

(19)



(11)

EP 3 032 184 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

15.06.2016 Bulletin 2016/24

(51) Int Cl.:

F24F 7/08 (2006.01)

(21) Application number: 14196995.6

(22) Date of filing: 09.12.2014

(84) Designated Contracting States:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR

Designated Extension States:

BA ME

(71) Applicant: Halton OY

47400 Kausala (FI)

(72) Inventors:

- Mustakallio, Panu
45100 Kouvola (FI)
- Borowiecki, Pawel
05-420 Józefów (PL)

• Bejczy-Kovács, László

2330 DUNAHARASZTI (HU)

• Grönvall, Ismo

45160 Kouvola (FI)

• Vuorimaa, Pekka

47400 Kausala (FI)

• Hagström, Kim

15520 Lahti (FI)

• Hyötynen, Kimmo

15540 Villähde (FI)

• Kosonen, Risto

01650 Vantaa (FI)

(74) Representative: Papula Oy

P.O. Box 981

00101 Helsinki (FI)

(54) Air supply element

(57) An air supply element (1) comprising a switching device (10, 10a) configured to switch the operation mode between a first mode (A) and a second mode (B), an inlet chamber (4) for supplying supply air (L4) and comprising at least a first inlet (12) for supplying air into the inlet chamber, an exhaust chamber (5) for receiving room air (L2) from the room space and comprising at least a first outlet (13) for removing room air from the exhaust cham-

ber; a first opening (6) and a second opening (7) separated from each other and leading to the switching device and towards the room space; in the first mode: the switching device connects the inlet chamber to the first opening and the exhaust chamber to the second opening, and in the second mode: the switching device connects the inlet chamber to the second opening and the exhaust chamber to the first opening.

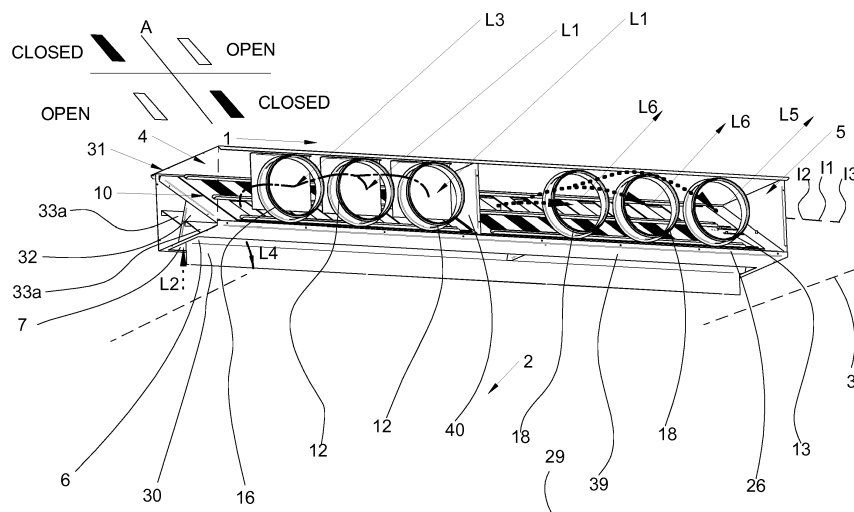


Fig. 3a

EP 3 032 184 A1

Description

BACKGROUND

[0001] The present invention relates to air supply equipment. Furthermore, the invention discloses an air supply element, a system and a method for supplying air to a room space and removing air from the room space.

[0002] An air supply element is used to supply and remove air from a room space. The air supply element does not usually comprise a heating and cooling element. The heated or cooled air may be arranged from (an) external air supply unit(s). The first air supply unit may be a central air handling unit in the building for fresh air, which might supply also recirculated air in some ventilation systems, and there also might be a second separate room-specific air heating-cooling unit such as a fan-coil or heat pump, which supplies heated, cooled and recirculated air to the room space. According to one solution an air supply unit is a combination of the central air handling unit and the fan-coil or heat pump. A separate supply source and a separate removal/exhaust source may operate as independent units. The location of supply and removal/exhaust sources is traditionally static in mixing ventilation; air is supplied from one location and removed/exhausted from another, both most often at the ceiling level. When cooling the room space, the air is supplied uniformly along the ceiling, and the air removal/exhaust source is usually located at the ceiling level near the opposite wall of the window wall, depending what is easiest for ducting. In that situation, supply air is distributed evenly, generating desired thermal conditions, but due to that and due to the location of the air removal/exhaust source, all heat loads from the window wall are mixed into room air, causing an increased peak cooling demand and a significant horizontal temperature gradient in the room space from the window wall. When heating the room with supply air, this traditional air distribution can easily cause temperature stratification and low ventilation effectiveness in the room, when the warm air supply air jet does not reach the lower part of the room space, and the ceiling level air removal/exhaust further decreases the effectiveness by removing warm air.

[0003] The objective of at least one of the example embodiments is to eliminate or at least alleviate at least some of the problems mentioned above.

SUMMARY

[0004] According to one aspect, there is provided an air supply element for supplying air into a room space, configured to be installed in connection with the ceiling of the room space. The air supply element comprises a switching device configured to switch the operation mode of the air supply element between a first mode and a second mode in response to the switching device receiving at least one control signal. The air supply element further comprises an inlet chamber for supplying supply

air to the room space, wherein the inlet chamber leads to the switching device and comprises at least a first inlet for supplying air into the inlet chamber; the air supply element further comprises an exhaust chamber for receiving room air from the room space, wherein the exhaust chamber leads to the switching device and comprises at least a first outlet for removing at least part of the room air from the exhaust chamber and from the room space. The air supply element further comprises a first opening and a second opening separated from each other and leading to the switching device and towards the room space, wherein the switching device is arranged between the chambers and the openings in such a way that in the first mode: the switching device is arranged to connect the inlet chamber to the first opening and the exhaust chamber to the second opening, and in the second mode: the switching device is arranged to connect the inlet chamber to the second opening and the exhaust chamber to the first opening. Connecting a chamber to an opening means, for example, opening a passage between the chamber and the opening, allowing the air flow between the opening and the chamber.

[0005] In one embodiment of the air supply element the first inlet is arranged to supply circulated air into the inlet chamber. In one embodiment of the air supply element the inlet chamber comprises a second inlet for supplying fresh air to the inlet chamber. In one embodiment of the air supply element, supply air further comprises fresh air and circulated air, wherein the supply chamber is arranged to combine the fresh air and the circulated air into supply air in the supply chamber.

[0006] In one embodiment of the air supply element the first inlet is arranged to receive the circulated air from an air supply unit configured to change the temperature of the circulated air. In one embodiment of the air supply element the exhaust chamber comprises at least a second outlet, wherein the exhaust chamber is arranged to divide the room air between the outlets in such a way that the first outlet is arranged to receive a first part of the room air to be removed from the room space and the second outlet is arranged to receive a second part of the room air to be removed from the exhaust chamber and to be circulated back to the first inlet via the air supply unit.

[0007] In one embodiment of the air supply element the control signal is based on temperature information or occupant control. In one embodiment of the air supply element the switching device is configured to switch the first mode in response to a first control signal caused by a temperature measurement value being larger than a temperature reference value, wherein the switching device is configured to switch the second mode in response to a second control signal caused by the temperature measurement value being smaller than the temperature reference value. In one embodiment of the air supply element the first mode is a cooling mode and the second mode is a heating mode.

[0008] In one embodiment of the air supply element the switching device further comprises a slotted plate and

a slotted base plate below the first slotted plate for enabling part of slots to open and part of slots to close in response to a reciprocating motion of the slotted plate caused by an actuator. In one embodiment of the air supply element the switching device further comprises a slotted plate and a slotted base plate below the first slotted plate for enabling part of slots to open and part of slots to close in response to a reciprocating motion of the slotted plate. In one embodiment of the air supply element the switching device comprises an actuator, which is arranged to reciprocate the slotted plate. In one embodiment of the air supply element the switching device comprises a linear actuator. In one embodiment of the air supply element the switching device comprises an electric motor. In one embodiment of the air supply element the slotted plate comprises plastic.

[0009] In one embodiment of the air supply element a bottom side of the air supply element is configured to be installed above an object with a variable temperature in the room space. In one embodiment of the air supply element a bottom side of the air supply element is configured to be installed above an object with a variable temperature in the room space, wherein a temperature of an inner side face of the target wall differs substantially from (the) temperature(s) of inner faces of other walls in the room space.

[0010] In one embodiment of the air supply element a longitudinal side of the air supply element is configured to be installed substantially parallel to a target wall of the room space, wherein the temperature of the target wall varies substantially. In one embodiment of the air supply element a longitudinal side of the air supply element is configured to be installed substantially parallel to a target wall of the room space, wherein the temperature of an inner side face of the target wall varies substantially from (the) temperature(s) of inner faces of other walls in the room space.

[0011] In one embodiment of the air supply element the target wall is an exterior side wall or a wall comprising a window. In one embodiment the air supply element is arranged to be located above a window of the room space. The air supply element may be arranged to the ceiling near the window wall or exterior side wall or near the wall that has significantly larger temperature variations than other walls of the room. This enables to reduce the feeling of draft.

[0012] In one embodiment of an air supply system the air supply system comprises a first guiding element configured to be connectable to the first opening, wherein the first guiding element is arranged to be placed at a first distance from the target wall and a second guiding element configured to be connectable to the second opening, wherein the second guiding element is arranged to be placed at a second distance from the target wall, wherein the first distance is further from the target wall than the second distance.

[0013] In one embodiment of an air supply system the air supply system comprises a first guiding element con-

figured to be connectable to the first opening, wherein the first guiding element is arranged to be placed at a first distance from the target wall, wherein a temperature of an inner side face of the target wall differs substantially from (the) temperature(s) of other inner faces of other walls in the room space, and a second guiding element configured to be connectable to the second opening, wherein the second guiding element is arranged to be placed at a second distance from the target wall, wherein the first distance is further from the target wall than the second distance.

[0014] In one embodiment of the air supply system, in the first mode: the first guiding element is configured to guide the supply air along the ceiling away from the target wall and the second guiding element is configured to receive the room air from the target wall side to be removed.

[0015] In one embodiment of the air supply system, in the second mode: the first guiding element is configured to receive the room air substantially from a side of the room space which is opposite to the target wall to be removed and the second guiding element is configured to guide the supply air towards a floor of the room space. In one embodiment of the air supply system, in the second mode: the first guiding element is configured to receive the room air substantially from any other sources other than the target wall to be removed and the second guiding element is configured to guide the supply air towards a floor of the room space.

[0016] In one embodiment of the air supply system, in the second mode: the first diffuser is configured to receive the room air substantially from the room air substantially from a side of the room space which is opposite to the target wall to be removed and the second guiding element is configured to guide the supply air along the ceiling towards the target wall.

[0017] In one embodiment of the air supply system the target wall is at least one of an exterior side wall and a window wall.

[0018] In one embodiment of the air supply system the first guiding element comprises a first diffuser and the second guiding element comprises a second diffuser. In one embodiment of the air supply system the first guiding element comprises a first diffuser block and the second guiding element comprises a second diffuser block, wherein the first diffuser block and the second diffuser block are arranged in a divided diffuser.

[0019] According to another aspect, there is provided a method for supplying air to a room space and removing air from the room space with the air supply system. The air is supplied and removed by:

- guiding the supply air along the ceiling away from the target wall with the first guiding element and receiving the room air from the target wall side for removing it with the second guiding element in response to the first mode,
- receiving the room air substantially from a side of the room space which is opposite to the target wall,

for removing it with the first guiding element and guiding the supply air towards a floor of the room space or in the ceiling direction towards the target wall with the second guiding element in response to the second mode.

[0020] The air supply element and the air supply system described herein have many significant advantages. The current technology for arranging ventilation supply and exhaust air terminals in the room is based most often on separate devices. In some cases, supply and exhaust air terminals are integrated into one unit, but without any active components between them changing the direction of air as described above. The benefits of the solutions explained above are for example better indoor climate conditions and energy efficiency in different operating conditions when comparing to the solutions based on the current technology. This is based on optimal operation of supply and exhaust air terminals in cooling and heating conditions, especially when the air supply element is located near the external façade with windows or other heat loads in the room. This reduces the uncomfortable feeling of variable temperatures or draft inside a room space.

[0021] The air supply can be switched according to outside climate changes. This is advantageous because winter and summer have different needs, which can be taken into account with the air supply element and with the air supply system.

[0022] Optimal operation in the cooling mode is achieved when cool supply air is directed to a first guiding element, such as a first diffuser, distributing the air along the ceiling away from the target wall, façade or a heat source, and room air is taken from a second guiding element, such as a second diffuser, from the top of the heat load to be delivered to the exhaust chamber and further to be removed from the room space.

[0023] In the heating mode, warm supply air is delivered to the second guiding element, such as a second diffuser, which is closer to the target wall or façade that emanates cold. The warm air is directed downwards or against the cold. The warm air is mixed to the room air effectively, creating good and uniform indoor climate conditions. As the warm air is directed downwards against cold, the cold is prevented from spreading along the floor into the room.

[0024] In one embodiment the control of the air supply element is based on occupant control. This may be arranged from a control panel where the occupant can easily change the operation modes and the element switches the operation mode according to the action performed on the control panel. This improves the usability of the air supply element. The control panel may have a screen which illustrates the current operation mode and, therefore, the operating of the air supply element is easy for anyone.

[0025] Although some of the advantages are described in the context of the target wall, as known to those skilled

in the art, the air supply element may be arranged above many different types of objects with a variable temperature.

[0026] The embodiments of the invention described herein may be used in any combination with each other. Several or at least two of the embodiments may be combined together to form a further embodiment of the invention. A method or a device to which the invention is related may comprise at least one of the embodiments of the invention described hereinbefore.

[0027] It is to be understood that any of the above embodiments or modifications can be applied singly or in combination to the respective aspects to which they refer, unless they are explicitly stated as excluding alternatives. Many of the attendant features will be more readily appreciated as they become better understood by reference to the following detailed description considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The present description will be better understood from the following detailed description read in light of the accompanying drawings, wherein:

Figures 1a - 1b are schematical example illustrations of an air supply element and an air supply system;

Figures 2a - 2b are schematical example illustrations of an air supply element and an air supply system;

Figure 3a - 3b are example illustrations of an air supply element;

Figure 4a - 4b are example illustrations of a switching device;

Figure 5 is a schematical example illustration of an air supply element;

Figure 6 is an example illustration of an air supply system in the first mode;

Figure 7 is an example illustration of an air supply system in the second mode; and

Figure 8 is an example illustration of an air supply system in the second mode.

DETAILED DESCRIPTION

[0029] The detailed description provided below in connection with the appended drawings is intended as a description of the present examples and is not intended to represent the only forms in which the present example may be constructed or utilized. Reference will now be

made in detail to the embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0030] Figures 1a - 1b are schematical example illustrations of an air supply element 1, 1a and an air supply system 14a. Figures 1a and 1b disclose examples of the air supply element 1, 1a for supplying air into a room space 2. The air supply element 1, 1a is configured to be installed in connection with the ceiling 3 of the room space 2. This can be done by attaching it to two guiding elements 8, 9, such as diffusers, or to one diffuser which is divided into a first diffuser block and a second diffuser block. The guiding elements 8, 9 are arranged in such a way that the air supply element 1, 1a may be mounted on top of them and the air supply element 1, 1a is connected to the ceiling 3 via the guiding elements 8, 9. In this example the guiding elements 8, 9 are arranged directly above a target wall 11, which emanates cold or warm depending on the outside temperature.

[0031] The air supply element 1, 1a of the air supply system 14a, 14b comprises a switching device 10, 10a configured to switch the operation mode of the air supply element 1, 1a between a first mode A and a second mode B in response to the switching device 10, 10a receiving at least one control signal I1, 12, 13. The air supply element 1, 1a further comprises an inlet chamber 4 for supplying supply air L4 to the room space 2, wherein the inlet chamber 4 leads to the switching device 10, 10a and comprises at least a first inlet 12 for supplying circulated air L1 into the inlet chamber 4. The air supply element 1, 1a further comprises an exhaust chamber 5 for receiving room air L2 from the room space 2, wherein the exhaust chamber 5 leads to the switching device 10, 10a and comprises at least a first outlet 13 for removing at least part of the room air L2 from the exhaust chamber 5 and from the room space 2. The air supply element 1, 1a further comprises a first opening 6 and a second opening 7 separated from each other and leading to the switching device 10, 10a and towards the room space 2. The switching device 10, 10a is arranged between the chambers 4, 5 and the openings 6, 7. The opening 6, 7 may be formed as a chamber that has an open passage to lead the airflow out of or in to the chamber.

[0032] Figure 1a discloses the switching device 10, 10a of the air supply element 1, 1a of the air supply system 14a in the first mode A, wherein the switching device 10, 10a is arranged to connect the inlet chamber 4 to the first opening 6 and the exhaust chamber 5 to the second opening 7. The first guiding element 8 is arranged at a first distance 24 from the target wall 11. The second guiding element 9 is arranged at a second distance 25 from the target wall 11. The length of the second distance 25 varies, and it depends on the size of the guiding elements 8, 9. The first distance 24 is further away from the wall than the second distance 25. The ceiling 3 is arranged at a first height 37 from the floor 29.

[0033] The first mode A may be used for cooling for example in the summer time. The first guiding element

8 is configured to guide the supply air L4 along the ceiling 3 away from the target wall 11 and the second guiding element 9 is configured to receive the room air L2 from the target wall 11 side to be removed. This feature is advantageous because the heat carried by the rising room air L2 can effectively be removed directly above the heat load emanating from the target wall 11. Further, the cool jet of the supply air L4 is not supplied directly towards the heat load but guided towards the ceiling 2. This enables the air to mix with the air on the opposite side of the room in relation to the target wall 11 and therefore create more uniform conditions in the room space 2. If the jet of the supply air L4 was directly guided in a direction of the heat emanating from the target wall 11, the occupant 15 near the target wall 11 might feel a sense of draught. This is eliminated or at least alleviated by guiding the jet of the supply air L4 towards the ceiling 3.

[0034] Figure 1b discloses the switching device 10, 10a of the air supply element 1, 1a of the air supply system 14a in the second mode B, wherein the switching device 10, 10a is arranged to connect the inlet chamber 4 to the second opening 7 and the exhaust chamber 5 to the first opening 6.

[0035] The first mode B may be used for heating for example in the winter time. The first guiding element 8 is configured to receive the room air L2 substantially from a side 38 of the room space 2 which is opposite to the target wall 11 to be removed and the second guiding element 9 is configured to guide the flow of the supply air L4 towards the floor 29 of the room space 2. In a case when the air supply element 1, 1a is arranged very far away from the target wall 11, for example the second dimension is over 1400mm, it might be more advantageous to direct the supply air L4 towards the floor 29. When the air supply element 1, 1a is this far away from the target wall 11, the jet of the supply air L4 might not have enough force firstly to travel along the ceiling 3 and secondly to travel down to the floor 29 level.

[0036] Figure 1a and 1b discloses examples of the guiding elements 8, 9. Each guiding element 8, 9 is equipped with a flow deflection element 42a, 42b, 42c. Vanes 28 of the flow deflection element 42a, 42b, 42c are arranged to be adjustable. The round face of the vane 28 guides the supply air L4 under the Coandă effect. As known to those skilled in the art, there are also other ways to arrange the guiding of the supply air L4 under the Coandă effect, and the supply system 14a, 14b is not limited to those structures of the guiding elements 8, 9 illustrated in Figure 1a and 1b, which are merely presented to illustrate some preferred embodiments of creating the desired guiding effect.

[0037] Figure 2a discloses an example of the switching device 10, 10a of the air supply element 1, 1a of the air supply system 14b in the first mode A. A second height 41 is further from the floor 29 than the first height 37. The positions of the vanes 28 of the flow deflection element 42c of the second guiding element 9 are set in different

positions than in Figure 1a. The operation and the air supply element 1, 1a is otherwise similar to that in Figure 1a.

[0038] Figure 2b discloses the switching device 10, 10a of the air supply element 1, 1a of the air supply system 14b in the second mode B. The first diffuser 8 is configured to receive the room air L2 substantially from a side 38 of the room space 2 which is opposite to the target wall 11 to be removed and the second guiding element 9 is configured to guide the supply air L4 in the ceiling 3 direction towards the target wall 11. This is advantageous for example when the ceiling is at a higher level than in Figures 1a and 1b. For example when the second height 41 is over 3000mm, it is perhaps more advantageous to guide the flow of supply air L4 towards the target wall 11, because the flow of supply air L4 may gain more force in the floor 29 direction when colliding with the target wall 11. This extra force is beneficial because the supply air L4 has a longer way to travel down to the floor 29 level than in the solution in Figure 1a and 1b. When the air supply element 1, 1a is arranged close to the target wall 11, for example when the second distance 25 may be from around 250mm up to around 500mm, it may be advantageous to guide the flow of the supply air L4 towards the target wall 11.

[0039] The jet of the supply air L4 can be collided with the target wall 11 in such a way that the supply air L4 can be guided down and mixed with the room air L2 in order to prevent air stratification.

[0040] Figure 3a - 3b are example illustrations of an air supply element 1. The air supply element 1 is illustrated without a side plate and without a front plate in order to illustrate the internal parts of the air supply element 1. The air supply element 1 disclosed in Figure 3a represents the solution presented in Figures 1a and 2a. The air supply element 1 comprises a box-shaped structure 31. Inside this box-shaped structure 31 there is provided the switching device 10. The switching device and the mid plate 40 separate two chambers 4, 5 in the box-shaped structure 31: an inlet chamber 4 and an exhaust chamber 5. The circulated air L1 is connected to the inlet chamber 4 via the first inlet 12 and fresh air L3 is connected to the inlet chamber 4 via a second inlet 16. The inlet chamber 4 is arranged to combine the fresh air L3 to the circulated air L1 for forming supply air L4 to be supplied to the room space 2.

[0041] Black slots block the passage of air and slots with no color let air pass through. The supply air L4 can be spread equally in one of the openings 6, 7 by leading the supply air L4 through net plates 33a, 33b. A first dividing plate 32 and the second dividing plate 30 separate the openings 6, 7 from each other. The supply air L4 and its route through the air supply element 1 is indicated with a dash-dot line and an arrow at the end of the dash-dot line. The route of the room air L2 is indicated with a dotted line and arrows. In the first mode A: the supply air L4 is led to the first opening 6 and the room air L2 is received from the second opening 7.

[0042] The first inlet 12 is arranged to receive the circulated air L1 from an air supply unit (not illustrated). The air supply unit is configured to change the temperature of the circulated air L1.

[0043] The exhaust chamber 5 further comprises at least a second outlet 18, wherein the exhaust chamber 5 is arranged to divide the room air L2 between the outlets 13, 18 in such a way that the first outlet 13 is arranged to receive a first part of the room air L5 to be removed from the room space 2 and the second outlet 18 is arranged to receive a second part of the room air L6 to be removed from the exhaust chamber 5 and to be circulated back to the first inlet 12 via the air supply unit.

[0044] The air supply element 1 disclosed in Figure 3b represents the example solution presented in Figures 1b and 2b. The structure of the air supply element 1 is the same as in Figure 3a; the only difference is that the switching device 10 is switched to a different position. In the second mode B: the supply air L4 is led to the second opening 7 and the room air L1 is received from the first opening 6.

[0045] Figures 4a - 4b are example illustrations of a switching device 10. Figure 4a discloses the switching device 10 in the first mode A. The switching device 10 comprises a slotted plate 20 and a slotted base plate 22 below the slotted plate 20 for enabling part of the slots 21 to open and part of the slots 21 to close in response to a reciprocating motion of the slotted plate 20. The reciprocating motion is enabled by an actuator 23. The slotted plate 20 has the slots 21 in a different spacing than the slotted base plate 22. By moving the slotted plate 20 left, part of the slots 21 close and part of the slots 21 open. The slots 21 that are closed are represented with a black color. Slots 21 that are open are represented with no color filling.

[0046] Figure 4b represents the switching device 10 in the second mode B. The slotted plate 20 is in its extreme position on the left.

[0047] The control signal I1, 12, 13 is arranged to the actuator 23, which is powered to move the slotted plate 20 according to the control signal I1, 12, 13. The switching device 10 is configured to switch the first mode A in response to a first control signal I1 caused by a temperature measurement value being larger than a temperature reference value, wherein the switching device 10 is configured to switch the second mode B in response to a second control signal 12 caused by the temperature measurement value 11 being smaller than the temperature reference value 9. The first control signal I1 and the second control signal 12 may be the same control signals if the actuator 23 is arranged to know in which direction it should be actuated. The first mode A is a cooling mode and the second mode B is a heating mode. The actuator 23 can be for example a linear actuator.

[0048] Figure 5 is a schematical example illustration of an air supply element 1a. The air supply element 1a is illustrated without a side plate, without a front plate and without a top plate in order to illustrate the internal parts

of the air supply element 1a. Figure 5 discloses another type of a switching device 10a. The switching device 10a is illustrated in the first mode A. The switching device 10a comprises a first flap 34 and a second flap 35, which are arranged on a common shaft 36 perpendicularly in relation to each other. The route of the supply air L4 and room air L2 is similar to the solution disclosed in Figure 3a. The first flap 34 is arranged so that the supply air L4 route from the inlet chamber 4 to the first opening 6 is open in the first mode A. The second flap 35 closes the first opening 6 and at the same time enables the room air L2 to be led from the second opening 7 to the exhaust chamber 5 and further to be removed via the outlets 18, 26 in the first mode A.

[0049] The fresh air L3 and the circulated air are similarly supplied to the inlet chamber 4 as in Figure 3a via inlets 16, 12. The position of the flaps in the second mode B is illustrated with dash-dot lines and arrows. This can be accomplished by rotating the common shaft 36 anti-clockwise as represented with arrows at the outer end of the flaps 34, 35. The actuator 23 can be a bi-directional electric motor, for instance. The control signal I1, 12, 13 is similarly led to the actuator 23 as in Figure 3a. An additional solution is to have one actuator (not illustrated) for each of the flaps 34, 35, and the flaps 34, 35 may be operated separately from each other (not illustrated).

[0050] Figure 6 is an example illustration of an air supply system 14a in the first mode A. The first mode A represents a cooling mode for example in the summer time. Figure 6 represents the solution illustrated in Figure 1a and comprises the air supply element 1 disclosed in Figure 3a. The air supply system 14a comprises the first guiding element 8, which is configured to be connected to the first opening 6. The first guiding element 8 is arranged to be placed at a first distance 24 from the target wall 11. The air supply system 14a comprises a second guiding element 9, which is configured to be connected to the second opening 7. The second guiding element 9 is arranged to be placed at a second distance 25 from the target wall 11, wherein the first distance 24 is further from the target wall 11 than the second distance 25. The first guiding element 8 is configured to guide the supply air L4 along the ceiling 3 away from the target wall 11 and the second guiding element 9 is configured to receive the room air L2 from the target wall 11 side to be removed. The guiding elements 8, 9 can be two different diffusers or one diffuser which is divided in the middle by the second dividing plate 30.

[0051] Figure 7 is an example illustration of an air supply system 14a in the second mode B. The second mode B represents a heating mode for example in the winter time. Figure 7 represents the solution illustrated in Figure 1b and comprises the air supply element 1 disclosed in Figure 3b. The first guiding element 8, such as a first diffuser (block), is configured to receive the room air L2 substantially from a side 38 of the room space 2 which is opposite to the target wall 11 to be removed and the second guiding element 9, such as a second diffuser

(block), is configured to guide the supply air L4 towards a floor 29 of the room space 2.

[0052] Figure 8 is an example illustration of an air supply system 14b in the second mode B. The second mode B represents a heating mode for example in the winter time. Figure 7 represents the solution illustrated in Figure 2b and comprises the air supply element 1 disclosed in Figure 3b. The first guiding element 8, such as a first diffuser (block), is configured to receive the room air L2 substantially from a side 38 of the room space 2 which is opposite to the target wall 11 to be removed and the second guiding element 9, such as a second diffuser (block), is configured to guide the supply air L4 in the ceiling 3 direction towards the target wall 11.

[0053] In all the Figures 6 to 8 the operation mode A, B can be switched according to the control signal I1, 12 or by an occupant 15. The occupant 15 can control the switching device 1 from a control panel 19 configured to send a third control signal 13. An air supply unit 17 is configured to supply heated or cooled circulated air L1. A control unit 22 of the air supply unit 17 compares the outside temperature to a reference value and determines whether the switching device 10 should be switched to the first mode A or to the second mode B. The control signal I1, 12 may be based on temperature information. Part of the room air L2 coming from the exhaust chamber 5 can be recirculated back to the inlet chamber 4 via the air supply unit 17. The system may comprise at least one processor and a memory storing instructions that, when executed, cause creating, sending, receiving of the control signal or executing a function. For example the control signal may be created and sent from the control panel 19 to the control unit 22. The control signal may be an electronic signal causing the actuator 23 to switch operation mode.

[0054] A bottom side 39 of the air supply element 1, 1a is configured to be installed above an object with a variable temperature 11 in the room space 2. A longitudinal side 26 of the air supply element 1, 1a is configured to be installed substantially parallel to the target wall 11 of the room space 2, wherein the temperature of the target wall 11 varies substantially as it is affected by outside climate changes. The target wall 11 can be an exterior side wall or a wall comprising a window 27. The air supply element 1, 1a and the air supply system 14a, 14b may preferably be located above a window 27 of the room space 2 if the target wall 11 is equipped with the window 27. If the room space 2 is located in a corner with two exterior walls, the air supply element 1, 1a and the air supply system 14a, 14b may be preferably arranged closer to the wall that is the window wall.

[0055] Figures 6 to 8 disclose a method for supplying air to a room space 2 and removing air from the room space 2 with the air supply system 14, 14b. The air is supplied and removed by:

- guiding the supply air L4 along the ceiling 3 away from the target wall 11 with the first guiding element

8 and receiving the room air L2 from the target wall 11 side for removing it with the second guiding element 9 in response to the first mode A,

- receiving the room air L2 substantially from a side 38 of the room space 2 which is opposite to the target wall 11, for removing it with the first guiding element 8 and guiding the supply air L4 towards a floor 29 of the room space 2 or in the ceiling 3 direction towards the target wall 11 with the second guiding element 9 in response to the second mode B.

[0056] It is obvious to a person skilled in the art that with the advancement of technology, the basic idea of the invention may be implemented in various ways. The invention and its embodiments are thus not limited to the examples described above; instead, they may vary within the scope of the claims.

[0057] The embodiments of the invention described herein may be used in any combination with each other. Several or at least two of the embodiments may be combined together to form a further embodiment of the invention. A method or a device to which the invention is related may comprise at least one of the embodiments of the invention described hereinbefore.

[0058] It is to be understood that any of the above embodiments or modifications can be applied singly or in combination to the respective aspects to which they refer, unless they are explicitly stated as excluding alternatives.

Claims

1. An air supply element (1, 1a) for supplying air into a room space (2), configured to be installed in connection with the ceiling (3) of the room space (2), **characterized in that** the air supply element (1, 1a) comprises
 - a switching device (10, 10a) configured to switch the operation mode of the air supply element (1, 1a) between a first mode (A) and a second mode (B) in response to the switching device (10, 10a) receiving at least one control signal (I1, 12, I3);
 - an inlet chamber (4) for supplying supply air (L4) to the room space (2), wherein the inlet chamber (4) leads to the switching device (10, 10a) and comprises at least a first inlet (12) for supplying air into the inlet chamber (4);
 - an exhaust chamber (5) for receiving room air (L2) from the room space (2), wherein the exhaust chamber (5) leads to the switching device (10, 10a) and comprises at least a first outlet (13) for removing at least part of the room air (L2) from the exhaust chamber (5) and from the room space (2);
 - a first opening (6) and a second opening (7) separated from each other and leading to the

switching device (10, 10a) and towards the room space (2),

wherein the switching device (10, 10a) is arranged between the chambers (4, 5) and the openings (6, 7) in such a way that

- in the first mode (A): the switching device (10, 10a) is arranged to connect the inlet chamber (4) to the first opening (6) and the exhaust chamber (5) to the second opening (7), and
- in the second mode (B): the switching device (10, 10a) is arranged to connect the inlet chamber (4) to the second opening (7) and the exhaust chamber (5) to the first opening (6).

2. The air supply element (1, 1a) according to claim 1, **characterized in that** the first inlet (12) is arranged to supply circulated air (L1) into the inlet chamber (4).
3. The air supply element (1, 1a) according to claim 1 or 2, **characterized in that** the inlet chamber (4) comprises a second inlet (16) for supplying fresh air (L3) to the inlet chamber (4).
4. The air supply element (1, 1a) according to claim 2 and 3, **characterized in that** supply air (L4) further comprises fresh air (L3) and circulated air (L1), wherein the supply chamber (4) is arranged to combine the fresh air (L3) and the circulated air (L1) into supply air (L4) in the supply chamber (4).
5. The air supply element (1, 1a) according any of the claims 1 to 4, **characterized in that** the first inlet (12) is arranged to receive circulated air (L1) from an air supply unit (17) configured to change the temperature of the circulated air (L1).
6. The air supply element (1, 1a) according to claim 5, **characterized in that** the exhaust chamber (5) further comprises at least a second outlet (18), wherein the exhaust chamber (5) is arranged to divide the room air (L2) between the outlets (13, 18) in such a way that the first outlet (13) is arranged to receive a first part of the room air (L5) to be removed from the room space (2) and the second outlet (18) is arranged to receive a second part of the room air (L6) to be removed from the exhaust chamber (5) and to be circulated back to the first inlet (12) via the air supply unit (17).
7. An air supply element (1, 1a) according to any of the claims 1 to 6, **characterized in that** the control signal (I1, 12, 13) is based on at least one of temperature information and occupant control.
8. The air supply element (1) according to any of the claims 1 to 7, **characterized in that** the switching device (10, 10a) further comprises a slotted plate (20) and a slotted base plate (22) below the slotted

plate (20) for enabling part of the slots (21) to open and part of the slots (21) to close in response to a reciprocating motion of the slotted plate (20) caused by an actuator (23).

9. The air supply element (1, 1a) according to any of the preceding claims 1 to 8, **characterized in that** a bottom side (39) of the air supply element (1, 1a) is configured to be installed above an object with a variable temperature (11) in the room space (2).

10. The air supply element (1, 1a) according to any of the preceding claims 1 to 9, **characterized in that** a longitudinal side (26) of the air supply element (1, 1a) is configured to be installed substantially parallel to a target wall (11) of the room space (2), wherein the temperature of the target wall (11) varies substantially.

11. The air supply element (1, 1a) according to any of the preceding claims 1 to 10, **characterized in that** the target wall (11) is an exterior side wall or a wall comprising a window (27).

12. The air supply element (1, 1a) according to any of the preceding claims 1 to 11, **characterized in that** the air supply element is arranged to be located above a window (27) of the room space (2).

13. An air supply system (14a, 14b) comprising the air supply element (1, 1a) according to any of the preceding claims 1 to 12, **characterized in that** the air supply system (14a, 14b) further comprises

- a first guiding element (8) configured to be connectable to the first opening (6), wherein the first guiding element (8) is arranged to be placed at a first distance (24) from the target wall (11) and
- a second guiding element (9) configured to be connectable to the second opening (7), wherein the second guiding element (9) is arranged to be placed at a second distance (25) from the target wall (11), wherein the first distance (24) is further from the target wall (11) than the second distance (25).

14. The air supply system (14a, 14b) according to claim 13, **characterized in that** in the first mode (A): the first guiding element (8) is configured to guide the supply air (L4) along the ceiling (3) away from the target wall (11) and the second guiding element (9) is configured to receive the room air (L2) from the target wall (11) side to be removed.

15. The air supply system (14a) according to claim 13 or 14, **characterized in that** in the second mode (B) : the first guiding element (8) is configured to receive the room air (L2) substantially from a side (38)

of the room space (2) which is opposite to the target wall (11) to be removed and the second guiding element (9) is configured to guide the supply air (L4) towards a floor (29) of the room space (2).

16. The air supply system (14b) according to claim 13 or 14, **characterized in that** in the second mode (B): the first guiding element (8) is configured to receive the room air (L2) substantially from a side (38) of the room space (2) which is opposite to the target wall (11) to be removed and the second guiding element (9) is configured to guide the supply air (L4) in the ceiling (3) direction towards the target wall (11).

17. The air supply system (14a, 14b) according to any of the claims 1 to 12, **characterized in that** the target wall (11) is at least one of an exterior side wall and a window wall.

18. The air supply system (14a, 14b) comprising the air supply element (1, 1a) according to any of the claims 1 to 13, **characterized in that** the first guiding element (8) comprises a first diffuser and the second guiding element (9) comprises a second diffuser.

19. The air supply system (14a, 14b) comprising the air supply element (1, 1a) according to any of the claims 1 to 13, **characterized in that** the first guiding element (8) comprises a first diffuser block and the second guiding element (9) comprises a second diffuser block, wherein the first diffuser block and the second diffuser block are arranged in a divided diffuser.

20. A method for supplying air to a room space (2) and removing air from the room space (2) with the air supply system (14, 14b) according to any of the preceding claims 13 to 17, **characterized in that** the method comprises:

- guiding the supply air (L4) along the ceiling (3) away from the target wall (11) with the first guiding element (8) and receiving the room air (L2) from the target wall (11) side for removing it with the second guiding element (9) in response to the first mode (A),
- receiving the room air (L2) substantially from a side (38) of the room space (2) which is opposite to the target wall, (11) for removing it with the first guiding element (8) and guiding the supply air (L4) towards a floor (29) of the room space (2) or in the ceiling (3) direction towards the target wall (11) with the second guiding element (9) in response to the second mode (B).

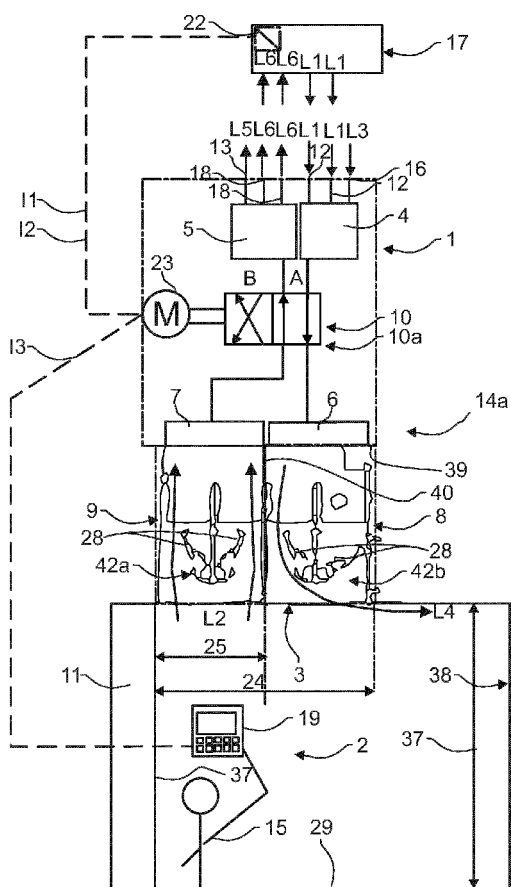


Fig. 1a

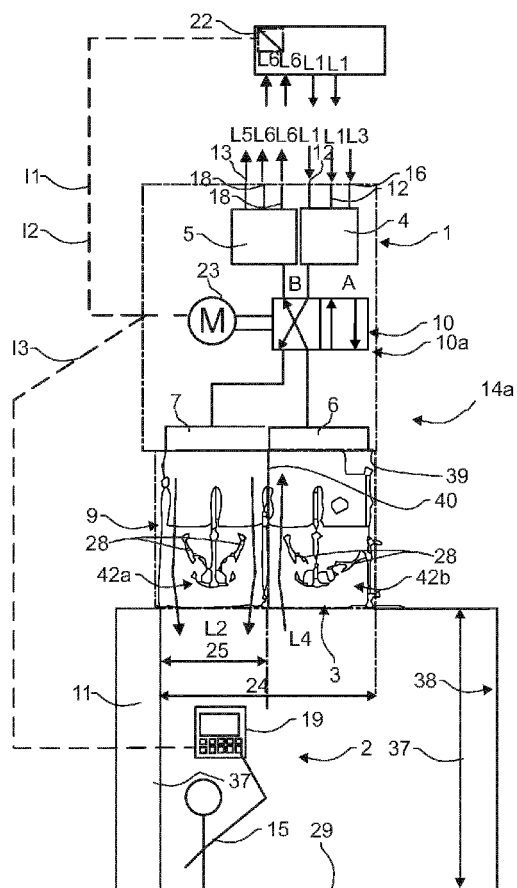


Fig. 1b

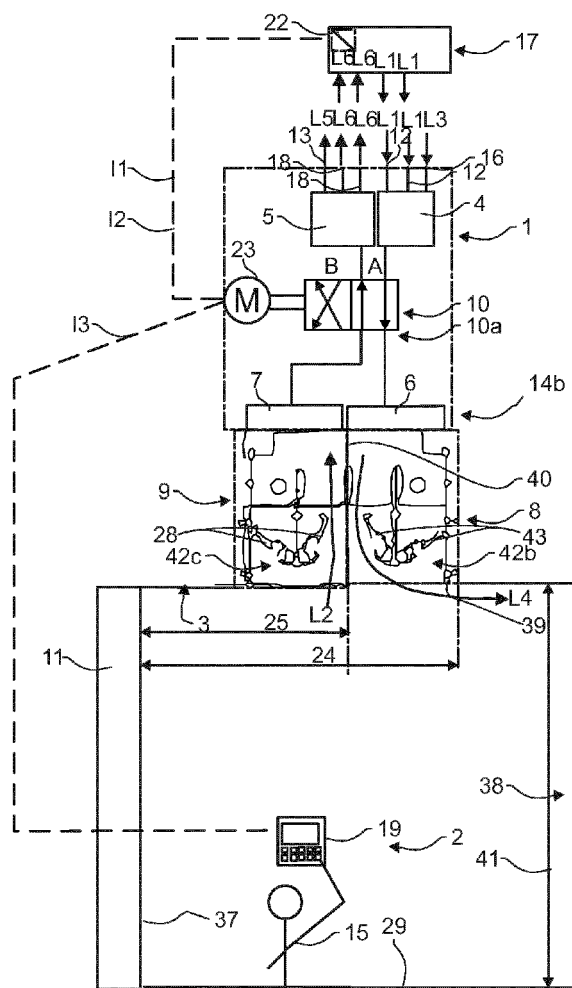


Fig. 2a

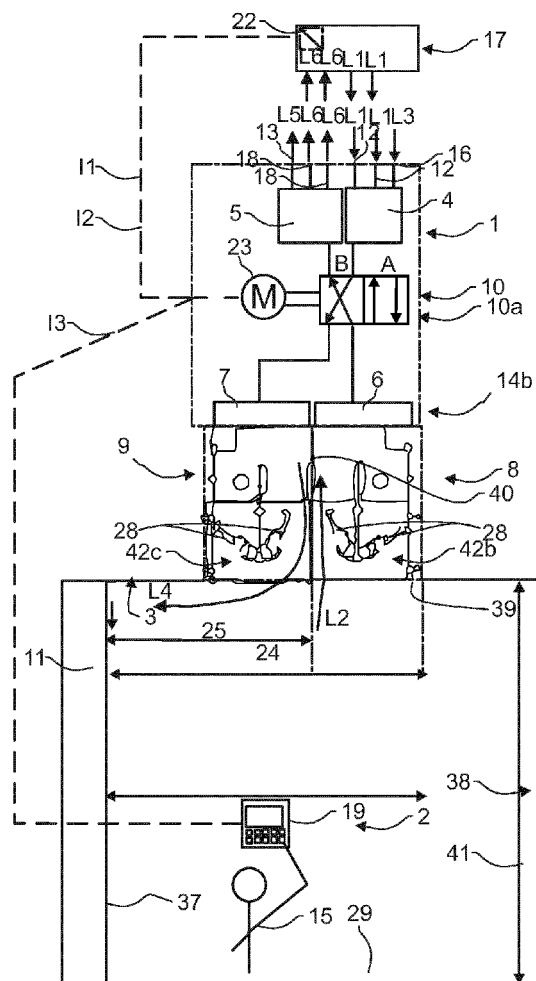
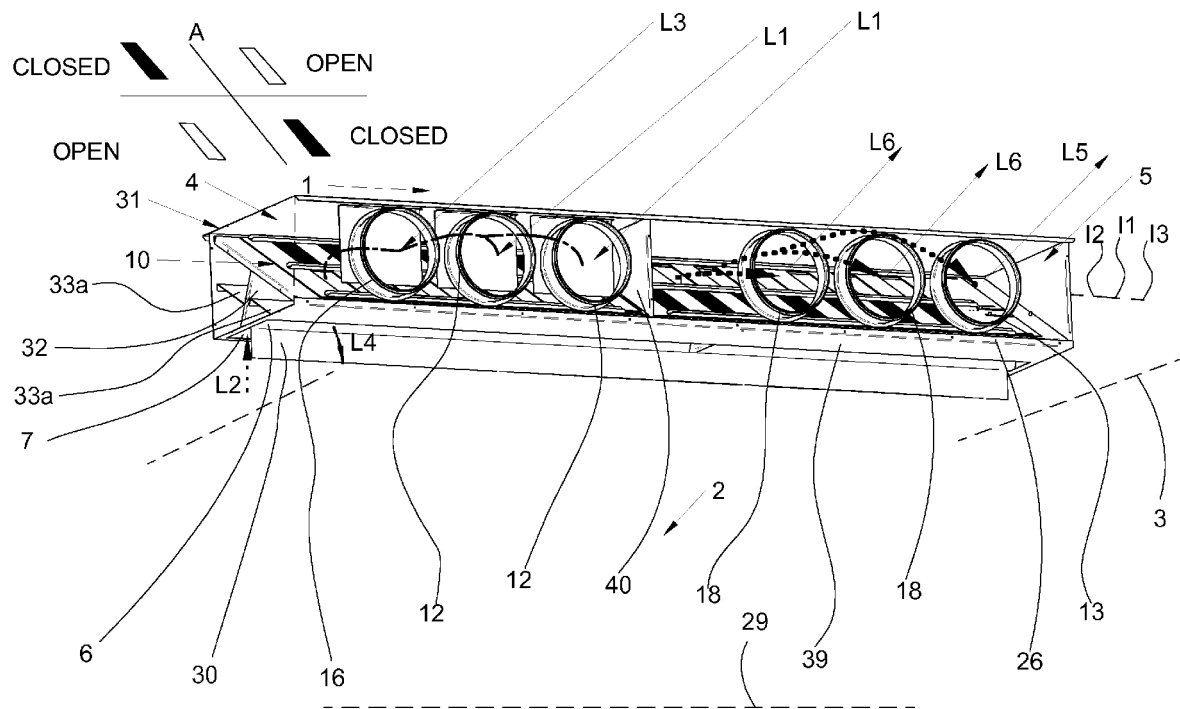


Fig. 2b



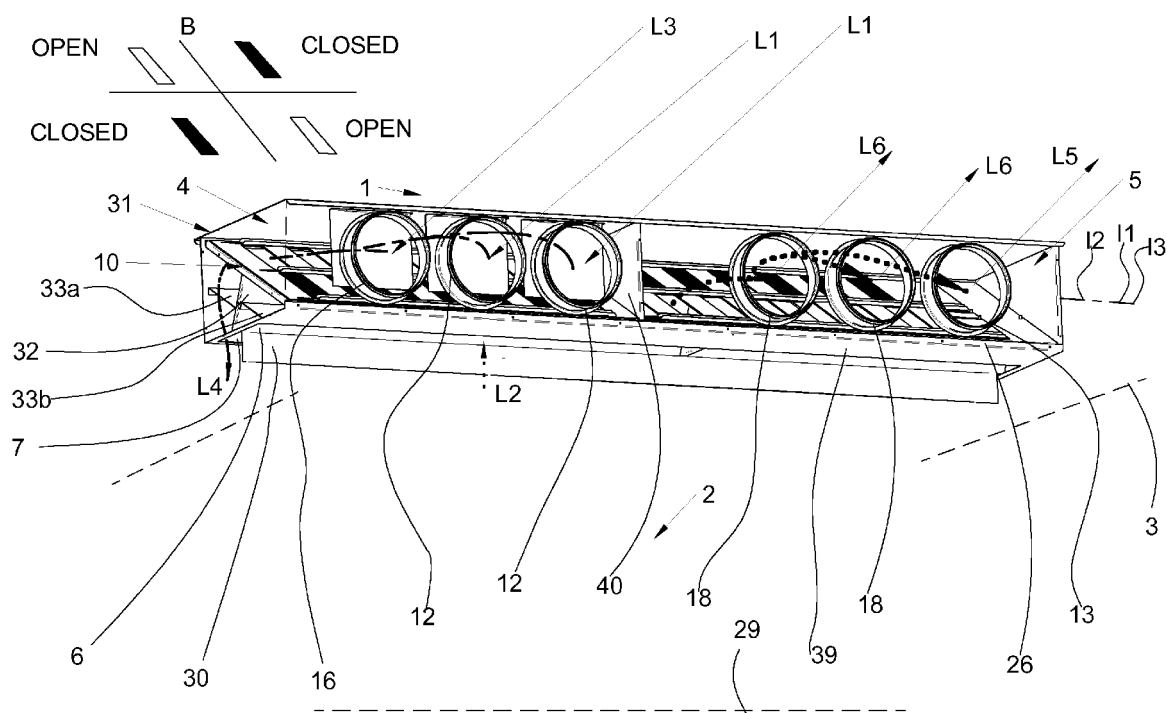


Fig. 3b

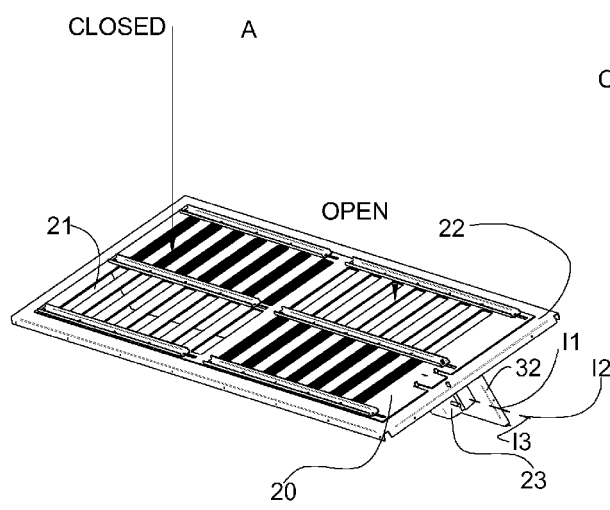


Fig. 4a

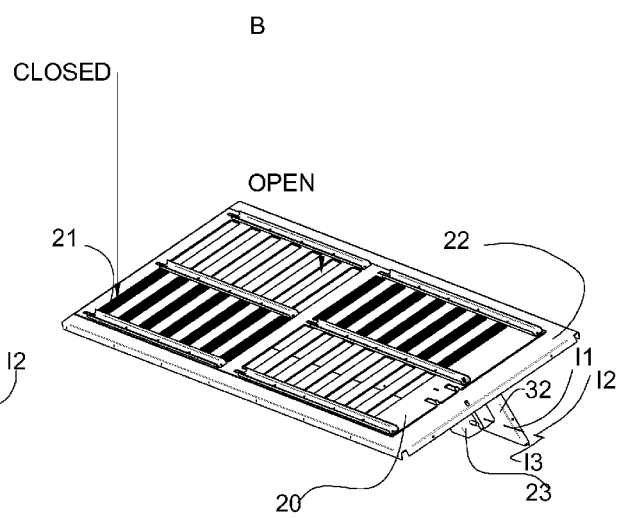
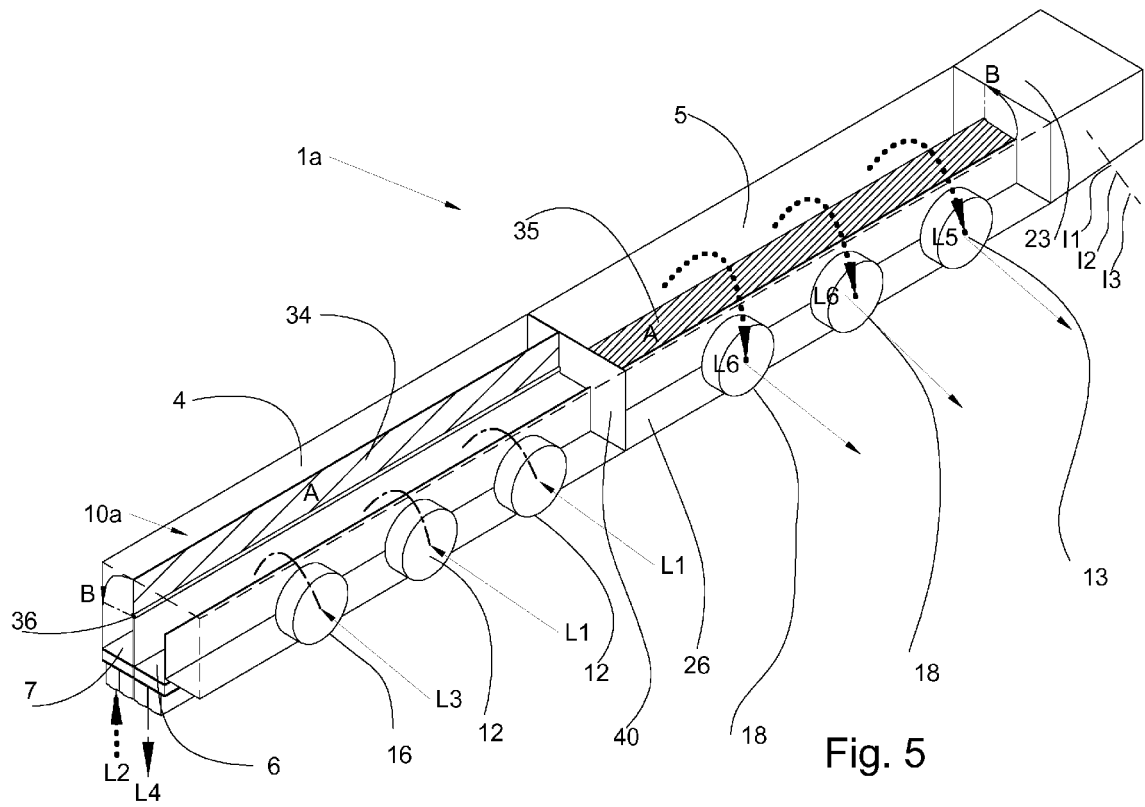


Fig. 4b



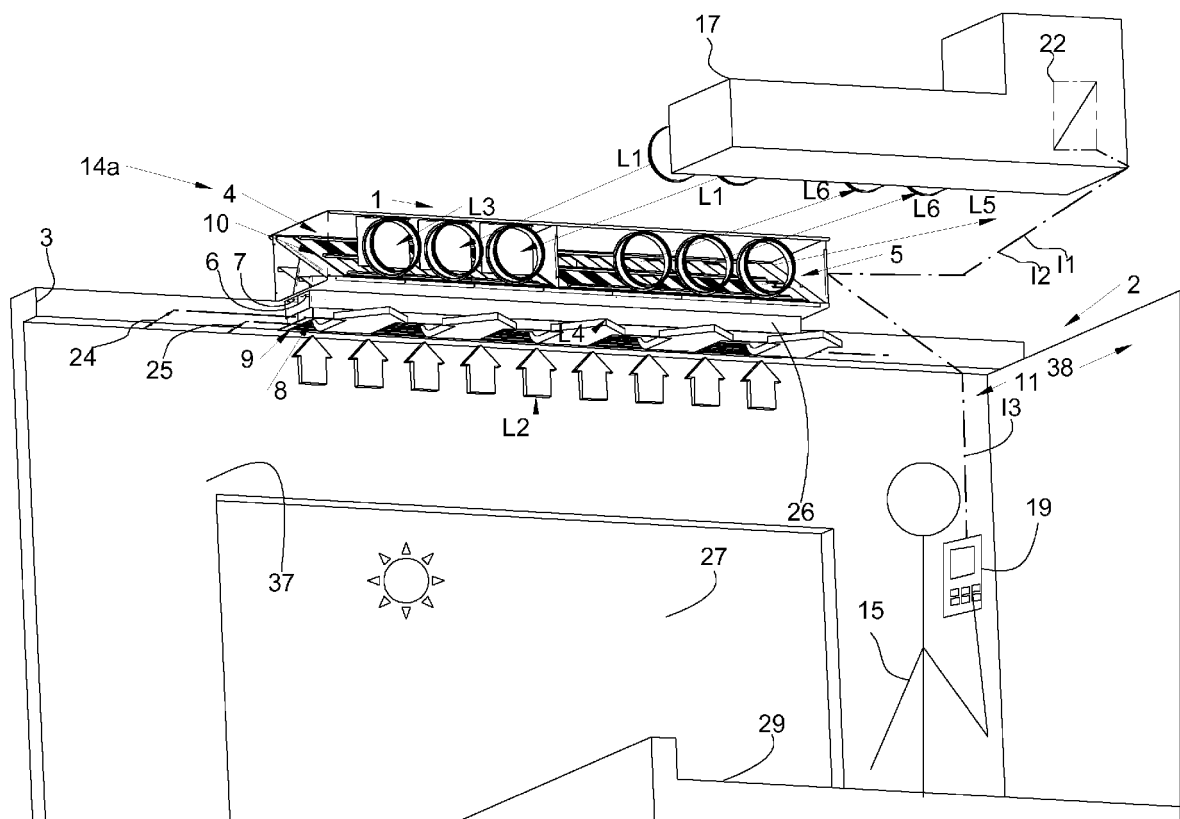


Fig. 6

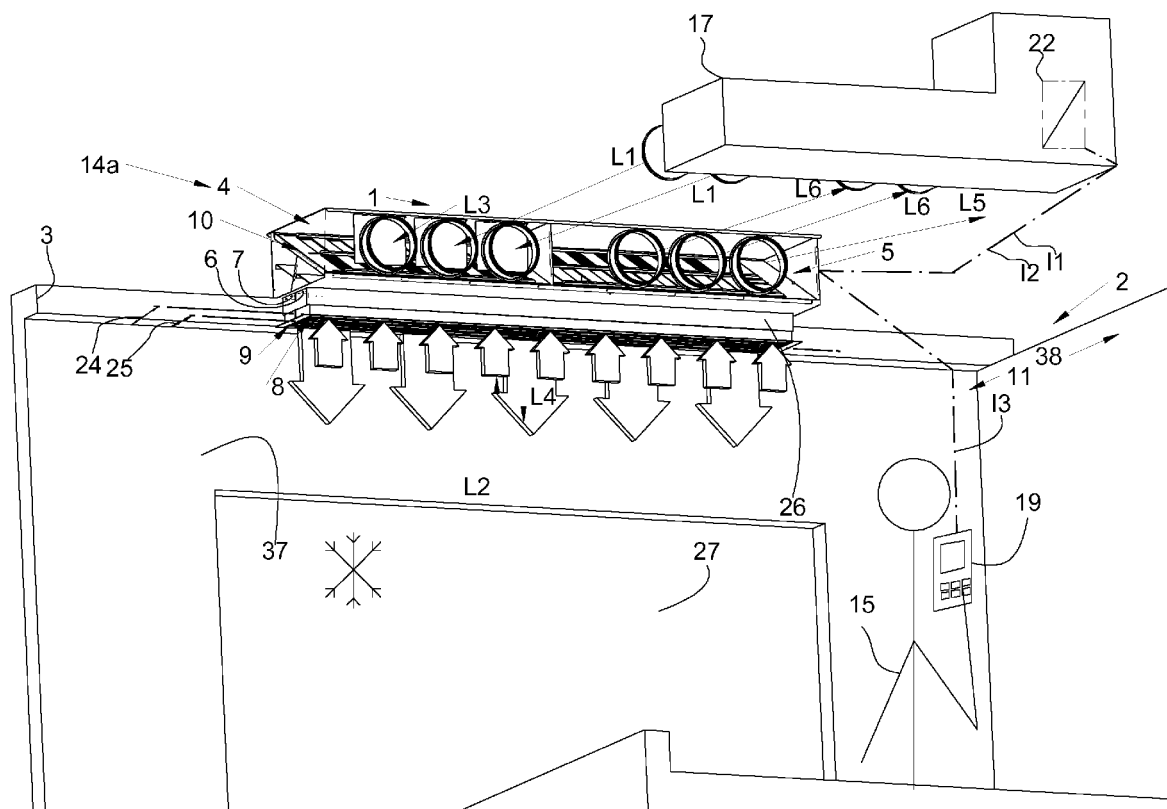


Fig. 7

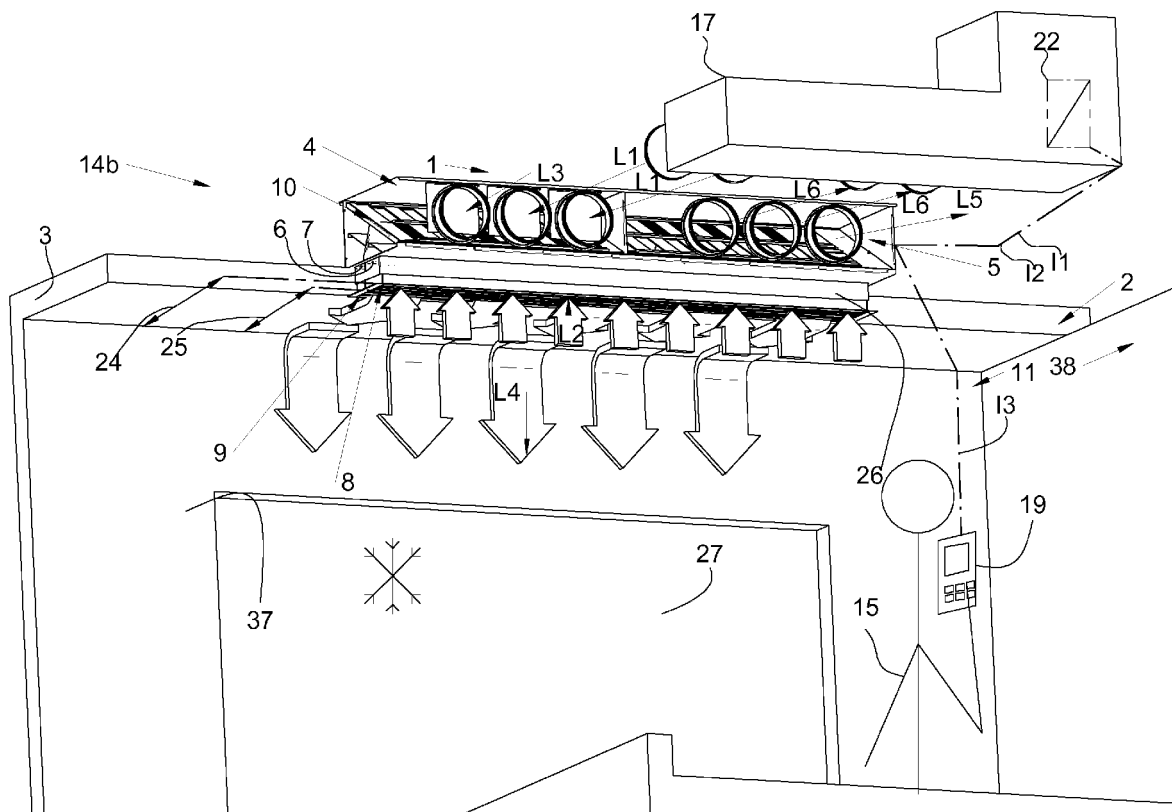


Fig. 8



EUROPEAN SEARCH REPORT

 Application Number
 EP 14 19 6995

5

10

15

20

25

30

35

40

45

50

55

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	US 2013/281000 A1 (NEWCOMER DOUGLAS A [US]) 24 October 2013 (2013-10-24) * paragraph [0050] - paragraph [0052] * * paragraph [0101] - paragraph [0110]; figures 1,15-19 *	1-20	INV. F24F7/08
X	US 2010/258642 A1 (NEWCOMER DOUGLAS A [US] ET AL) 14 October 2010 (2010-10-14) * paragraph [0078] - paragraph [0086]; figures 15-19 *	1-20	
A	WO 80/02064 A1 (THUNBERG S) 2 October 1980 (1980-10-02) * page 5, line 33 - page 7, line 38; figures 1-2 *	1-7	
A	EP 1 701 101 A2 (LG ELECTRONICS INC [KR]) 13 September 2006 (2006-09-13) * paragraph [0047] - paragraph [0071]; figures 1-4 *	1-8	
A	EP 2 169 324 A1 (DAIKIN IND LTD [JP]) 31 March 2010 (2010-03-31) * abstract; figures 1-3,9-13 *	1-8	TECHNICAL FIELDS SEARCHED (IPC) F24F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 18 May 2015	Examiner Anconetani, Mirco
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention 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			

EPO FORM 1503 03/82 (P04C01)

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

EP 14 19 6995

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

18-05-2015

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013281000 A1	24-10-2013	CA 2870971 A1	31-10-2013
		CN 104334944 A	04-02-2015
		US 2013281000 A1	24-10-2013
		WO 2013163060 A1	31-10-2013
US 2010258642 A1	14-10-2010	US 2010258642 A1	14-10-2010
		US 2015105011 A1	16-04-2015
WO 8002064 A1	02-10-1980	DE 3068489 D1	16-08-1984
		EP 0026766 A1	15-04-1981
		JP S6335900 B2	18-07-1988
		JP S56500268 A	05-03-1981
		SE 440275 B	22-07-1985
		US 4391321 A	05-07-1983
		WO 8002064 A1	02-10-1980
EP 1701101 A2	13-09-2006	CN 1821669 A	23-08-2006
		EP 1701101 A2	13-09-2006
		KR 20060091428 A	21-08-2006
		US 2006199510 A1	07-09-2006
EP 2169324 A1	31-03-2010	AU 2008263367 A1	18-12-2008
		AU 2008263368 A1	18-12-2008
		AU 2008263370 A1	18-12-2008
		CN 101688674 A	31-03-2010
		CN 101688675 A	31-03-2010
		CN 101688676 A	31-03-2010
		EP 2169324 A1	31-03-2010
		EP 2169325 A1	31-03-2010
		EP 2169326 A1	31-03-2010
		JP 4311488 B2	12-08-2009
		JP 4311489 B2	12-08-2009
		JP 4311490 B2	12-08-2009
		JP 2009019862 A	29-01-2009
		JP 2009019863 A	29-01-2009
		JP 2009019864 A	29-01-2009
		JP 2009019865 A	29-01-2009
		KR 20090130254 A	21-12-2009
		KR 20090130263 A	21-12-2009
		KR 20090130428 A	23-12-2009
		US 2010170280 A1	08-07-2010
		US 2010170292 A1	08-07-2010
		US 2010181690 A1	22-07-2010

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82