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Buhlmann(10) **Pub. No.: US 2005/0103483 A1**(43) **Pub. Date: May 19, 2005**(54) **VENTILATION DEVICE AND METHOD FOR ITS OPERATION**(52) **U.S. Cl. 165/158; 165/135; 165/109.1**(76) **Inventor: Bernhard Buhlmann, Zurich (CH)**(57) **ABSTRACT**

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INDIANAPOLIS, IN 46204-5137 (US)**(21) **Appl. No.: 10/927,896**(22) **Filed: Aug. 27, 2004**(30) **Foreign Application Priority Data**

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An inlet chamber (7) having an air supply inlet (8) and an outlet chamber (10) having an air supply outlet (11) are connected by pipes (13) which run in the longitudinal direction through a cavity (12) which is connected to a waste air inlet (16) via a supply line section (19) running counter to it and has a waste air outlet (17) with a fan (18) at the end adjacent to the inlet chamber (7). The cavity (12) together with the pipes (13) forms a countercurrent heat exchanger for transferring heat between the waste air and the air supply. Between the waste air inlet (16) and a passage (15) connecting the supply line section (19) to the cavity (12) at that end of said supply line section which is adjacent to the outlet chamber (10), a partition (14) separating the supply line section (19) from the cavity (12) there has a plurality of openings (20a, 20b, 20c) which are staggered in the direction of flow and in each case produce, for a part of the waste air stream, short-circuit connections bridging a part of the cavity (12).

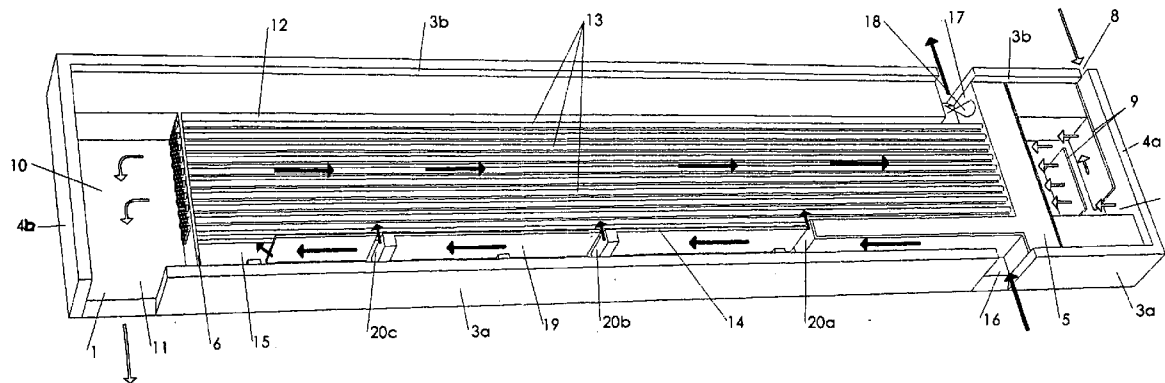
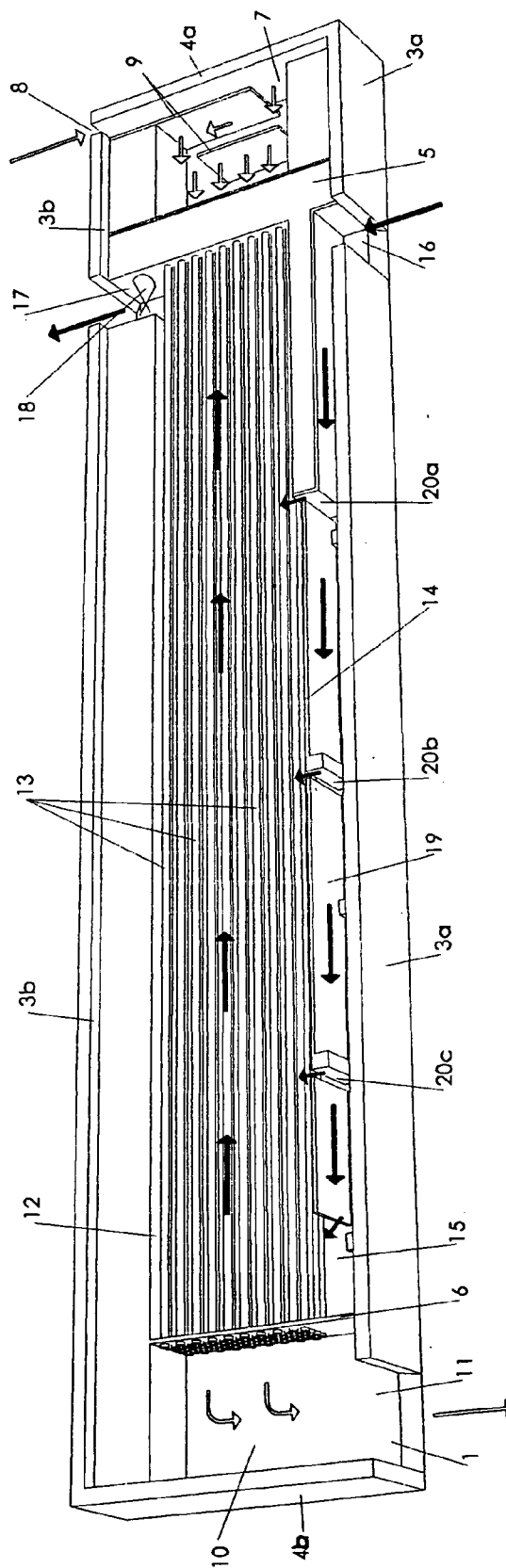


Fig. 1



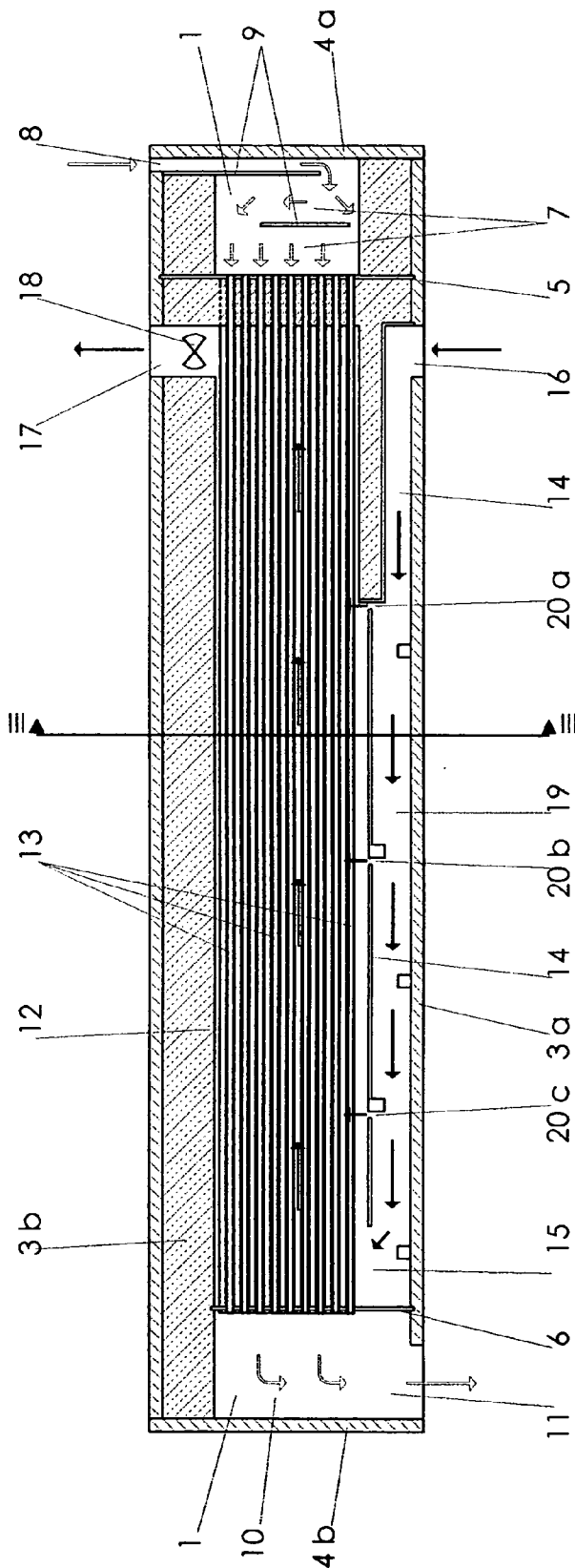


Fig. 2

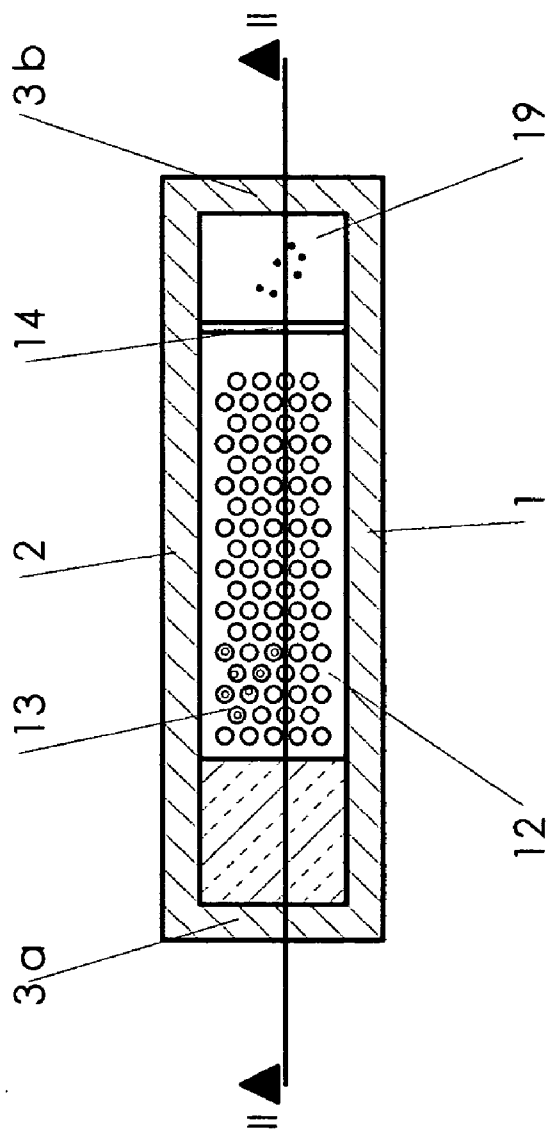


Fig. 3

VENTILATION DEVICE AND METHOD FOR ITS OPERATION

FIELD OF THE INVENTION

[0001] The invention relates to a ventilation device according to the precharacterizing clause of claim 1. Such ventilation devices make it possible to replace waste air from a closed room by air which is supplied from outside and exchanges heat with the waste air. The invention also relates to a method for operating a ventilation device according to the invention.

[0002] Prior Art

[0003] Many ventilation devices which comprise a countercurrent heat exchanger have already been described. Thus, EP 1 308 678 A1 discloses a ventilation device of the generic type which can be installed, for example, in a window and in which a dual channel which consists of an air supply channel and a waste air channel closely thermally coupled therewith is led in a serpentine manner in a cuboid housing. The device is very compact and can also easily be retrofitted. Owing to the sharp deflections, the flow is substantially turbulent and the efficiency is relatively high. The length of the dual channel can moreover easily be adapted to the requirements which are set for the ventilation device with regard to the efficiency.

[0004] DE 33 47 028 A1 discloses a ventilation device which is integrated in a window frame. The air supply channel and the waste air channel are each led almost completely around the window, over a part of the circumference as a dual channel, which is deflected at two corners of the window frame by 90° in each case. This arrangement requires a great deal of space and can be used practically only in the form described, i.e. with integration in a window frame or the like. The length of the dual channel and hence the degree of achievable heat exchange are determined substantially by the dimensions of the window frame. The flow is likely to have relatively little turbulence, so that the heat transfer tends to be small owing to the formation of laminar flow, in any case unless additional measures are taken, for example heat exchanger ribs are provided.

[0005] In a similar ventilation device according to DE 32 30 279 A1, the dual channel extends only over one side of the window frame. Here, the heat transfer is likely to be relatively slight in spite of heat exchanger ribs or a, concentric path of the air supply channel.

[0006] DE 34 26 778 A1 describes a ventilation device which can likewise be installed, for example, in a crossbeam of a window frame. Here, air supply channel and waste air channel are divided into straight channel segments separated by lamellae so that air supply and waste air channels alternate. The design of the apparatus is therefore relatively complex. The more numerous and narrower the channel segments are for the purpose of effective heat transfer, the higher is the resistance to flow.

[0007] WO 96/12 145 A1 discloses a basically similar ventilation device in which the channel segments are arranged concentrically and have a helical shape. This ventilation device is likely to have the same disadvantages as the last-mentioned one. In particular, the design is very complex and the production is likely to be correspondingly expensive.

SUMMARY OF THE INVENTION

[0008] It is the object of the invention to improve the efficiency of known ventilation devices of the generic type. This object is achieved by the features in the characterizing clause of claim 1. Claim 18 describes an advantageous mode of operation of the ventilation device according to the invention.

[0009] It has been found that the efficiency is substantially increased by the measures according to the invention. At the same time, the ventilation device according to the invention can be designed to be compact and can have relatively low resistance to flow. Furthermore, troublesome development of noise can be kept very low. It can have a simple design and be capable of being manufactured correspondingly economically.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Below, the invention is explained in more detail with reference to figures which show only one embodiment.

[0011] FIG. 1 shows a perspective view of the air cooling element according to the invention, obliquely from above, with a ceiling removed,

[0012] FIG. 2 shows a horizontal longitudinal section through the ventilation element according to the invention of FIG. 1, corresponding to II-II in FIG. 3, and

[0013] FIG. 3 shows a cross-section through the ventilation element according to the invention, along III-III in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] The ventilation device comprises a cuboid housing having a base 1, a ceiling 2, side walls 3a,b and end walls 4a,b. The interior of the housing is further divided by two intermediate walls 5, 6 parallel to the end walls 4a,b. Between the first intermediate wall 5 and the end wall 4a is a short inlet chamber 7 which is connected to the outer space by a narrow rectangular air supply inlet 8. Deflecting walls 9 which are parallel to the end wall 4b and in each case extend over a part of the cross-section are installed as turbulence-generating baffles in the inlet chamber 8. Between the second intermediate wall 6 and the end wall 4b opposite the end wall 4a is a short outlet chamber 10 which is connected by a rectangular air supply outlet 11 in the side wall 3a to the space to be ventilated.

[0015] Between the first intermediate wall 5 and the second intermediate wall 6 is a relatively long cavity 12 of rectangular cross-section. Parallel pipes 13 which are a distance apart laterally and connect the inlet chamber 8 to the outlet chamber 10, are led through the first intermediate wall 5, run in the longitudinal direction through the cavity 12, distributed approximately uniformly over the cross-section, and pass through the second intermediate wall 6. On the side facing away from the inlet chamber 8, the first intermediate wall 5 has an insulating layer so that the inlet chamber 8 is thermally insulated from the cavity 12. The side wall 3b, too, has on its inside an insulating layer which thermally insulates the inlet chamber 8, the cavity 12 and the outlet chamber 10 from the outside. Similarly, in the inlet chamber 8, the side wall 3a has an insulating layer on the

inside so that the inside chamber **8** is also thermally insulated from the room to be ventilated.

[0016] Arranged parallel to the side wall **3a** is a partition **14** which extends from the first intermediate wall **5** towards the second intermediate wall **6** in such a way that a rectangular passage **15** to the cavity **12** remains free there. Adjacent to the first intermediate wall **5**, a rectangular waste air inlet **16** passes through the side wall **3a**. A rectangular waste air outlet **17** in which a fan **18** is mounted passes through the opposite side wall **3b**, likewise adjacent to the first intermediate wall **5**.

[0017] The cavity **12** together with the pipes **13** forms a countercurrent heat exchanger having an exchange section of an air supply channel which connects the air supply inlet **8** to the air supply outlet **11** and is formed by the space enclosed by the pipes **13**, while the remaining part of the cavity **12** forms an exchange section of a waste air channel connecting the waste air inlet **16** to the waste air outlet **17**. The two exchange sections have a close heat-conducting connection through the pipes **13**. The region located between the side wall **3a** and the partition **14** forms a supply line section **19** of the waste air channel, which section connects the waste air inlet **16** to the exchange section of the waste air channel and, running counter to the exchange section, extends up to the passage **15**.

[0018] The supply line section **19** is connected to the cavity **12** by a plurality of short-circuit connections staggered in the longitudinal direction—in the example three of said connections. They are formed by openings in the partition **14** which are in the form of narrow slots **20a,b,c**. By means of projections on the partition **14**, constrictions are created in each case directly before the slots **20b,c** so that the supply line section **19** widens directly at the slots **20b,c**. At the slot **20a**, the supply line section **19** likewise widens since, up to this opening, the partition **14** comprises an insulating layer thermally insulating the supply line section **19** from the cavity **11** and hence from the exchange section of the waste air channel and is therefore thicker. Between the slots **20a,b,c** and the passage **15**, the supply line section **19** has further constrictions which are formed by projections on the side wall **3a**.

[0019] Suitable materials for the base **1**, the cover **2**, the side walls **3a,b**, the end walls **4a,b**, the intermediate walls **5**, **6**, the deflecting walls **9** and the partition **14** are wood, metal, plastic, pressboards and the like, it being possible for the insulating layers to consist of foam, e.g. polyurethane foam. The pipes **13** must consist of material having good thermal conductivity. Metals, such as aluminium, steel or copper, are suitable.

[0020] The waste air stream is shown in the figures by means of a single arrow and the air supply stream by means of a double arrow. By means of the fan **18**, waste air is sucked out of the room to be ventilated through the waste air channel and is ejected. Noise pollution of the room is substantially avoided by the arrangement of the fan **18** in the region of the waste air outlet **17**. The waste air passes through the waste air inlet **16** into the ventilation device and flows through the supply line section **19** and the exchange section in the cavity **12** to the waste air outlet **17**. As a result of the reduced pressure generated in the room to be ventilated, fresh air is sucked in at the air supply inlet **8** and is passed through the air supply channel and the air supply

outlet **11** into the room. Owing to leaks in the room, the air supply stream is usually smaller than the waste air stream.

[0021] A part of the waste air stream remains up to the passage **15**, where it is deflected through **1800** and passes into the cavity **12**, in the air supply section **19**, where it is thermally insulated from the exchange section of the air supply channel. Other parts thereof are, however, branched off upstream of the passage **15** through the slots **20a,b,c** out of the air supply section **19** and pass further downstream into the waste air stream in the cavity **12**, i.e. into the exchange section of the waste air channel. Parts of the cavity **12** are therefore bridged by the slots **20a,b,c**, the entry point of the short-circuit connection being the further downstream in the cavity **12** the further upstream its branching point is located in the air supply section **19**. The bridged part is relatively short in the case of the slot **20c** but is substantially more than half the length of the cavity **12** in the case of the slot **20a**.

[0022] The slots **20a,b,c** are dimensioned so that they each branch off about 10-15% of the total waste air stream, and the proportion of the waste air stream which in this way bypasses a smaller or larger part of the exchange section of the waste air channel is altogether about 25-50%. It has been found that this short-circuiting of parts of the exchange section by parts of the waste air stream surprisingly improves the efficiency of the ventilation device.

[0023] Various modifications of the ventilation device described are possible. Inter alia, the roles of the waste air channel and of the air supply channel can be substantially interchanged. It is also possible to provide a fan in the air supply channel too. In order as substantially as possible to avoid noise in the room to be ventilated, fans should where possible always be arranged at that end of the waste air channel and optionally of the air supply channel which faces the outer space.

List of Reference Symbols

- [0024] **1** Base
- [0025] **2** Cover
- [0026] **3a,b** Side walls
- [0027] **4a,b** End walls
- [0028] **5** First intermediate wall
- [0029] **6** Second intermediate wall
- [0030] **7** Inlet chamber
- [0031] **8** Air supply inlet
- [0032] **9** Deflecting walls
- [0033] **10** Outlet chamber
- [0034] **11** Air supply outlet
- [0035] **12** Cavity
- [0036] **13** Pipes
- [0037] **14** Partition
- [0038] **15** Passage
- [0039] **16** Waste air inlet
- [0040] **17** Waste air outlet
- [0041] **18** Fan

[0042] 19 Supply line section

[0043] 20a,b,c Openings

1. Ventilation device comprising a first channel which connects a first inlet to a first outlet and a second channel which connects a second inlet to a second outlet, a first exchange section which forms a section of the first channel and a second exchange section which forms a section of the second channel forming a heat exchanger in that they are led diametrically oppositely and have a heat-conducting connection, characterized in that the first inlet is connected to at least one entry point located downstream of the beginning of the first exchange section, via a short-circuit connection which bridges that part of the first exchange section which is located between the beginning and the entry point.

2. Ventilation device according to claim 1, characterized in that the first channel has a supply line section (19) which connects the first inlet to the beginning of the first exchange section and of which the at least one short-circuit connection branches off at a branching point located downstream of the first inlet.

3. Ventilation device according to claim 2, characterized in that it has a plurality of short-circuit connections, the entry points of which are staggered in sequence downstream in the first exchange section while their branching points are staggered in sequence upstream in the supply line section (19).

4. Ventilation device according to claim 2 or 3, characterized in that at least a part of the supply line section (19) is arranged adjacent to the first exchange section and running counter to the same.

5. Ventilation device according to claim 4, characterized in that the short-circuit connection is formed in each case as an opening through a partition (14) separating the supply line section (19) from the first exchange section.

6. Ventilation device according to claim 5, characterized in that the opening is in each case in the form of a slot (20a, 20b, 20c).

7. Ventilation device according to claim 4 or 5, characterized in that the supply line section (19) widens directly at the opening.

8. Ventilation device according to any of claims 2 to 7, characterized in that the supply line section (19) has a plurality of constrictions.

9. Ventilation device according to any of claims 2 to 8, characterized in that at least one part of the supply line

section (19) which may be upstream of the first branching point is thermally insulated from the heat exchanger.

10. Ventilation device according to any of claims 1 to 9, characterized in that the heat exchanger is in the form of an elongated cavity (12) having a plurality of pipes (13) which pass through said cavity in the longitudinal direction and whose interior forms the second exchange section, while the remaining part of the cavity (12) forms the first exchange section.

11. Ventilation device according to claim 10, characterized in that the pipes (13) are parallel.

12. Ventilation device according to claim 10 or 11, characterized in that the pipes (13) are connected to the second inlet via an inlet chamber (7) separated by a first intermediate wall (5) through which the pipes (13) are led.

13. Ventilation device according to claim 12, characterized in that the inlet chamber (7) has turbulence-generating baffles.

14. Ventilation device according to claim 12 or 13, characterized in that the inlet chamber (7) is thermally insulated from the cavity (12).

15. Ventilation device according to any of claims 10 to 14, characterized in that the pipes (13) are connected to the second outlet via an outlet chamber (10) separated from the cavity (12) by a second intermediate wall (6) through which the pipes (13) are led.

16. Ventilation device according to any of claims 12 to 15, characterized in that the first inlet and the first outlet are arranged directly at the first intermediate wall (5).

17. Ventilation device according to any of claims 1 to 16, characterized in that a fan (18) is arranged in the region of the first outlet.

18. Method for operating the ventilation device according to any of claims 1 to 17 for ventilating a heated or cooled room, characterized in that the first channel is used as a waste air channel, with the first inlet as waste air inlet (16) arranged in the room and the first outlet as waste air outlet (17) arranged outside the room, and the second channel as air supply channel, with the second inlet as air supply inlet (8) arranged outside the room and the second outlet as air supply outlet (11) arranged in the room.

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