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(54) A PASSIVE VENTILATION STACK

PASSIVER LÜFTUNGSKAMIN

COLONNE DE VENTILATION PASSIVE

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(56) References cited:
WO-A-86/07438 FR-A- 2 420 724
FR-A- 2 474 657 US-B1- 6 450 414

- **PATENT ABSTRACTS OF JAPAN vol. 007, no. 244 (M-252), 28 October 1983 (1983-10-28) -& JP 58 130920 A (MATSUSHITA SEIKO KK), 4 August 1983 (1983-08-04)**
- **PATENT ABSTRACTS OF JAPAN vol. 2000, no. 02, 29 February 2000 (2000-02-29) -& JP 11 310970 A (SEKISUI HOUSE LTD), 9 November 1999 (1999-11-09)**
- **PATENT ABSTRACTS OF JAPAN vol. 1996, no. 08, 30 August 1996 (1996-08-30) -& JP 08 094138 A (SEKISUI CHEM CO LTD), 12 April 1996 (1996-04-12)**

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Description

[0001] The present invention relates to a passive ventilation stack for a room, building or the like, and to a method of ventilating a room, building or the like.

[0002] Passive stacks are well known as devices for extracting warm air from the upper regions of a room or building, with incoming air being admitted via inlets lower down in the room or building. In winter, such incoming air will need to be heated for the comfort of occupants and this is wasteful.

[0003] Other systems for ventilating rooms and the like include air conditioning devices. These however are energy intensive devices that can be expensive to operate, and do not function without electrical input.

[0004] JP 58130920 concerns a forced ventilation system that utilises warm attic air to warm a room beneath the attic during winter and discharges it to the atmosphere in summer.

[0005] It is therefore desirable to produce a ventilation system that is both relatively efficient and cost effective, and which need not rely on electrical input for power.

[0006] According to a first claim of the present invention, there is provided a passive ventilation stack for a room, building or the like, the stack having an interior space, a first opening which in use provides two way fluid communication between the interior space and the room, building or the like to be ventilated, and a second opening which in use provides two way fluid communication between the interior space and ambient atmosphere, and a control device for varying the size of each of the first and second openings.

[0007] An advantage of this passive ventilation stack is that cooler ventilation air entering the stack from outside is able to mix in the interior space with warmer air from the room or building to be ventilated, such that ventilation air is provided to a room at a controlled temperature that is comfortable to the occupants of the room, without the need for electrical or other form of power to preheat the ventilation air. This in turn can make the system cheaper to operate than prior art systems.

[0008] Further aspects of the invention are as claimed in claim 2 and claim 3.

[0009] The size of the first opening and the size of the second opening may be independently variable.

[0010] The stack may provide substantially the only inlet of the ambient atmosphere into the room, building or the like to be ventilated. In this manner, the passive ventilation stack operates most efficiently.

[0011] The control device may comprise an electric stepper motor. The control device may comprise a fluid thermostat.

[0012] At least two said interior spaces may be provided in series. Preferably, a third independently variable opening is provided between the said interior spaces to provide fluid communication therebetween.

[0013] The passive stack may include at least one sensor, the output of which provides an input to the control device. The sensor may comprise a temperature sensor. At least one further sensor may be provided in the room, building or the like to be ventilated. The further sensor may comprise a temperature sensor and/or a CO_2 sensor.

[0014] According to claim 21 of the present invention, there is provided a method of ventilating a room, building or the like having a first variable size opening in an upper region of the said room, building or the like, said first opening providing fluid communication with an interior space substantially adjacent the room, building or the like, said interior space having a second variable size opening providing fluid communication with the atmosphere, the method comprising the steps of controlling the size of the first opening such that room air in said upper region passes via said opening into the interior space, and controlling the size of the second opening such that ventilation air from the atmosphere enters the interior space, to cause heat exchange by mixing in said interior space of relatively warm room air and relatively cool ventilation air, such that warmed ventilation air is passed into the room, building or the like, and room air from the upper region passes to the atmosphere, substantially without external power.

[0015] Still further aspect of the invention is claimed in claim 22.

[0016] The first variable size opening and second variable size opening may be independently controllable by a control device.

[0017] The method may comprise the further step of obtaining air temperature measurements in the interior space, outside of the interior space and in the room or building to be ventilated, and controlling the size of the first opening and the second opening based upon the said air temperature measurements.

[0018] The method may comprise the further step of obtaining a CO_2 concentration measurement in the room or building to be ventilated, and controlling the size of the first opening and the second opening based upon the said CO_2 concentration measurement.

[0019] The passive ventilation stack may be installed on a room, building or the like, and the installation may include at least one sensor in the interior space, at least one said sensor in the room, building or the like, and at least one sensor located in the atmosphere external to the interior space.

[0020] The interior space may include at least two said first openings and at least two said second openings provided at spaced locations on the room, building or the like. This arrangement can be advantageous where large rooms, buildings or the like are to be ventilated.

[0021] The passive ventilation stack may be located at the top of the room, building or the like.

[0022] An additional power source may be provided to ensure mixing of air in the interior space. The additional power source may comprise a fan. At least one splitter plate may be provided within said interior space to ensure mixing of air in the interior space.

[0023] The invention will now be described by way of example only with reference to the accompanying drawings, in which:

Fig. 1 shows a schematic view of a building having a ventilation stack according to the invention;
Fig. 2 shows a schematic view of a building having two ventilation stacks according to a second embodiment of the invention;
Fig.3 shows a schematic view of a building having a ventilation stack according to a third embodiment of the invention;
Fig. 4 shows a schematic view of a passive ventilation stack according to a fourth embodiment of the invention;
Fig. 5 shows a schematic enlarged detail view of the passive ventilation stack of Figure 4;
Fig. 6 shows a schematic view of the passive ventilation stack of the fourth embodiment with an extended partition; and
Fig. 7 shows a schematic partial view of a passive ventilation stack according to a fifth embodiment of the invention.

[0024] Referring to Figure 1, a room or building 10 has a single ventilation stack 20 mounted at the top of the room or building. The stack 20 has a first lower opening 40 leading into and providing fluid communication with an interior space 41. The lower opening 40 has a valve member 42 for selectively varying the size of the first opening. The term 'size' can include single dimensional quantities such as length or width of the opening, or it could be a two-dimensional area. The valve member 42 is controlled in this embodiment by an electric stepper motor (not shown), but other devices, such as a fluid thermostat (not shown) directly controlling the member could be provided. The valve member 42 may be a slide valve or any other suitable opening-controller, including an iris-type diaphragm, or a single or multi-blade damper such as is well known in the art.

[0025] The stack has a second upper opening 30 from the interior space to the outside. The upper opening 30 has a valve member 32 for selectively varying the size of the second opening 30. The valve member 32 is controlled in this embodiment by an electric stepper motor (not shown), but other devices, such as a fluid thermostat (not shown) directly controlling the member could be provided. The valve member 32 may be a slide valve or any other suitable opening-controller, including an iris-type diaphragm.

[0026] The passive ventilation stack system operates most efficiently in a room or building in which there is substantially no other source of inlet air into the room or building 10 - for example when any windows and doors are closed. In this manner, the system is not dependent upon exterior wind conditions to admit cooler ventilation air into the stack. When the room or building 10 is occupied with people or computers or other heat sources, the room air warms up and naturally rises into an upper region 50 of the room or building. The warm room air passes through opening 40 into the stack 20 at a controlled flow rate, dependent upon the size of the opening 40. The room air passes through the stack 20 and through opening 30, again at a controlled flow rate that is dependent upon the size of the opening 30. As the opening 30 is substantially the only inlet/outlet of air into and out of the room or building 10, the room air leaving the stack 20 is replaced by incoming cooler ventilation air. This ventilation air enters the stack 20 through opening 30 at a controlled flow rate dependent upon the size of the opening 30. Once inside the stack 20, the ventilation air is able to mix with the warmer room air such that a degree of natural heat exchange takes place between the two streams of air. The ventilation air becomes warmer whilst the room air becomes cooler. The warmed ventilation air then passes through the opening 40 at a controlled flow rate dependent upon the size of the opening 40, and into the room or building 10 where it falls to occupant level at a temperature that is comfortable to the occupants.

[0027] A temperature sensor 15 is located in the interior of the room or building 10 in order to measure the room temperature. A second temperature sensor 25 is located in the stack 20 for measurement of the stack temperature. A third temperature sensor 35 is located outside of the stack 20, close to the upper end thereof, for measurement of the ambient air temperature outside of the room/building. In the present embodiment, a CO_2 sensor 17 is also present in the room or building 10. The measurements recorded by each of the sensors 15, 25, 35 and 17 are used as input data into an algorithm for controlling the size of the openings 30 and 40. The algorithm computes the desired ratio of size of the openings 30 and 40 that will provide a desired stack temperature, measured at temperature sensor 25, where the desired stack temperature is higher than the external ambient temperature, measured at temperature sensor 35, but lower than the internal room or building temperature, measured at temperature sensor 15.

[0028] The output of the algorithm is used by the electric stepper motor or other controlling device to adjust the valve members 32 and/or 42 independently of each other to automatically produce the desired stack temperature.

[0029] In an embodiment, the desired stack temperature (T_s) is interpolated using the outside temperature (T_e), and the temperature inside the room to be ventilated (T_i):

$$T_s = T_e + (T_i - T_e) \times f(A_2/A_1)$$

where A_2 and A_1 are the areas of the second opening 30 and the first opening 40 respectively.

[0030] The optimum value of the function *f* can be empirically determined by the skilled person, depending upon the stack design and the specific geometry of the openings.

[0031] In the present embodiment, the desired size of the openings 30 and 40 is also a function of the optimum CO_2 level inside the room, measured at sensor 17. For example, if the sensor 17 detects that there is too high a concentration of CO_2 in the room or building, the openings 30 and 40 can be increased in size whilst maintaining the optimum ratio of size of the two openings.

[0032] In a second embodiment of the invention, more than one stack may be appropriate as shown in Figure 2. This arrangement can enhance the mixing of ventilation air and room air, providing further control of the temperature of air moving into the room, building or the like 110. This arrangement may be particularly appropriate where there is a relatively large temperature difference between the atmospheric air temperature and the room temperature. In this embodiment, a second stack 180 is located adjacent to and above a first stack 120, as shown in Figure 2. However, the two stacks need not be vertically stacked and could be located side by side. A third opening 170 provides fluid communication between an interior space of the first stack 120 and an interior space of the second stack 180. A third valve member 172 is provided in the opening 170 for selectively varying the size thereof. In addition to temperature sensors 115, 125 and 135, a further temperature sensor 175 in the second interior space of second stack 180 provides an additional input into the algorithm.

[0033] In a third embodiment of the invention as shown in Figure 3, a large room or building 210 has an elongate stack 220 mounted on top of the room or building, the stack 220 having multiple lower openings 240 in a lower wall 241 of the stack and multiple upper openings 230 in an upper wall 231 of the stack, at spaced locations thereon. A fan (not shown) is optionally employed to assist mixing of the ventilation air with the room air in the stack 220. Alternatively, one or more splitter plates 255 are optionally employed to assist mixing of the ventilation air and the room air.

[0034] In a fourth embodiment of the invention shown in Figures 4 and 5, a stack 320 is located between an upper stack 380 and a lower stack 390. The stack 320 includes a first opening 330 providing fluid communication between the stack 320 and the upper stack 380, and a second opening 340 providing fluid communication between the stack 320 and the lower stack 390. Valve members 332 are located in opening 330 to vary the size thereof. In Figure 4, the valve members are shown as multiblade dampers, through which air can pass when the blades are open or partially open, although other appropriate types of opening control member can be used. Valve members 342 are located in opening 340 to vary the size thereof. The valve members 332 may comprise two separate valve members 332a, 332b that are controllable independently of each other or they may be coupled so as to be controllable together to vary the size of the opening 330. Similarly, the valve members 342 separate valve members 342a, 342b and may be controllable independently of each other or they may be coupled so as to be controllable together to vary the size of the opening 340.

[0035] The upper stack 380 is open to the atmosphere at an opening 370 located at an upper end thereof, and is protected from unwanted ingress of debris, rainwater etc by an exterior hood 385 that is disposed above the stack 380 in spaced relation therewith, so as to allow for the opening 370 to the atmosphere. An optional partition wall 360 may be included in the upper stack 380 so as to at least partially divide the upper stack into first and second flow passages extending substantially from a lower end of the stack 380 to an upper end thereof.

[0036] The lower stack 390 is open to the room, building or the like to be ventilated. An optional partition wall 365 may be included so as to at least partially divide the lower stack 390 into first and second flow passages extending substantially between the upper end of the lower stack 390 and the room, building or the like to be ventilated. Where the partition walls 360 and/or 365 are partial dividing walls as is described here, a small amount of mixing of the incoming cool air stream and the warmer air exiting the room may take place in the upper stack 380 and/or lower stack 390 respectively.

[0037] Figure 5 shows an enlarged detail view of the stack 320. The stack optionally includes a fan 352 mounted on an inner wall thereof to enhance mixing of the flow streams entering the stack 320 from the upper stack 380 and the lower stack 390. The orientation of the fan 352 may be variable such that it can be optimised according to operating conditions A further optional fan 354 is disposed towards the upper end of the stack 320, below or above the valve member 332, to assist in drawing air downwards from the ambient atmosphere into the stack 320. A still further optional fan 356 is disposed towards the lower end of stack 320, configured to draw air upwards from the room into the stack 320 through valve 342.

[0038] During use of this embodiment of the invention, the passive stack system can be operated such that cool air from the atmosphere is drawn through the opening 370 into the upper stack 380 as shown by the arrow in Figure 4. The cool air flows downwards into stack 320. Meanwhile, warm air from the room is drawn upwards by the lower stack 390 into the stack 320. The cool and warm streams of air meet and mix in the stack 320, causing a certain amount of natural heat exchange between the two air streams.

[0039] The heated ventilation air then exits the stack 320 into the lower stack 390, and hence into the room, building or the like to be ventilated as before, providing the room with naturally heated ventilation air at a temperature that is comfortable for the occupants of the room.

[0040] The remaining warmer air stream is drawn into the upper stack 380 and to the ambient atmosphere.

[0041] A further variation of this embodiment is shown in Figure 6. Here, the partition in the upper stack 380 extends all the way up to the exterior hood 385, such that the first and second passages of the upper stack 380 are completely separated from each other. No mixing of the cooler incoming air stream and the warmer room air stream occurs in the upper stack 380 in this variation.

[0042] In a yet further embodiment shown in Figure 7, a stack 420 comprises only one opening of variable size 430, at an upper end thereof. A pair of valve members 432a, 432b is provided to selectively vary the size of the opening 430. The opening 430 provides fluid communication between the stack 420 and an upper stack 480. A lower end of the stack 420 is open to the lower stack 490 with a fixed size opening. The stack is in all other aspects identical to the stack system of the fourth embodiment of the invention and may have a partial or full partition 460.

[0043] The valve members 432 may be controllable independently of each other as inflow valve member 432a and outflow valve member 432b or they may be coupled so as to be controllable together to vary the size of the opening 430. A controller 446 uses the inputs from a room temperature sensor 415, stack temperature sensor 425, external temperature sensor 435 and from a CO_2 sensor 417 to determine how the valve members 432 and the fans 452, 454 should be operated.

[0044] An example of a control algorithm for opening and closing of the valve members will now be described. The skilled man will appreciate that other ways of operating the passive ventilation stack will be possible without departing from the scope of the invention. The example algorithm pertains to the embodiment of Figure 7, but it will be apparent to the skilled person that the algorithm can be adapted for use with each of the embodiments described herein.

[0045] In the present example, the valve members 432 are coupled to operate as a single valve member. The passive ventilation stack can be user set at a designated switch 444 to one of three different modes of operation as follows:

a) On, in 'summer' mode/'winter' mode
b) On, in 'night cooling' mode
c) Off

[0046] When the switch is turned on in summer/winter mode, the outside temperature (T_e) is measured by a temperature sensor 435. If the measured temperature is above a pre-determined temperature, here 18°C, the passive ventilation stack will operate in 'summer' mode. If the measured temperature is below the pre-determined temperature, the passive ventilation stack will operate in 'winter' mode.

[0047] In 'summer' mode, the passive ventilation stack operates to provide a predominantly upflow displacement of warm room air to the ambient atmosphere. Input of air into the room in this case occurs through another opening e.g. a window. The optional fans 452 and 454, if present, are operated in the same rotational direction and the valve members 432 are fully opened. The controller uses the inputs from temperature sensors 415, 425, 435 and from CO_2 sensor 417 to determine how the valve members 432 and the fans 452, 454 should be operated.

[0048] In the present example, if a CO_2 level of >900 ppm (parts per million) is detected by CO_2 sensor 417, the fans 452, 454 are operated on a slow setting, with the valve members 432 open. If a CO_2 level of >1000 ppm is detected, the fans are operated on a fast setting with the valve members 432 open.

[0049] Temperature sensor 415 measures the interior room temperature (T_i). If the measured temperature is T_i > 21°C, the valve members are opened. If the measured temperature is T_i > 24°C, the fans are turned on at a slow setting and the valve members are opened. If the measured temperature is T_i > 24°C, the fan speed is set to fast and the valve members are opened. For all other measured temperatures, the valve members 432 are closed and the fans are turned off. The room temperature is checked every 2.5 minutes. The position of the valve members and the fan settings are altered accordingly.

[0050] In 'winter' mode, the passive ventilation stack is operated to provide mixing of the warm and cool airstreams. Substantially all ventilation air is obtained through the stack in this mode, and the room is otherwise substantially sealed from the exterior e.g. windows and doors are closed. Temperature sensor 425 measures the temperature in the stack 420 (T_s). If the stack temperature is measured to be T_s > 15°C, the valve members 432 are opened almost completely. If 10°C < T_s <15°C, the valve members 432 are opened approximately half way. If T_s < 10°C, the valve members 432 are opened between the half way and fully closed positions.

[0051] The optional fans 452, 454 can be operated such that they rotate in counter-rotation to each other in this 'winter' mixing mode. The controller then uses the input from the CO_2 sensor 417 and from the room temperature sensor 415 to alter the valve member positions and fan speeds as necessary. In the present example, if the CO_2 measurement is > 900 ppm, the valve members are opened and the fans 452, 454 are run on a slow setting. If the CO_2 measurement is > 1000 ppm, the valve members 432 are opened and the fans 452, 454 are run on a fast setting. If the room temperature is measured at T_i > 22°C, the valve members 432 are opened and the fans 452, 454 are run on a slow setting. If the room temperature is measured at T_i > 24°C, the valve members 432 are opened and the fans are run on a fast setting.

[0052] For all other detected conditions, the valve members are kept closed and the fans are turned off. As with the 'summer' mode, the controller checks the inputs every 2.5 minutes.

[0053] When the switch 444 is set to 'night cooling' mode, the controller checks whether the inputs from temperature sensors 435, 415 show that the external temperature (T_e) is less than the room temperature (T_i). If the check is found to be true, the 'night cooling mode' is initiated.

[0054] The fans 452, 454 are operated in co-rotation and the valve members 432 are fully opened. The controller then checks the inputs from the CO_2 sensor 417 and the room temperature sensor 415 and alters the valve member 432 positions accordingly. In the present example, if the CO_2 measurement is >900, or the room temperature is T_i > 18°C, the valve members are kept open. If the room temperature is T_i > 21°C and/or the CO_2 measurement is >900 and the time is between 3am and 6am, the fans 452, 454 are turned on and the valve members are open. Otherwise, the valve members 32 are closed.

[0055] In 'night cooling' mode, the above checks may be made every 5 minutes.

[0056] In the 'off' mode, the valve members 432 remain closed and the fans 452, 454 turned off.

[0057] The skilled person in the art will appreciate that there are many ways of programming such an algorithm, and that these are conventional in the art and will not be described here.

[0058] In each of the embodiments described above, the first and second openings are shown to be located at the top and bottom of the stack. However, one or both the openings could be located on the sides of the stack. The first and second openings need not be vertically displaced, and could be located at the same vertical level as each other. The stack or stacks may be mounted at locations other than the top of the building.

[0059] The term 'opening' will be understood by the skilled person to include an aperture or a conduit, the size of which is or may be variable to control flow rate there through. Where the valve members are single or multi-blade dampers, it will be understood that the size of the 'opening' can be varied by opening or closing the single or multiple blades.

[0060] It will be appreciated by the skilled person that the desired stack temperature depends upon the environment in which the system is operated, and that in practice it may be higher or lower than the desired temperature in the embodiment above.

[0061] The passive ventilation system may be an integral part of the building design or it may be added later as a retro-fit.

[0062] Various modifications may be made to the embodiments described without departing from the scope of the invention as defined by the following claims.

Claims

1. A passive ventilation stack (20; 120, 180; 220; 320, 380, 390; 420) for a room, building or the like (10; 110; 210), the stack having an interior space (41), a first opening (40; 240; 340) which in use provides two way fluid communication between the interior space and the room, building or the like to be ventilated, and a second opening (30; 230; 370; 430) which in use provides two way fluid communication between the interior space and ambient atmosphere, the interior space in use providing a mixing space for air entering the stack from the room and air entering the stack from the ambient atmosphere, and a control system for varying the size of at least one of the first and second openings.

2. A passive ventilation stack (120, 180; 320, 380, 390; 420) as claimed in claim 1, further comprising a second interior space adjacent the first interior space, the second opening providing flow communication between the first interior space and the second interior space, the second interior space comprising a third opening (170) providing fluid communication between the second interior space and ambient atmosphere.

3. A passive ventilation stack (20; 120, 180; 220; 320, 380, 390; 420) as claimed in claim 1 or claim 2 in which the control system is adapted to vary the size of both the first opening (40; 240; 340) and the second opening (30; 230; 370).

4. A passive ventilation stack (20; 120, 180; 220; 320, 380, 390; 420) as claimed in claim 1 or claim 2 in which the size of the first opening (40; 240; 340) and the size of the second opening (30; 230; 370) are independently variable.

5. A passive ventilation stack (20; 120, 180; 220; 320, 380, 390; 420)as claimed in any of claims 1 to 4, in which the stack provides substantially the only inlet of the ambient atmosphere into the room, building or the like (10; 110; 210) to be ventilated.

6. A passive ventilation stack (20; 120, 180; 220; 320, 380, 390; 420) as claimed in any of claims 1 to 5, in which the stack provides substantially the only outlet of room air out of the room, building or the like (10; 110; 210) to be ventilated.

7. A passive ventilation stack (20; 120, 180; 220; 320, 380, 390; 420) as claimed in any of claims 1 to 6, in which the control system comprises an electric stepper motor.

8. A passive ventilation stack (20; 120, 180; 220; 320, 380, 390; 420) as claimed in any of claims 1 to 6, in which the control system comprises a fluid thermostat.

9. A passive ventilation stack (120; 180; 320, 380, 390) as claimed in any of claims 1 to 8 comprising at least two said passive ventilation stacks arranged in series.

10. A passive ventilation stack (120, 180; 320, 380, 390) as claimed in claim 9, in which a third independently

variable opening (170; 330) is provided between the at least two passive ventilation stacks to provide fluid communication therebetween.

11. A passive ventilation stack (320, 380, 390) as claimed in claim 2, further comprising an exterior hood (385) disposed over the third opening (370).

12. A passive ventilation stack (320, 380, 390)as claimed in claim 2 or claim 11, in which the second interior space further comprises a partition (360) dividing the second interior space at least partially into first and second flow passages, each flow passage extending substantially between the second opening (330) and the third opening (370).

13. A passive ventilation stack (320, 380, 390) as claimed in claim 12, in which the partition (360) extends fully between the second opening (330) and the exterior hood (385).

14. A passive ventilation stack (420, 480, 490) as claimed in claim 2 or any of claims 11 to 13, further comprising a third interior space extending between the first interior space and the room, building or the like to be ventilated.

15. A passive ventilation stack (420, 480, 490) as claimed in claim 14, the third interior space comprising a partition (460) extending substantially between the first opening and the room, building or the like to be ventilated.

16. A passive ventilation stack (20; 120, 180; 220; 320, 380, 390; 420, 480, 490) as claimed in any of claims 1 to 15, further comprising at least one sensor (15, 17, 25, 35; 115, 125, 175, 135; 415, 425, 435, 417), the output of which provides an input to the control device.

17. A passive stack (20; 120, 180; 220; 320, 380, 390; 420, 480, 490) as claimed in claim 16, comprising at least one further sensor locatable in the room, building or the like to be ventilated.

18. A passive ventilation stack (20; 120, 180; 220; 320, 380, 390; 420, 480, 490) as claimed in claim 16 or claim 17 in which the sensor is a temperature sensor or a CO_2 sensor.

19. A passive ventilation stack (320, 380, 390; 420, 480, 490) as claimed in any preceding claim in which an additional power source (352, 354, 356; 452, 454) is provided to assist mixing of air in said interior space.

20. A passive ventilation stack (320, 380, 390; 420, 480, 490) as claimed in claim 19 in which the additional power source (352, 354, 356; 452, 454) is a fan.

21. A method of ventilating a room, building or the like (10; 110; 210) having a first opening (40; 240; 340) in an upper region of the said room, building or the like, said first opening being in fluid communication with an interior space substantially adjacent the room, building or the like, said interior space having a second opening (30; 230; 370; 420) providing fluid communication with the atmosphere, and at least one of the first opening and the second opening being of variable size, the method comprising the steps of controlling the size of the first opening or controlling the size of the second opening, such that room air in said upper region passes via said first opening into the interior space and ventilation air from the atmosphere enters the interior space through the second opening to cause heat exchange by mixing in said interior space of relatively warm room air and relatively cool ventilation air, such that warmed ventilation air is passed into the room, building or the like, and room air from the upper region passes to the atmosphere, substantially without external power.

22. A method of ventilating a room, building or the like (10;' 110; 210) as claimed in claim 21, said interior space having a second opening (170; 330) providing fluid communication with a second interior space, the second interior space having a third opening providing fluid communication with the atmosphere, wherein the method step of controlling the size of the first opening or controlling the size of the second opening causes room air in said upper region to pass via said first opening into the interior space and ventilation air from the atmosphere enters the second interior space through the third opening, and into the interior space through the second opening to cause heat exchange by mixing in said interior space of relatively warm room air and relatively cool ventilation air, such that warmed ventilation air is passed into the room, building or the like, and room air from the upper region of the room passes to the atmosphere, substantially without external power.

23. A method as claimed in claim 21 or claim 22 in which the first opening (40; 240; 340) and the second opening (30; 230; 370; 430) are of variable size, the method further comprising varying the size of both the first opening and of the second opening.

24. A method as claimed in claim 22 or claim 23, in which the size of the first opening (40; 240; 340) and the size of the second opening (30; 230; 370; 430) are independently controllable by a control system.

25. A method as claimed in any of claims 20 to 24 comprising the further step of obtaining air temperature measurements in the interior space, outside of the interior space and in the room or building to be ventilated, and controlling the size of the first opening (40; 240; 340) and the second opening (30; 230; 370; 430) based upon the said air temperature measurements.

26. A method as claimed in claim 25, comprising the further step of obtaining a CO_2 concentration measurement in the room or building to be ventilated, and controlling the size of the first opening (40; 240; 340) and the second opening (30; 230; 370; 430) based upon the said CO_2 concentration measurement.

27. A method as claimed in claim 24 or claim 25 or claim 26 in which the control system comprises an electric stepper motor.

28. A method as claimed in claim 24 or claim 25 or claim 26 in which the control system comprises a fluid thermostat.

29. A room, building or the like (10; 110; 210), including a passive ventilation stack (20; 120, 180; 220; 320, 380, 390; 420) as claimed in any of claims 1 to 20.

30. A room, building or the like (10; 110; 210) as claimed in claim 29 including at least one sensor in the interior space (25; 125, 175; 425), at least one said sensor in the room, building or the like (15, 17; 115; 417, 415), and at least one sensor located in the atmosphere external (35; 135; 435) to the interior space.

31. A room, building or the like (210) as claimed in claim 29 or claim 30, in which the interior space includes at least two said first openings (240) and at least two said second openings (230) provided at spaced locations on the room, building or the like.

32. A room, building or the like (10; 110; 210) as claimed in claim 29 or claim 30 or claim 31 in which the interior space is located at the top of the room, building or the like.

33. A room, building or the like (10; 110; 210) as claimed in claim 29, in which at least one splitter plate (255) is provided within said interior space to assist mixing of air in said interior space.

Patentansprüche

1. Passiver Lüftungskamin (20; 120, 180; 220; 320, 380, 390; 420) für einen Raum, ein Gebäude oder dergleichen (10; 110; 210), wobei der Kamin einen Innenraum (41), eine erste Öffnung (40; 240; 340), die im Gebrauch eine Zwei-Wege-Fluidkommunikation zwischen dem Innenraum und dem zu belüftenden Raum, Gebäude oder dergleichen vorsieht, und eine zweite Öffnung (30; 230; 370; 430) hat, die im Gebrauch eine Zwei-Wege-Fluidkommunikation zwischen dem Innenraum und der Umgebungsatmosphäre vorsieht, wobei der Innenraum im Gebrauch einen Mischraum für Luft, die in den Kamin ausgehend von dem Raum eintritt, und Luft vorsieht, die in den Kamin ausgehend von der Umgebungsatmosphäre eintritt, sowie ein Steuer- bzw. Regelsystem zum Variieren der Größe von wenigstens einer der ersten und zweiten Öffnungen hat.

2. Passiver Lüftungskamin (120, 180; 320, 380, 390; 420) nach Anspruch 1, der des Weiteren einen zweiten Innenraum benachbart dem ersten Innenraum aufweist, wobei die zweite Öffnung eine Strömungskommunikation zwischen dem ersten Innenraum und dem zweiten Innenraum vorsieht, wobei der zweite Innenraum eine dritte Öffnung (170) aufweist, die eine Fluidkommunikation zwischen dem zweiten Innenraum und der Umgebungsatmosphäre vorsieht.

3. Passiver Lüftungskamin (20; 120, 180; 220; 320, 380, 390; 420) nach Anspruch 1 oder Anspruch 2, bei dem das Steuer- bzw. Regelsystem dafür ausgelegt ist, die Größe sowohl der ersten Öffnung (40; 240; 340) als auch der zweiten Öffnung (30; 230; 370) zu variieren.

4. Passiver Lüftungskamin (20; 120, 180; 220; 320, 380, 390; 420) nach Anspruch 1 oder Anspruch 2, bei dem die Größe der ersten Öffnung (40; 240; 340) und die Größe der zweiten Öffnung (30; 230; 370) unabhängig voneinander variierbar sind.

5. Passiver Lüftungskamin (20; 120, 180; 220; 320, 380, 390; 420) nach einem der Ansprüche 1 bis 4, bei dem der Kamin im Wesentlichen den einzigen Einlass für die Umgebungsatmosphäre in den zu belüftenden Raum, das Gebäude oder dergleichen (10; 110; 210) vorsieht.

6. Passiver Lüftungskamin (20; 120, 180; 220; 320, 380, 390; 420) nach einem der Ansprüche 1 bis 5, bei dem der Kamin im Wesentlichen den einzigen Auslass für die Raumluft aus dem zu belüftenden Raum, Gebäude oder dergleichen (10; 110; 210) vorsieht.

7. Passiver Lüftungskamin (20; 120, 180; 220; 320, 380, 390; 420) nach einem der Ansprüche 1 bis 6, bei dem das Steuer- bzw. Regelsystem einen elektrischen Schrittmotor aufweist.

8. Passiver Lüftungskamin (20; 120, 180; 220; 320, 380, 390; 420) nach einem der Ansprüche 1 bis 6, bei dem das Steuer- bzw. Regelsystem ein Fluidthermostat aufweist.

9. Passiver Lüftungskamin (120, 180; 320, 380, 390) nach einem der Ansprüche 1 bis 8, der wenigstens zwei solcher passiver Lüftungskamine in Reihe angeordnet aufweist.

10. Passiver Lüftungskamin (120, 180; 320, 380, 390) nach Anspruch 9, bei dem eine dritte, unabhängig variierbare Öffnung (170; 330) zwischen den wenigstens zwei passiven Lüftungskaminen vorgesehen ist, um eine Fluidkommunikation zwischen diesen vorzusehen.

11. Passiver Lüftungskamin (320, 380, 390) nach Anspruch 2, der des Weiteren eine äußere Haube (385) aufweist, die über der dritten Öffnung (370) angeordnet ist.

12. Passiver Lüftungskamin (320, 380, 390) nach Anspruch 2 oder Anspruch 11, bei dem der zweite Innenraum des Weiteren eine Abtrennung (360) aufweist, die den zweiten Innenraum wenigstens teilweise in erste und zweite Strömungskanäle unterteilt, wobei sich jeder Strömungskanal im Wesentlichen zwischen der zweiten Öffnung (320) und der dritten Öffnung (370) erstreckt.

13. Passiver Lüftungskamin (320, 380, 390) nach Anspruch 12, bei dem sich die Abtrennung (360) vollständig zwischen der zweiten Öffnung (330) und der äußeren Haube (385) erstreckt.

14. Passiver Lüftungskamin (420, 480, 490) nach Anspruch 2 oder nach einem der Ansprüche 11 bis 13, der des Weiteren einen dritten Innenraum aufweist, der sich zwischen dem ersten Innenraum und dem zu belüftenden Raum, Gebäude oder dergleichen erstreckt.

15. Passiver Lüftungskamin (420, 480, 490) nach Anspruch 14, wobei der dritte Innenraum eine Abtrennung (460) aufweist, die sich im Wesentlichen zwischen der ersten Öffnung und dem zu belüftenden Raum, Gebäude oder dergleichen erstreckt.

16. Passiver Lüftungskamin (20; 120, 180; 220; 320, 380, 390; 420, 480, 490) nach einem der Ansprüche 1 bis 15, der des Weiteren wenigstens einen Sensor (15, 17, 25, 35; 115, 125, 175, 135; 415, 425, 435, 417) aufweist, wobei die Ausgabe des Sensors eine Eingabe für die Steuerungs- und Regelungsvorrichtung vorsieht.

17. Passiver Lüftungskamin (20; 120, 180; 220; 320, 380, 390; 420, 480, 490) nach Anspruch 16, der wenigstens einen weiteren Sensor aufweist, der in dem zu belüftenden Raum, Gebäude oder dergleichen angeordnet werden kann.

18. Passiver Lüftungskamin (20; 120, 180; 220; 320, 380, 390; 420, 480, 490) nach Anspruch 16 oder Anspruch 17, bei dem der Sensor ein Temperatursensor oder ein CO_2-Sensor ist.

19. Passiver Lüftungskamin (320, 380, 390; 420, 480, 490) nach einem der vorhergehenden Ansprüche, bei dem eine zusätzliche Kraftquelle (352, 354, 356; 452, 454) vorgesehen ist, um das Mischen der Luft in dem Innenraum zu unterstützen.

20. Passiver Lüftungskamin (320, 380, 390; 420, 480, 490) nach Anspruch 19, bei dem die zusätzliche Kraftquelle (352, 354, 356; 452, 454) ein Ventilator ist.

21. Verfahren zum Belüften eines Raums, Gebäudes oder dergleichen (10; 110; 210), das eine erste Öffnung (40; 240; 340) in einem oberen Bereich des Raums, Gebäudes oder dergleichen hat, wobei die erste Öffnung in Fluidkommunikation mit einem Innenraum steht, der sich im Wesentlichen angrenzend an den Raum, das Gebäude oder dergleichen befindet, wobei der Innenraum eine zweite Öffnung (30; 230; 370; 420) hat, die eine Fluidkommunikation mit der Atmosphäre vorsieht, und wenigstens eine von der ersten Öffnung und der zweiten Öffnung von variabler Größe ist, wobei das Verfahren die Schritte des Steuerns bzw. Regelns der Größe der ersten Öffnung oder des Steuerns bzw. Regelns der Größe der zweiten Öffnung derart umfasst, dass die Raumluft in dem oberen Bereich über die erste Öffnung in den Innenraum strömt und Belüftungsluft von der Atmosphäre her in den Innenraum durch die zweite Öffnung eintritt, um einen Wärmeaustausch zu bewirken, indem in dem Innenraum relativ warme Raumluft und relative kühle Belüftungsluft gemischt werden, so dass eine angewärmte Belüftungsluft in den Raum, das Gebäude oder dergleichen eingeleitet wird und Raumluft von dem oberen Bereich in die Atmosphäre strömt, und zwar im Wesentlichen ohne eine externe Kraft.

22. Verfahren zum Belüften eines Raums, Gebäudes oder dergleichen (10; 110; 210) nach Anspruch 21, wobei der Innenraum eine zweite Öffnung (170; 330) hat, die eine Fluidkommunikation mit einem zweiten Innenraum vorsieht, der zweite Innenraum eine dritte Öffnung hat, die eine Fluidkommunikation mit der Atmosphäre vorsieht, wobei der Verfahrensschritt des Steuerns bzw. Regelns der Größe der ersten Öffnung oder des Steuerns bzw. Regelns der Größe der zweiten Öffnung bewirkt, dass Raumluft in dem oberen Bereich über die erste Öffnung in den Innenraum strömt und Belüftungsluft aus der Atmosphäre in den zweiten Innenraum durch die dritte Öffnung eintritt und in den Innenraum durch die zweite Öffnung strömt, um einen Wärmeaustausch zu bewirken, indem in dem Innenraum relativ warme Raumluft und relativ kühle Belüftungsluft derart gemischt werden, dass eine angewärmte Belüftungsluft in den Raum,, das Gebäude oder dergleichen eingeleitet wird und die Raumluft von dem oberen Bereich des Raums in die Atmosphäre strömt, und zwar im Wesentlichen ohne eine externe Kraft.

23. Verfahren nach Anspruch 21 oder Anspruch 22, bei dem die erste Öffnung (40; 240; 340) und die zweite Öffnung (30; 230; 370; 430) von variabler Größe sind, wobei das Verfahren des Weiteren das Variieren der Größe sowohl der ersten Öffnung als auch der zweiten Öffnung umfasst.

24. Verfahren nach Anspruch 22 oder Anspruch 23, bei dem die Größe der ersten Öffnung (40; 240; 340) und die Größe der zweiten Öffnung (30; 230; 370; 430) unabhängig voneinander durch ein Steuer bzw. Regelsystem steuer- bzw. regelbar sind.

25. Verfahren nach einem der Ansprüche 20 bis 24, das den weiteren Schritt des Erhaltens von Lufttemperaturmessungen in dem Innenraum, außerhalb des Innenraums und in dem zu belüftenden Raum oder Gebäude und des Steuerns bzw. Regelns der Größe der ersten Öffnung (40; 240; 340) und der zweiten Öffnung (30; 230; 370; 430) auf der Basis der Lufttemperaturmessungen umfasst.

26. Verfahren nach Anspruch 25, das den weiteren Schritt des Erhaltens einer CO_2-Konzentrations-Messung in dem zu belüftenden Raum oder Gebäude und des Steuerns bzw. Regelns der Größe der ersten Öffnung (40; 240; 340) und der zweiten Öffnung (30; 230; 370; 430) auf der Basis der CO_2-Konzentrations-Messung umfasst.

27. Verfahren nach Anspruch 24 oder Anspruch 25 oder Anspruch 26, bei dem das Steuer- bzw. Regelsystem einen elektrischen Schrittmotor aufweist.

28. Verfahren nach Anspruch 24 oder Anspruch 25 oder Anspruch 26, bei dem das Steuer- bzw. Regelsystem ein Fluidthermostat aufweist.

29. Raum, Gebäude oder dergleichen (10; 110; 210), der bzw. das einen passiven Lüftungskamin (20; 120, 180; 220; 320, 380, 390; 420) nach einem der Ansprüche 1 bis 20 aufweist.

30. Raum, Gebäude oder dergleichen (10; 110; 210) nach Anspruch 29, der bzw. das wenigstens einen Sensor in dem Innenraum (25; 125, 175; 425), wenigstens einen Sensor in dem Raum, Gebäude oder dergleichen (15, 17; 115; 417, 415) und wenigstens einen Sensor aufweist, der sich in der Atmosphäre außerhalb (35; 135; 435) des Innenraums befindet.

31. Raum, Gebäude oder dergleichen (210) nach Anspruch 29 oder Anspruch 30, bei dem der Innenraum wenigstens zwei erste Öffnungen (240) und wenigstens zwei zweite Öffnungen (230) aufweist, die an beabstandeten Stellen in dem Raum, Gebäude oder dergleichen vorgesehen sind.

32. Raum, Gebäude oder dergleichen (10; 110; 210) nach Anspruch 29 oder Anspruch 30 oder Anspruch 31, bei dem sich der Innenraum oben auf dem Raum, Gebäude oder dergleichen befindet.

33. Raum, Gebäude oder dergleichen (10; 110; 210) nach Anspruch 29, bei dem wenigstens eine Aufsplittplatte (255) in dem Innenraum vorgesehen ist, um das Mischen von Luft in dem Innenraum zu unterstützen.

Revendications

1. Colonne de ventilation passive (20 ; 120, 180 ; 220 ; 320, 380, 390 ; 420) pour une chambre, un bâtiment ou similaire (10 ; 110 ; 210), la colonne comprenant un espace intérieur (41), une première ouverture (40 ; 240 ; 340) qui, lors de l'utilisation, assure une communication fluidique dans les deux sens entre l'espace intérieur et la chambre, le bâtiment ou similaire à ventiler, et une deuxième ouverture (30 ; 230 ; 370 ; 430) qui, lors de l'utilisation, assure une communication fluidique dans les deux sens entre l'espace intérieur et l'atmosphère ambiante, l'espace intérieur, lors de l'utilisation, fournissant un espace de mélange pour l'air entrant dans la colonne depuis la chambre et l'air entrant dans la colonne depuis l'atmosphère ambiante, et un système de commande permettant de modifier la taille de l'au moins une des première et deuxième ouvertures.

2. Colonne de ventilation passive (120, 180 ; 320, 380, 390 ; 420) selon la revendication 1, comprenant en outre un deuxième espace intérieur adjacent au premier espace intérieur, la deuxième ouverture assurant une communication fluidique entre le premier espace intérieur et le deuxième espace intérieur, le deuxième espace intérieur comprenant une troisième ouverture (170) assurant une communication fluidique entre le deuxième espace intérieur et l'atmosphère ambiante.

3. Colonne de ventilation passive (20 ; 120, 180 ; 220 ; 320, 380, 390 ; 420) selon la revendication 1 ou la revendication 2, dans laquelle le système de commande est conçu pour modifier la taille de la première ouverture (40 ; 240 ; 340) et de la deuxième ouverture (30 ; 230 ; 370).

4. Colonne de ventilation passive (20 ; 120, 180 ; 220 ; 320, 380, 390 ; 420) selon la revendication 1 ou la revendication 2, dans laquelle la taille de la première ouverture (40 ; 240 ; 340) et la taille de la deuxième ouverture (30 ; 230 ; 370) sont modifiables de manière indépendante.

5. Colonne de ventilation passive (20 ; 120, 180 ; 220 ; 320, 380, 390 ; 420) selon l'une quelconque des revendications 1 à 4, dans laquelle la colonne fournit essentiellement la seule entrée de l'atmosphère ambiante dans la chambre, le bâtiment ou similaire (10 ; 110 ; 210) à ventiler.

6. Colonne de ventilation passive (20 ; 120, 180 ; 220 ; 320, 380, 390 ; 420) selon l'une quelconque des revendications 1 à 5, dans laquelle la colonne fournit essentiellement la seule sortie de l'air ambiant hors de la chambre, du bâtiment ou similaire (10 ; 110 ; 210) à ventiler.

7. Colonne de ventilation passive (20 ; 120, 180 ; 220 ; 320, 380, 390 ; 420) selon l'une quelconque des revendications 1 à 6, dans laquelle le système de commande comprend un moteur pas à pas électrique.

8. Colonne de ventilation passive (20 ; 120, 180 ; 220 ; 320, 380, 390 ; 420) selon l'une quelconque des revendications 1 à 6, dans laquelle le système de commande comprend un thermostat à fluide.

9. Colonne de ventilation passive (120 ; 180 ; 320, 380, 390) selon l'une quelconque des revendications 1 à 8, comprenant au moins deux desdites colonnes de ventilation passive disposées en série.

10. Colonne de ventilation passive (120, 180 ; 320, 380, 390) selon la revendication 9, dans laquelle une troisième ouverture (170 ; 330) modifiable de manière indépendante est prévue entre les colonnes de ventilation passive au moins au nombre de deux pour assurer une communication fluidique entre elles.

11. Colonne de ventilation passive (320, 380, 390) selon la revendication 2, comprenant en outre un capot extérieur (385) disposé au-dessus de la troisième ouverture (370) .

12. Colonne de ventilation passive (320, 380, 390) selon la revendication 2 ou la revendication 11, dans laquelle le deuxième espace intérieur comprend en outre une cloison (360) divisant le deuxième espace intérieur au moins en partie en un premier et un deuxième passage de flux, chaque passage de flux s'étendant essentiellement entre la deuxième ouverture (330) et la troisième ouverture (370).

13. Colonne de ventilation passive (320, 380, 390) selon la revendication 12, dans laquelle la cloison (360) s'étend complètement entre la deuxième ouverture (330) et le capot extérieur (385).

14. Colonne de ventilation passive (420, 480, 490) selon la revendication 2 ou selon l'une quelconque des revendications 11 à 13, comprenant en outre un troisième espace intérieur s'étendant entre le premier espace intérieur et la chambre, le bâtiment ou similaire à ventiler.

15. Colonne de ventilation passive (420, 480, 490) selon la revendication 14, le troisième espace intérieur comprenant une cloison (460) s'étendant essentiellement entre la première ouverture et la chambre, le bâtiment ou similaire à ventiler.

16. Colonne de ventilation passive (20 ; 120, 180 ; 220 ; 320, 380, 390 ; 420, 480, 490) selon l'une quelconque des revendications 1 à 15, comprenant en outre au moins un capteur (15, 17, 25, 35 ; 115, 125, 175, 135 ; 415, 425, 435, 417) dont la sortie fournit une entrée au dispositif de commande.

17. Colonne de ventilation passive (20 ; 120, 180 ; 220 ; 320, 380, 390 ; 420, 480, 490) selon la revendication 16, comprenant au moins un capteur supplémentaire pouvant être situé dans la chambre, le bâtiment ou similaire à ventiler.

18. Colonne de ventilation passive (20 ; 120, 180 ; 220 ; 320, 380, 390 ; 420, 480, 490) selon la revendication 16 ou la revendication 17, dans laquelle le capteur est un capteur de température ou un capteur de CO_2.

19. Colonne de ventilation passive (320, 380, 390 ; 420, 480, 490) selon l'une quelconque des revendications précédentes, dans laquelle une source de puissance supplémentaire (352, 354, 356 ; 452, 454) est prévue pour aider à mélanger l'air dans ledit espace intérieur.

20. Colonne de ventilation passive (320, 380, 390 ; 420, 480, 490) selon la revendication 19, dans laquelle la source de puissance supplémentaire (352, 354, 356 ; 452, 454) est un ventilateur.

21. Procédé de ventilation d'une chambre, d'un bâtiment ou similaire (10 ; 110 ; 210) ayant une première ouverture (40 ; 240 ; 340) dans une région supérieure de ladite chambre, dudit bâtiment ou similaire, ladite première ouverture étant en communication fluidique avec un espace intérieur essentiellement adjacent à la chambre, au bâtiment ou similaire, ledit espace intérieur ayant une deuxième ouverture (30 ; 230 ; 370 ; 420) assurant une communication fluidique avec l'atmosphère, et au moins une parmi la

première ouverture et la deuxième ouverture étant de taille variable, le procédé comprenant les étapes de commande de la taille de la première ouverture ou de commande de la taille de la deuxième ouverture, de telle sorte que l'air ambiant dans ladite région supérieure passe via ladite première ouverture dans l'espace intérieur et l'air de ventilation provenant de l'atmosphère entre dans l'espace intérieur à travers la deuxième ouverture pour provoquer l'échange thermique par mélange dans ledit espace intérieur de l'air ambiant relativement chaud et de l'air de ventilation relativement froid, de telle sorte que l'air de ventilation chauffé passe dans la chambre, le bâtiment ou similaire et l'air ambiant de la région supérieure passe à l'atmosphère, essentiellement sans puissance externe.

22. Procédé de ventilation d'une chambre, d'un bâtiment ou similaire (10 ; 110 ; 210) selon la revendication 21, ledit espace intérieur ayant une deuxième ouverture (170 ; 330) assurant une communication fluidique avec un deuxième espace intérieur, le deuxième espace intérieur ayant une troisième ouverture assurant une communication fluidique avec l'atmosphère, dans lequel l'étape de procédé de commande de la taille de la première ouverture ou de commande de la taille de la deuxième ouverture fait passer l'air ambiant de ladite région supérieure via ladite première ouverture dans l'espace intérieur et l'air de ventilation provenant de l'atmosphère entre dans le deuxième espace intérieur à travers la troisième ouverture et dans l'espace intérieur à travers la deuxième ouverture pour provoquer l'échange thermique par mélange dans ledit espace intérieur de l'air ambiant relativement chaud et de l'air de ventilation relativement froid, de telle sorte que l'air de ventilation chauffé passe dans la chambre, le bâtiment ou similaire, et l'air ambiant provenant de la région supérieure de la chambre passe à l'atmosphère, essentiellement sans puissance externe.

23. Procédé selon la revendication 21 ou la revendication 22, dans lequel la première ouverture (40 ; 240 ; 340) et la deuxième ouverture (30 ; 230 ; 370 ; 430) sont de taille variable, le procédé comprenant en outre l'étape consistant à modifier la taille de la première ouverture et de la deuxième ouverture.

24. Procédé selon la revendication 22 ou la revendication 23, dans lequel la taille de la première ouverture (40 ; 240 ; 340) et la taille de la deuxième ouverture (30 ; 230 ; 370 ; 430) peuvent être commandées de manière indépendante par un système de commande.

25. Procédé selon l'une quelconque des revendications 20 à 24, comprenant l'étape supplémentaire consistant à obtenir des mesures de la température de l'air dans l'espace intérieur, à l'extérieur de l'espace intérieur et dans la chambre ou le bâtiment à ventiler, et à commander la taille de la première ouverture (40 ; 240 ; 340) et de la deuxième ouverture (30 ; 230 ; 370 ; 430) sur la base desdites mesures de la température de l'air.

26. Procédé selon la revendication 25, comprenant l'étape supplémentaire consistant à obtenir une mesure de la concentration de CO_2 dans la chambre ou le bâtiment à ventiler et à commander la taille de la première ouverture (40 ; 240 ; 340) et de la deuxième ouverture (30 ; 230 ; 370 ; 430) sur la base de ladite mesure de concentration de CO_2.

27. Procédé selon la revendication 24 ou la revendication 25 ou la revendication 26, dans lequel le système de commande comprend un moteur pas à pas électrique.

28. Procédé selon la revendication 24 ou la revendication 25 ou la revendication 26, dans lequel le système de commande comprend un thermostat à fluide.

29. Chambre, bâtiment ou similaire (10 ; 110 ; 210), comprenant une colonne de ventilation passive (20 ; 120, 180 ; 220 ; 320, 380, 390 ; 420) selon l'une quelconque des revendications 1 à 20.

30. Chambre, bâtiment ou similaire (10 ; 110 ; 210) selon la revendication 29, comprenant au moins un capteur dans l'espace intérieur (25 ; 125, 175 ; 425), au moins un dit capteur dans la chambre, le bâtiment ou similaire (15, 17 ; 115 ; 417, 415) et au moins un capteur situé dans l'atmosphère (35 ; 135 ; 435) extérieure à l'espace intérieur.

31. Chambre, bâtiment ou similaire (210) selon la revendication 29 ou la revendication 30, dans lequel l'espace intérieur comprend au moins deux desdites premières ouvertures (240) et au moins deux desdites deuxièmes ouvertures (230) prévues à des endroits espacés de la chambre, du bâtiment ou similaire.

32. Chambre, bâtiment ou similaire (10 ; 110 ; 210) selon la revendication 29 ou la revendication 30 ou la revendication 31, dans lequel l'espace intérieur est situé au niveau de la partie supérieure de la chambre, du bâtiment ou similaire.

33. Chambre, bâtiment ou similaire (10 ; 110 ; 210) selon la revendication 29, dans lequel au moins une plaque de répartition (255) est prévue à l'intérieur dudit espace intérieur pour aider à mélanger l'air dans ledit espace intérieur.

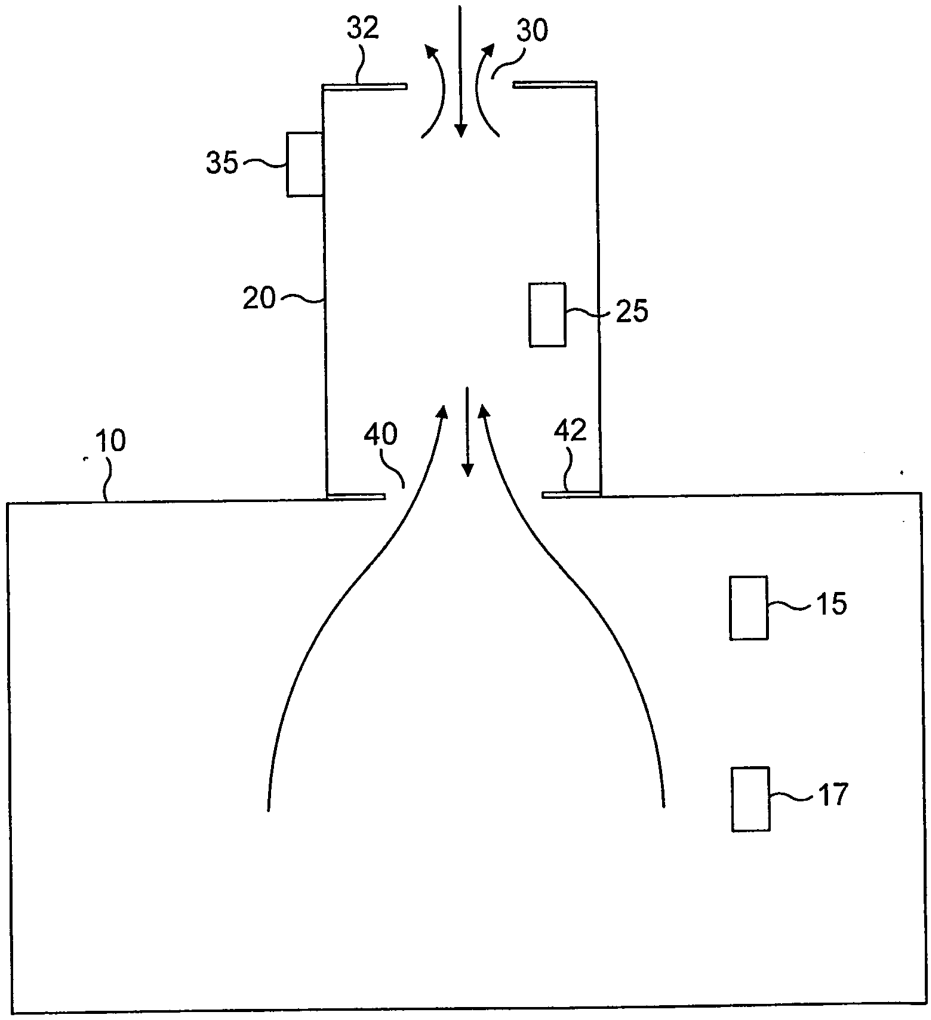


FIG. 1

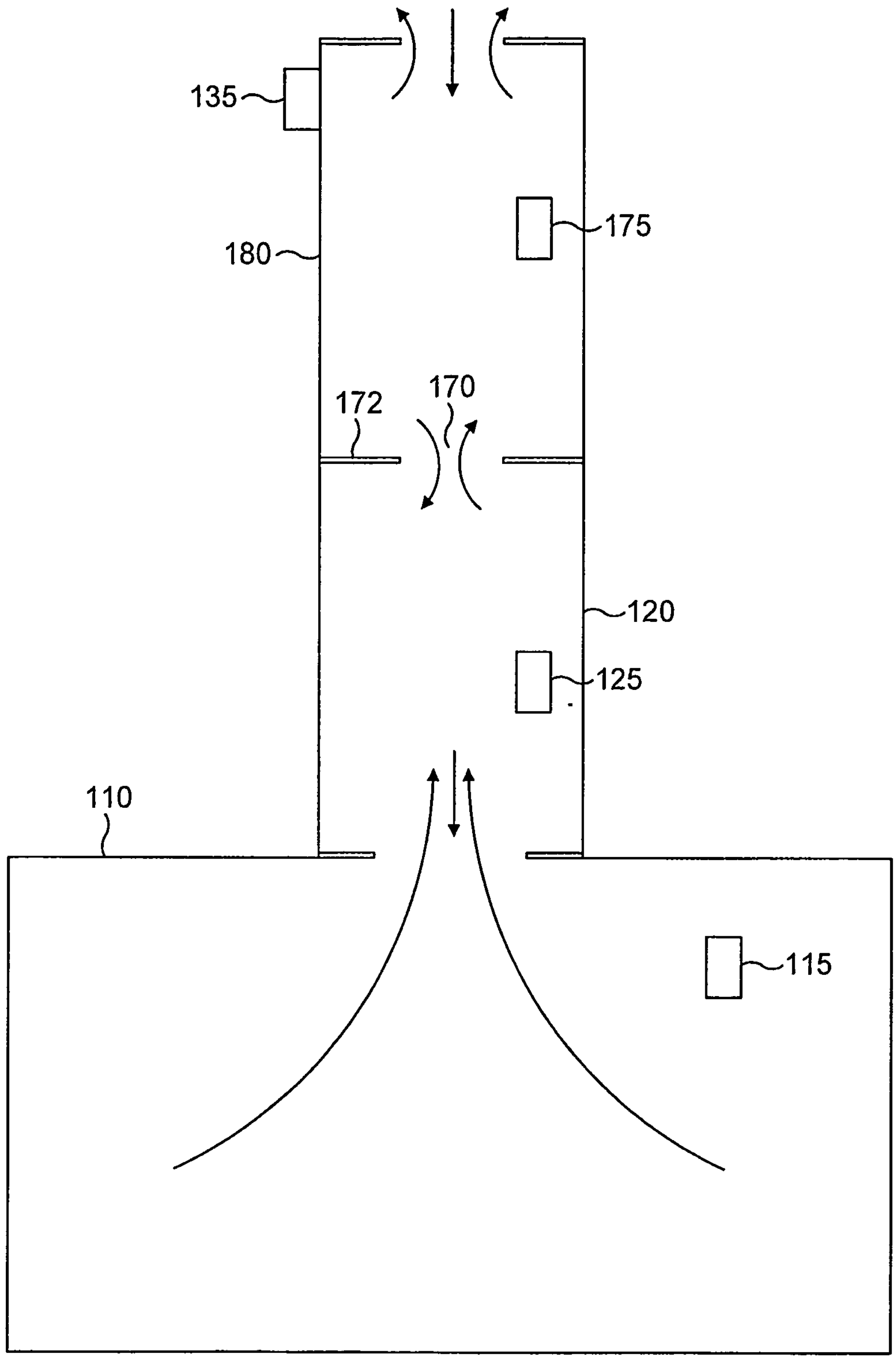


FIG. 2

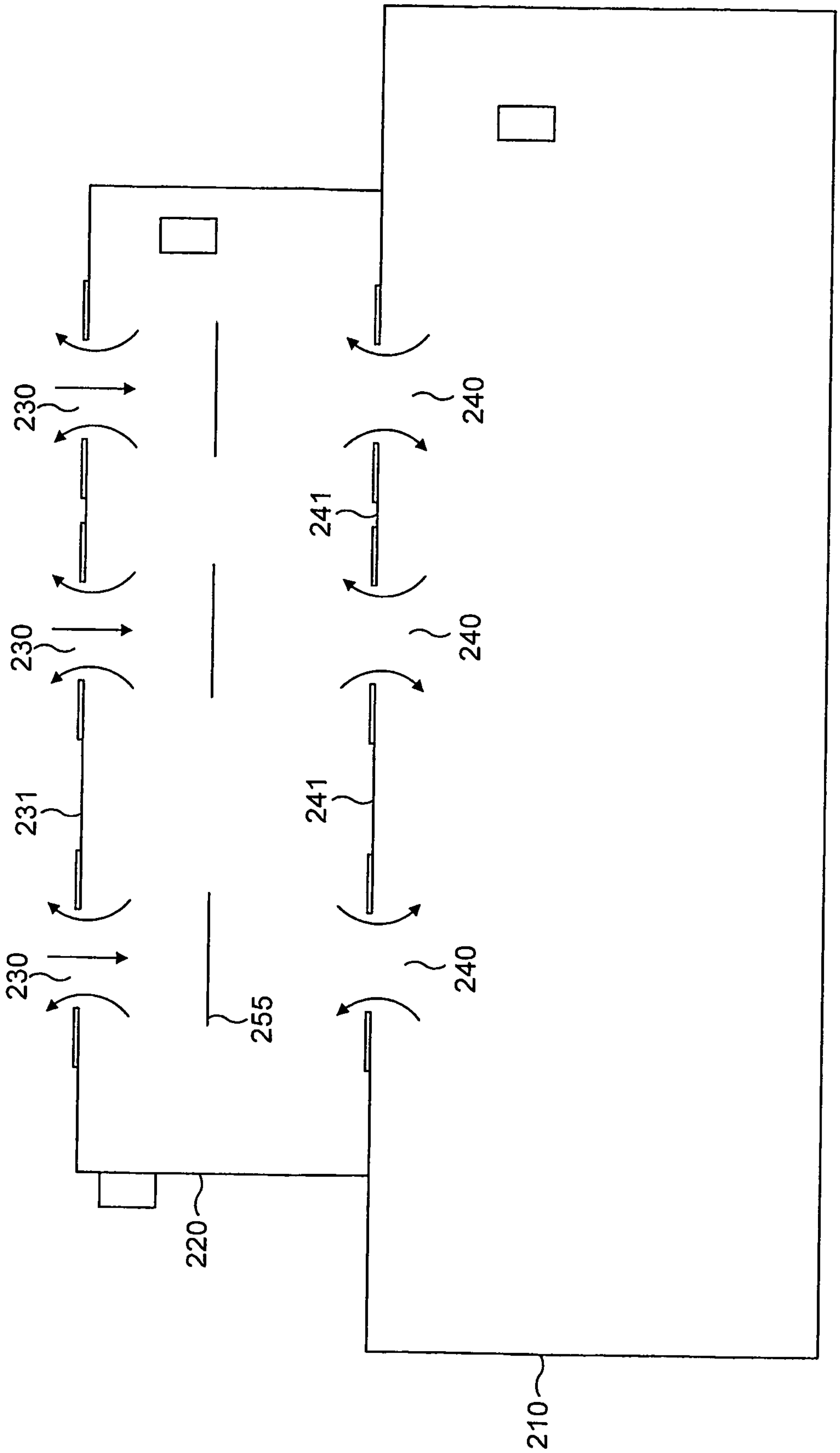
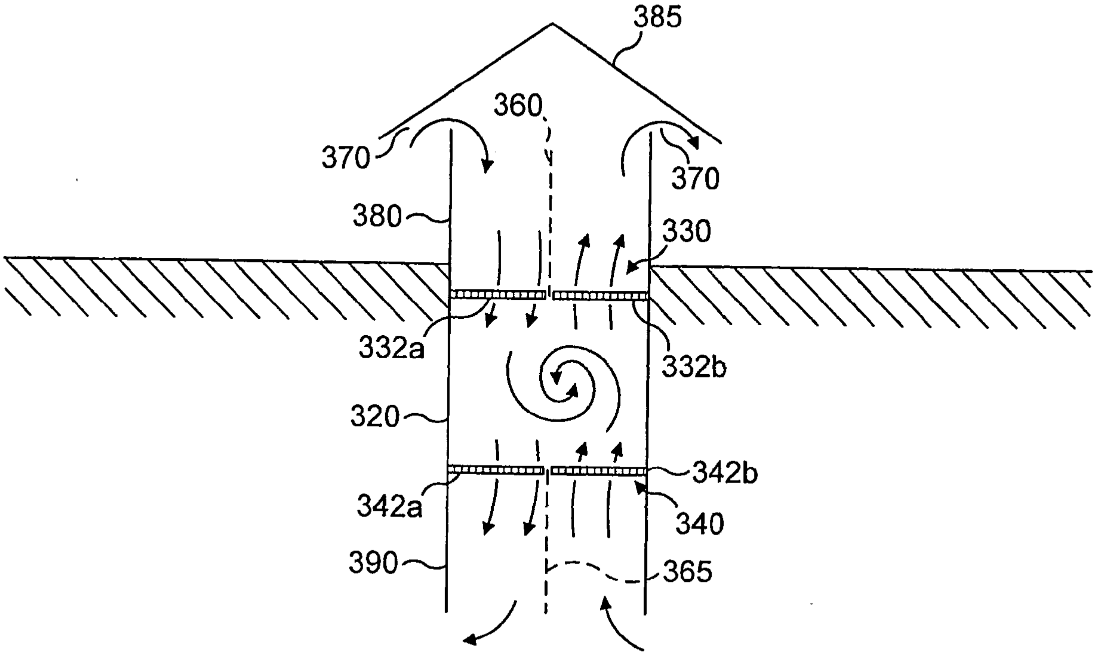


FIG. 3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330
332a
332b
320
342b
342a
340
390
365

FIG. 4

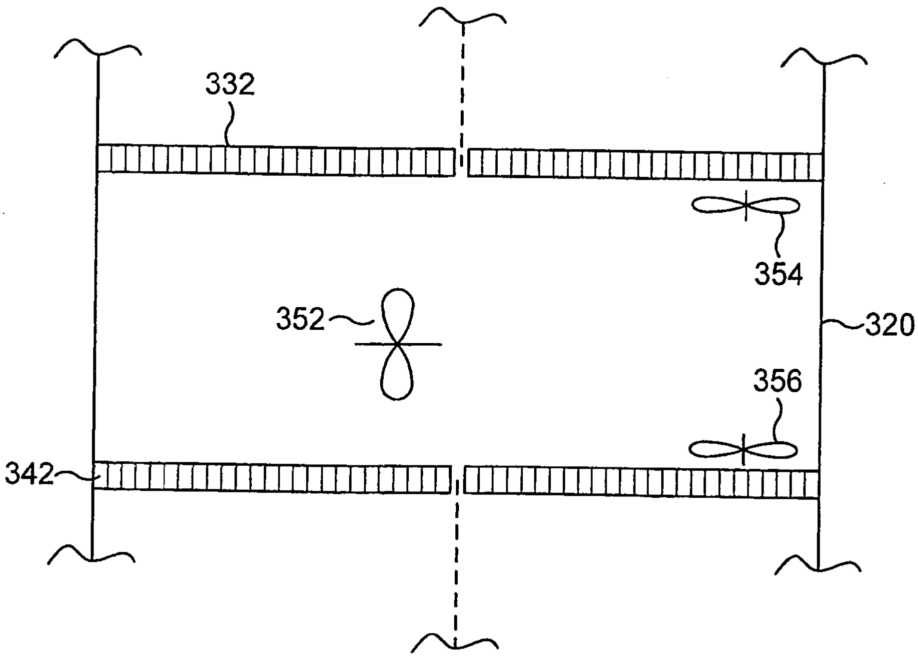
332
354
352
320
356
342

FIG. 5

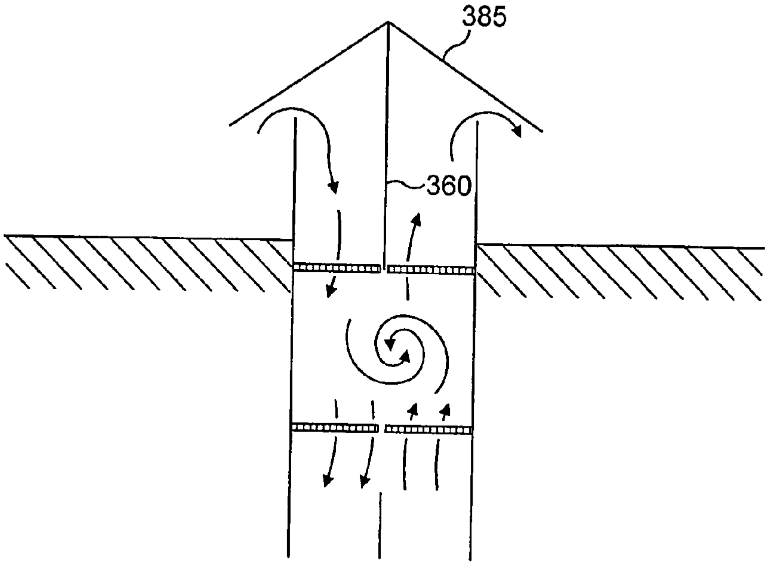
385
360

FIG. 6

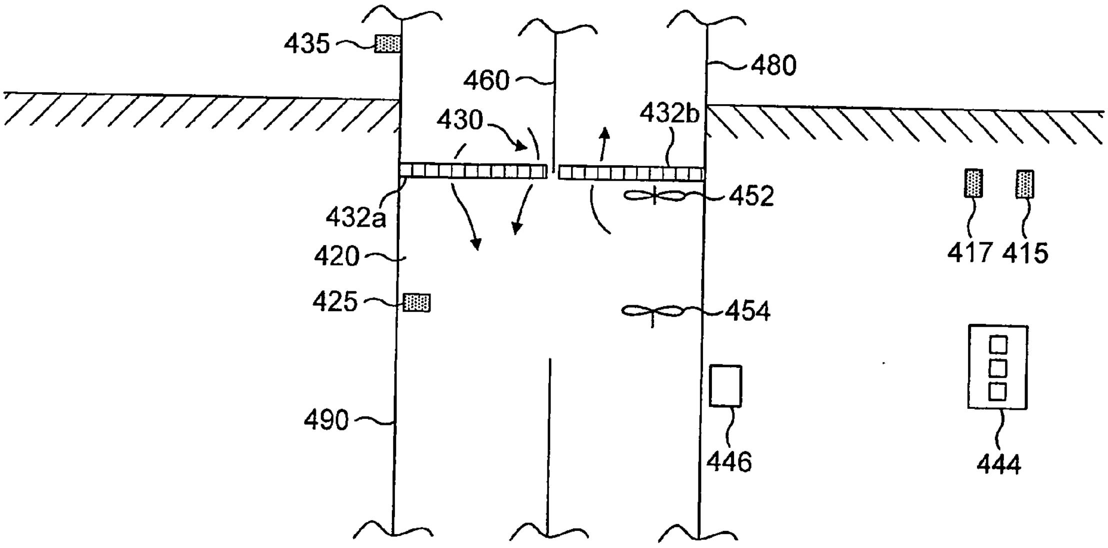
435
460
480
430
432b
432a
452
420
425
454
490
446
417 415
444

FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 58130920 B **[0004]**