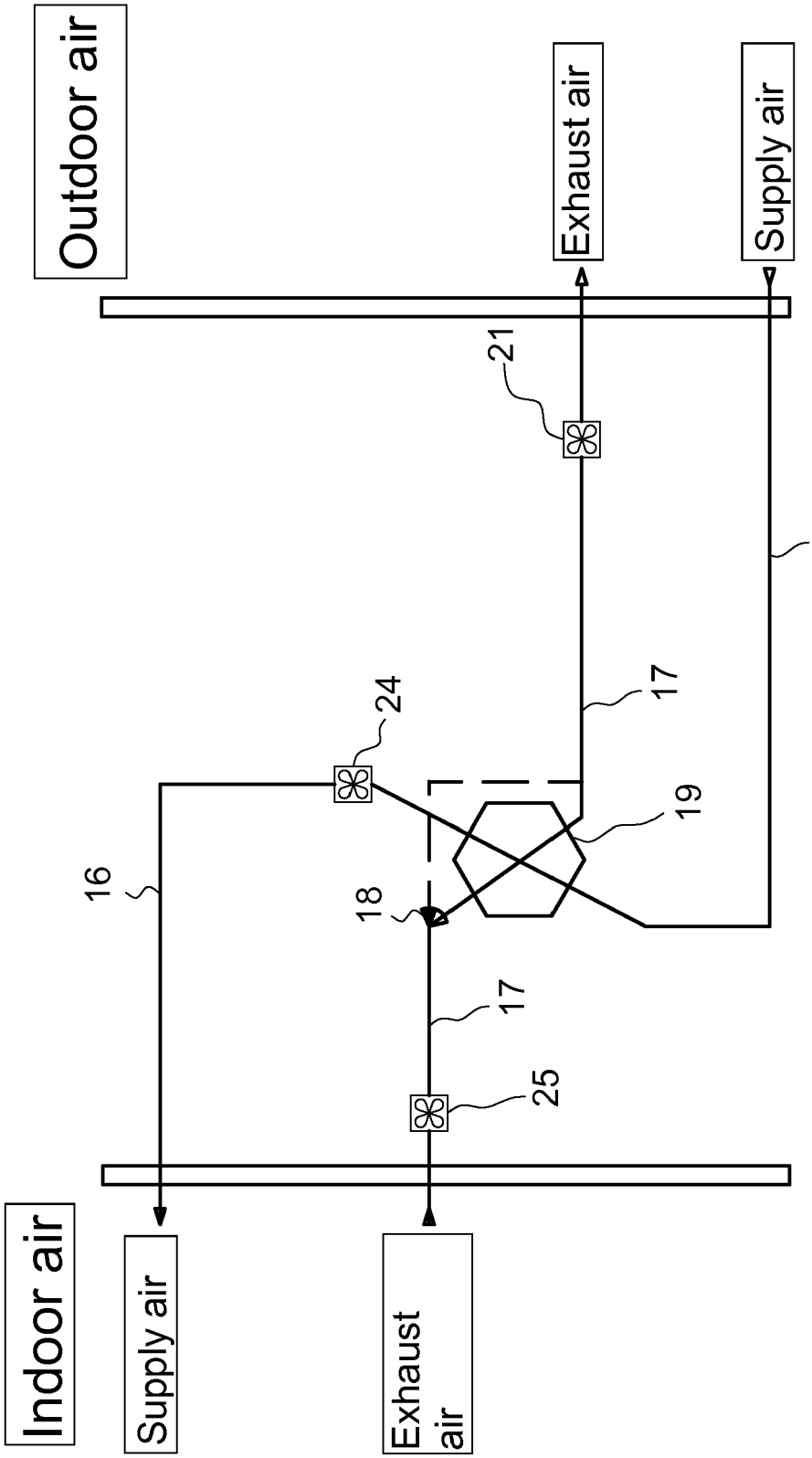
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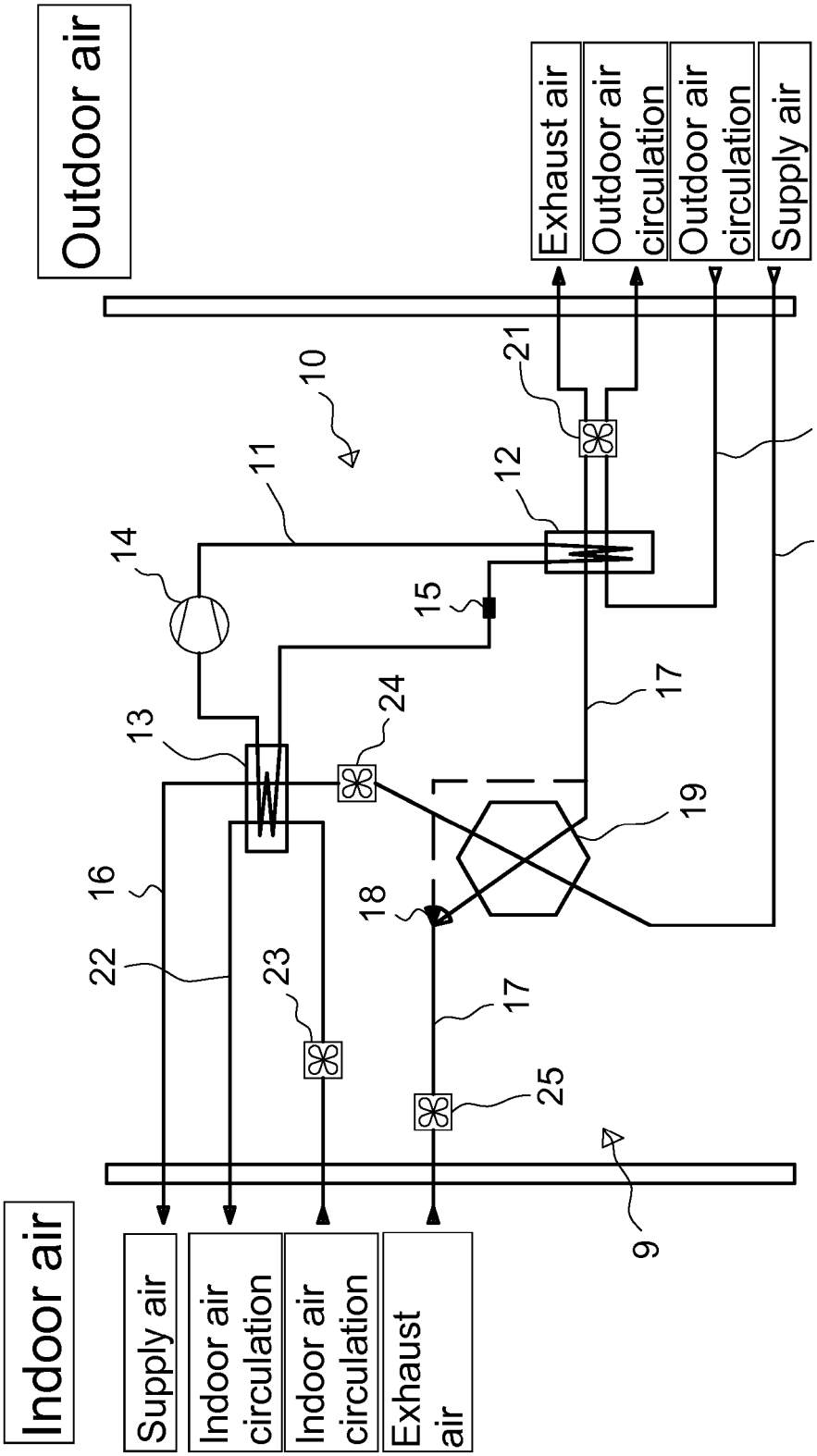
Fig.7b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Indoor air
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Indoor air circulation
Indoor air circulation
Exhaust air

Fig.7c

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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 0380

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2012/076858 A1 (HONEYWELL TECHNOLOGIES SARL [CH]; SWINBOURNE HARRY THOMAS [GB]; GORDON) 14 June 2012 (2012-06-14) * figures 1-7 * * page 6, line 25 - line 33 * * page 8, line 14 - line 16 * * page 6, line 19 - line 25 * * page 12, line 32 - line 33 * * page 7, line 6 - line 15 * * page 5, line 8 - line 14 * * claim 10 * -----	1-15	INV. E04F17/08
X	FR 2 936 828 A1 (MAISON EAU & SOLEIL [FR]) 9 April 2010 (2010-04-09) * figures 1, 4 * * page 2, line 27 - line 34 * * page 2, line 11 - line 17 * -----	1-15	
X	US 3 742 666 A (ANTONIOU A) 3 July 1973 (1973-07-03) * figure 1 * * column 4, line 23 - line 47 * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC) E04F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 March 2014	Cobusneanu, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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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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