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(54) **DUAL PLENUM FOR AIR DISTRIBUTION**

(57) The dual plenum for air distribution comprises a first chamber (1) and a second chamber (2) sharing at least one common wall (14), an air inlet (3) only in the first chamber communicated to an air supply source (8) by a pressurized air supply conduit (9), an air passage regulating device (7) in the common wall (14) selectively communicating the second chamber to the first chamber in response to an air pressure level in the first chamber, a first air outlet (10) in the first chamber and a second air outlet (11) in the second chamber through which pressurized air is evacuated from the first and second chambers, respectively, to an enclosure. The first and second air outlets have respective first and second diffusers (12, 13) which provide respective horizontal first and second air passage areas (S1, S2) and which direct air within an enclosure in general of a building.

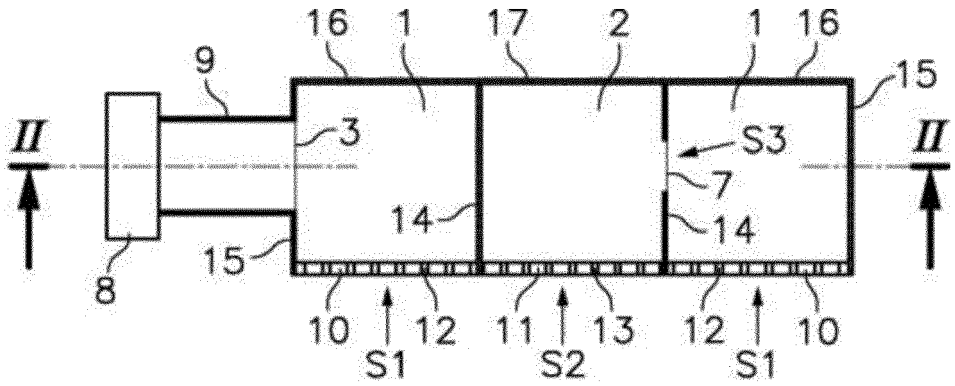

Fig. 1

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Description

Technical Field

[0001] The present invention relates to a dual plenum useful in the field of air conditioning ventilation and distribution systems, particularly to distribution systems for variable pressurized air volumes.

State of the Art

[0002] Air conditioning flow regulation and control systems are known in the state of the art in which pressurized air from an air supply source accesses a plenum from where it is distributed to an enclosure, such as a room, through a ceiling diffuser grating having a constant air passage area.

[0003] The thermal load within an enclosure such as a room is highly variable due, for example, to room temperature, the number of persons staying in the enclosure, the kind of work they do, the number of apparatuses they use, the heat emissions that the apparatuses produce, etc. The known air conditioning flow regulation and control systems are designed to adapt themselves to the changes in the room thermal load by automatically increasing or decreasing an air flow rate which is supplied from the air supply source to the plenum and which is evacuated from the plenum to the room through the ceiling diffuser grating having the constant air passage area. As a result, the speed of the air flow that is distributed to the enclosure from the plenum increases under high thermal load conditions, and a high speed of the air flowing from the ceiling diffuser grating can be uncomfortable for people in the room.

[0004] Document US 6986708 B2 discloses a dual plenum for air distribution which is divided into two spaces with a transverse partition, namely an air supply plenum which acts to supply air from an air handling unit to a room and an air return plenum which operates for returning room air to the air handling unit, with the air supply plenum being arranged below the air return plenum. A terminal unit having a controllable damper blade is applied to a diffuser to permit the unit to be convertible between a constant volume unit and a variable volume unit. A thermostat generates signals that open and close the damper blade at determined intervals. However, this dual plenum is not intended for nor does it allow regulating the speed of the air flow that is distributed to the enclosure from the two plenums by varying an outlet air passage area and without the use of mechanically operated elements.

[0005] Document US 3929280 A discloses a terminal air outlet device for use at a discharge from a building air distribution system including a plenum for air distribution comprising a housing; a chamber defined within the housing; an inlet leading into the chamber and being adapted for connection to an air supply source; a first air outlet from the chamber through which air is adapted to be discharged in a first fixed direction; a second air outlet from the chamber through which air is adapted to be discharged in a second fixed direction different from the first one, which is substantially at right angles to the first direction; and control means for regulating air discharge through the first and second outlets. The first direction is substantially vertical, and the second direction is substantially horizontal. Heated air is discharged in the first vertical direction, and cool air in the second horizontal direction. However, this plenum is not intended for nor does it allow discharging air to an enclosure from the two air outlets in response to the fluctuations of thermal load within the enclosure, in mutually parallel directions, or in different directions that can be selected and oriented because the two adjacent chambers do not share an air outlet.

[0006] Document US 4259898 A discloses a dual plenum having all the features of the preamble of claim 1.

[0007] Accordingly the dual plenum of US 4259898 A comprises a first chamber having a first air inlet and a first air outlet, a second chamber having a second air inlet and a second air outlet, and an air-feed device configured to introduce pressurized air from an air supply source to the first chamber through the first air inlet and to the second chamber through the second air inlet. First and second chamber in this dual plenum share an air supply conduit and also share an air outlet having diffusers allowing to direct the pressurized air to common or different selectable/orientable directions. A regulating damper is swingable suspended in the second air inlet and subjected to the action of its own weight so that when the air supply source delivers a relatively small volume of air the regulating damper remains in a closed position and the supplied air flows only through the first air inlet and the first air outlet. If the air supply source delivers a relatively large volume of air the regulating damper is swung and the supplied air flows both through the first and second air inlets and first and second air outlets. However, in this dual plenum there is no an air passage regulating device selectively communicating the second chamber to the first chamber and therefore a given flow rate of pressurized air is not shunt from the first chamber to the second chamber in response to an air pressure level in the first chamber in order to cause a decrease in the speed of the air discharged from the first air outlet when a relatively large volume of air is delivered to the plenum.

[0008] Therefore, new plenums for air distribution are required which, by means of the variability of the outlet air passage area for diffusing air from the plenum to an enclosure, allow maintaining the output speed of the air as constant as possible in different flow rate conditions, thus improving comfort and energy efficiency in the enclosures, rooms or premises to be air conditioned.

Disclosure of the Invention

[0009] For that purpose, the present invention provides

a dual plenum for air distribution comprising, as is already known for example from the cited document US 4259898 A, a first chamber and a second chamber sharing at least one common wall, and further sharing an air outlet having diffusers in an air passage area configured to direct air within an enclosure in general of a building. The dual plenum is connected to an air-feed device configured to selectively introduce pressurized air from an air supply source to the first chamber or to both the first chamber and the second chamber in response to a supplied pressurized air flow rate, wherein the first chamber has a first air outlet through which pressurized air is evacuated from the first chamber to an enclosure, and the second chamber has a second air outlet through which pressurized air is evacuated from the second chamber to the enclosure, and wherein the first air outlet has first diffusers which provide a horizontal first air passage area and which are configured to direct air in a downwards direction, and the second air outlet has second diffusers which provide a horizontal second air passage area and which are configured to direct air in the same downwards direction than the first diffusers or in different directions, so that the air flow that comes out from the double plenum through the shared outlet can be directed as desired by using the first and second diffusers On the other hand, the two diffusers can be the same or different

[0010] Unlike the prior art, the air-feed device of the dual plenum of the present invention comprises an air inlet connected only to the first chamber, a pressurized air supply conduit connected to the air supply source and to the air inlet, and an air passage regulating device in the common wall, wherein the air passage regulating device is configured to selectively communicate the second chamber to the first chamber in response to an air pressure level in the first chamber caused by the supplied pressurized air flow rate.

[0011] According to a preferred embodiment of this invention the common wall including the air passage regulating device is adjacent to a region of the first chamber directly connected to the first surface area of the air outlet without interposed constrictions, i.e. the air passage is far from the air inlet of the air supply conduit.

[0012] Thus, when the air pressure level in the first chamber is relatively low, the air passage regulating device completely or almost completely prevents an air communication between the first chamber and the second chamber so that all or almost all the supplied pressurized air is discharged through the first air outlet, the first air passage area of which is selected to determine a relatively low air output speed. However, when the air pressure level in the first chamber is relatively high, the air passage regulating device allows an air communication between the first chamber and the second chamber so that a given flow rate of pressurized air is shunt from the first chamber to the second chamber and the supplied pressurized air is discharged through both the first and second air outlets, the first and second air passage areas of which add together to keep the air output speed at a relatively low level.

[0013] In one embodiment, the air passage regulating device comprises one or more communication openings in the common wall. These one or more communication openings are sized so that they provide a third air passage, and a ratio of the third air passage area to the first air passage area is selected to allow a given flow rate of pressurized air to be shunt from the first chamber to the second chamber in response to the air pressure level in the first chamber.

[0014] The one or more communication openings are permanently open, so that when the air pressure in the first chamber is relatively low, the air will be diffused primarily through the first outlet air passage area and only to a small extent through the second outlet air passage area. But when the air pressure in the first chamber is relatively high, the air will be diffused through both the first and second outlet passage areas.

[0015] In another embodiment, the air passage regulating device comprises a one-way valve device associated to a communication opening in the common wall. The one-way valve device is configured to open in response to a pressure value inside the first chamber above a specific threshold value thereby allowing a given flow rate of pressurized air to be shunt from the first chamber to the second chamber. The one-way valve device allows the passage of the pressurized air in one direction and prevents it in the opposite direction.

[0016] For example, the one-way valve device may be calibrated to open a specific section of the communication opening depending on the higher or lower pressure difference between the first chamber and the second chamber. If the one-way valve device is more open, the air flow would be diffused through the first air passage area of the first chamber and through the second air passage area of the second chamber outlet. In the event that the one-way valve device is more closed, the air would be diffused primarily through the first air passage area and only to a small extent through the second air passage area.

[0017] In the event that the one-way valve device is completely closed, air flow is not allowed to pass from the first chamber to the second chamber, so that air cannot be diffused through the second outlet air passage area and the entire air flow is diffused through the first air passage area.

[0018] In one embodiment, the mentioned one-way valve device is comprised of a sheet fixed at one of its ends to a wall common to the first and second chambers and adjacent to the communication opening, with the capacity to pivot with respect to the fixing and block the mentioned communication opening to a greater or lesser degree, allowing a larger or smaller amount of air to pass through the communication opening. This sheet can be a flexible sheet which deforms in response to external forces with respect to the sheet, such as air pressure for example, and when flexing the flexible sheet frees the communication opening between the chambers.

[0019] Alternatively, the sheet can be a rigid sheet, in which case the fixing comprises a hinge at an edge of the sheet. The rigid sheet has the capacity to pivot to open the communication opening to a greater or lesser degree in response to a pressure exerted on the rigid sheet. In one embodiment, the communication opening is located in a vertical section of the common wall, the hinge is located over the communication opening, and the rigid sheet is biased to a closed position blocking the communication opening by the action of its own weight. In another embodiment, the communication opening is located in any wall common to the first and second chambers, the hinge is attached to the common wall in a place adjacent to the communication opening, and the rigid sheet is biased to the closed position blocking the communication opening by an elastic element.

[0020] Alternatively the one-way valve device can be, for example, an automatically actuated mechanical valve device with which the circulation of pressurized air through the communication opening can be started, stopped, or regulated by means of a movable part which partially opens, closes, or obstructs one or more orifices or conduits associated to the communication opening in cooperation with one or more pressure sensors and an electronic control device.

[0021] The first and second chambers of the dual plenum can be arranged according to several configurations. In an embodiment, the common wall is a vertical cylindrical or prismatic wall surrounded by a cylindrical or prismatic side outer wall, and the second chamber is surrounded by the first chamber. The first chamber is delimited by the common wall, the side outer wall, a first top wall, and a first bottom wall in which the first air outlet and the first diffusers are located. The second chamber is delimited by the common wall, a second top wall, and a second bottom wall in which the second air outlet and the second diffusers are located. The air inlet is located in the side outer wall or in the first top wall.

[0022] However, while other shapes of the common wall, for example frustum conical or similar are considered suitable),

[0023] In this embodiment, the first top wall has a perimetral edge connected to the side outer wall and an aperture with an inner edge connected to the common wall, and the second top wall has a perimetral edge connected to the common wall, whereby the second chamber is surrounded by the first chamber, or alternatively the first top wall has a perimetral edge connected to the side outer wall, the second top wall has a perimetral edge connected to the common wall, whereby the second chamber is surrounded by the first chamber and a section of the first chamber extends between the first top wall and the second top wall.

[0024] In another embodiment, the common wall is also a vertical cylindrical or prismatic wall surrounded by a cylindrical or prismatic side outer wall, but the first chamber is surrounded by the second chamber. The first chamber is delimited by the common wall, a first top wall, and a first bottom wall in which the first air outlet and the first diffusers are located. The second chamber is delimited by the common wall, the prismatic side outer wall, a second top wall, and a second bottom wall in which the second air outlet and the second diffusers are located. The air inlet is located in the common wall and the pressurized air supply conduit communicates with the air inlet of the first chamber going through the second chamber, or alternatively the air inlet is located in the first top wall.

[0025] In this embodiment, the first top wall has a perimetral edge connected to the common wall, and the second top wall has a perimetral edge connected to the side outer wall and an aperture with an inner edge connected to the common wall, whereby the first chamber is surrounded by the second chamber, or alternatively the first top wall has a perimetral edge connected to the common wall, and the second top wall has a perimetral edge connected to the side outer wall, whereby the first chamber is surrounded by the second chamber and a section of the second chamber extends between the first top wall and the second top wall.

[0026] Preferably, in the embodiment where the second chamber is surrounded by the first chamber, the one or more communication openings of the air passage regulating device are formed in a region of the common wall facing a portion of the side outer wall opposite the air inlet, and in the embodiment where the first chamber is surrounded by the second chamber, the one or more communication openings of the air passage regulating device are formed in a region of the common wall opposite the air inlet.

[0027] In a further embodiment the common wall is a vertical partition wall which is connected to the inside of a vertical cylindrical or prismatic side outer wall so that the first chamber and the second chamber are arranged adjacent side by side. In this case, the first chamber is delimited by the common wall, a first portion of the side outer wall, a first top wall, and a first bottom wall in which the first air outlet and the first diffusers are located, and the second chamber is delimited by the common wall, a second portion of the side outer wall, a second top wall and a second bottom wall in which the second air outlet and the second diffusers are located.

[0028] The air inlet can be located either in the first portion of the side outer wall, or in the common wall, or in the first top wall. If the air inlet is located in the common wall, then the pressurized air supply conduit communicates with the air inlet of the first chamber going through the second chamber.

Brief Description of the Drawings

[0029] The foregoing and other advantages and features will be better understood based on the following detailed description of several embodiments with reference to the attached drawings which are to be taken by way of non-limiting illustration, in which:

Figure 1 is a vertical cross-section view of a dual plenum for air distribution according to a first embodiment of the present invention, taken by the plane I-I of Figure 2.

Figure 2 is a horizontal cross-section view taken by the plane II-II of Figure 1.

Figure 3 is a bottom view of the dual plenum of Figure 1.

Figure 4 is an isometric view of the dual plenum of Figure 1 showing a bottom side thereof from where diffusers have been removed for clarity;

Figure 5 is an isometric view of a dual plenum according to a second embodiment of the present invention, showing a bottom side thereof from where diffusers have been removed for clarity;

Figure 6 is a bottom view of a dual plenum according to a third embodiment of the present invention;

Figure 7 is a vertical cross-section view of a dual plenum for air distribution according to a fourth embodiment of the present invention, taken by the plane VII-VII of Figure 8.

Figure 8 is a horizontal cross-section view taken by the plane VIII-VIII of Figure 7.

Figure 9 is a vertical cross-section view of a dual plenum for air distribution according to a fifth embodiment of the present invention;

Figure 10 is a vertical cross-section view of a dual plenum for air distribution according to a sixth embodiment of the present invention;

Figures 11 is a vertical cross-section view of a dual plenum for air distribution according to a seventh embodiment of the present invention;

Figures 12 and 13 are vertical cross-section views of a dual plenum for air distribution according to an eighth embodiment of the present invention, showing a one-way valve device in a closed position and an open position, respectively;

Figure 14 is a vertical cross-section view of a dual plenum for air distribution according to a ninth embodiment of the present invention;

Figures 15 and 16 are vertical cross-section views of a dual plenum for air distribution according to a tenth embodiment of the present invention, showing a one-way valve device in a closed position and an open position, respectively; and

Figure 17 is a vertical cross-section view of a dual plenum for air distribution according to an eleventh embodiment of the present invention.

Detailed Description of Several Embodiments

[0030] The attached drawings show non-limiting illustrative embodiments of a dual plenum for air distribution of the present invention, which is useful in general as a ceiling air outlet, although it can provide equally horizontal flows from a wall or with a certain inclination, maintaining the principles of the invention, for an air conditioning ventilation and distribution system.

[0031] It will be understood that the different parts constituting the invention described in one embodiment can be freely combined with the parts described in other different embodiments, even though the combination has not been explicitly described, provided that this is not detrimental to the combination.

[0032] In the following drawings, a chamber the pressurized air supply conduit accesses will be understood to mean a first chamber 1, and a chamber which communicates with the first chamber through one or more communication openings will be understood to mean a second chamber 2.

[0033] Figures 1 to 4 show a dual plenum according to a first embodiment comprising a first chamber 1 and a second chamber 2 sharing a common wall 14 which has the shape of a vertical quadrangular prismatic wall. The common wall 14 is surrounded by a quadrangular prismatic side outer wall 15. The first chamber 1 is delimited by the common wall 14, the side outer wall 15, a first top wall 16, and a first bottom wall, and the second chamber 2 is delimited by the common wall 14, a second top wall 17, and a second bottom wall, so that the second chamber 2 is surrounded by the first chamber 1.

[0034] An air inlet 3 is located in the side outer wall 15. Alternatively, the air inlet 3 could be located in the first top wall 16. A pressurized air supply conduit 9 is connected to an air supply source 8 and to the air inlet 3, so that pressurized air from the air supply source 8 is introduced to the first chamber 1. An air passage regulating device 7 is located in the common wall 14. The air passage regulating device 7 comprises a communication opening configured to selectively communicate the second chamber 2 to the first chamber 1 in response to an air pressure level in the first chamber 1 caused by a pressurized air flow rate supplied from the air supply source 8. The communication opening of the air passage regulating device 7 is formed in a region of the common wall 14 facing a portion of the side outer wall 15 opposite the air inlet 3 in this embodiment

[0035] Thus, the air supply source 8, the pressurized air supply conduit 9, the air inlet 3, and the air passage regulating device 7 constitute an air-feed device configured to selectively introduce pressurized air to the first chamber 1 or to both the first chamber and the second chamber 2 in response to a supplied pressurized air flow rate.

[0036] A first air outlet 10 provided with first diffusers 12 is located in the first bottom wall of the first chamber 1, and a second air outlet 11 provided with second diffusers 13 is located in the second bottom wall of the second chamber 2. Pressurized air is evacuated from the first and second chambers 1, 2 to an enclosure through the respective first and second air outlets 10, 11. The first and second diffusers 12, 13 are configured to direct air in one and the same downwards direction or in different directions, given the adjustable condition of the diffusers, for example of the grid type, according to the needs of the room or enclosure whose thermal load is to

be controlled The first air outlet 10 and the corresponding first diffusers 12 provide a first air passage area S1 in a horizontal plane, and the second air outlet 11 and the corresponding second diffusers 13 provide a second air passage area S2 in a horizontal plane.

[0037] The communication opening constituting the air passage regulating device 7 between the first and second chambers 1, 2 provides a third air passage area S3. The ratio of the third air passage area S3 to the first air passage area S1 is selected to allow a given flow rate of pressurized air to be shunt from the first chamber 1 to the second chamber 2 in response to the air pressure level in the first chamber 1. The higher is the air pressure level in the first chamber 1 the greater is the flow rate of pressurized air that is shunt from the first chamber 1 to the second chamber 2.

[0038] Thus, the air flow rate entering the second chamber 2 through the third air passage area S3 increases and decreases with the rise and fall of the pressure in the first chamber 1, and the first and second air passage areas S1, S2 of the first and second air outlets 10, 11 of the first and second chambers 1, 2 add together as convenient at any time to keep the air output speed at a relatively constant level.

[0039] The first top wall 16 has a perimetral edge connected to the side outer wall 15 and an inner edge connected to the common wall 14 and the second top wall 17 has a perimetral edge connected to the common wall 14. As can be seen in Figure 1, the first and second top walls 16, 17 are flush in a horizontal plane and can optionally be made of a single element, and the first and second diffusers 12, 13 are flush in another horizontal plane and can optionally be made of a single element. Alternatively, the first and second top walls 16, 17 could be staggered on different levels and the first and second diffusers 12, 13 could also be staggered on different horizontal levels. As can be seen in Figure 3, the first and second diffusers 12, 13 have a different design. Alternatively, the first and second diffusers 12, 13 could be of the same type o be a single diffuser, but in where the wall 14 they share determines that they can operate as two distinct, separate diffusers.

[0040] Figure 5 shows a dual plenum according to a second embodiment which differs from the first embodiment (Figures 1 to 4) in that the common wall 14 is a cylindrical wall instead of a quadrangular prismatic wall, and the air passage regulating device 7 comprises a plurality of smaller communication openings instead of a single greater communication opening. The smaller communication openings provide all together the third air passage area S3.

[0041] Figure 6 shows a dual plenum according to a third embodiment which differs from the second embodiment (Figure 5) in that the outer side wall 15 is a cylindrical wall instead of a quadrangular prismatic wall. Here, the first and second diffusers 12, 13 are joined into a common diffuser spanning over the first and second outlets 10, 11.

[0042] Figures 7 and 8 show a dual plenum according to a fourth embodiment which differs from the first embodiment (Figures 1 to 4) in that the first chamber 1 is delimited by the common wall 14, the first top wall 16, and the first bottom wall in which the first air outlet 10 and the first diffusers 12 are located, and the second chamber 2 is delimited by the common wall 14, the side outer wall 15, the second top wall 17, and the second bottom wall in which the second air outlet 11 and the second diffusers 13 are located, so that the first chamber 1 is surrounded by the second chamber 2. Furthermore, the air inlet 3 is located in the common wall 14 and the pressurized air supply conduit 9 communicates with the air inlet 3 of the first chamber 1 going through the second chamber 2. The communication opening of the air passage regulating device 7 is formed in a region of the common wall 14, preferably opposite the air inlet 3.

[0043] Figure 9 shows a dual plenum according to a fifth embodiment which differs from the fourth embodiment (Figures 7 and 8) in that the air inlet 3 is located in the first top wall 16 instead of in the common wall 14, and the pressurized air supply conduit 9 is directly connected to the air inlet 3.

[0044] Figure 10 shows a dual plenum according to a sixth embodiment having a vertical design in which the common wall 14 is a vertical partition wall which is connected inside of a vertical cylindrical or prismatic side outer wall 15a, 15b, so that the first and second chambers 1, 2 are arranged side by side adjacent to each other. The first chamber 1 is delimited by the common wall 14, a first portion of the side outer wall 15a, a first top wall 16, and a first bottom wall in which the first air outlet 10 and the first diffusers 12 are located. The second chamber 2 is delimited by the common wall 14, a second portion of the side outer wall 15b, a second top wall 17 and a second bottom wall in which the second air outlet 11 and the second diffusers 13 are located. Surfaces 16 and 17 are in general coplanar or can optionally be made of a single surface.

[0045] The air inlet 3 is located in the first portion of the side outer wall 15a and the pressurized air supply conduit 9 is connected to the air supply source 8 and to the air inlet 3. Alternatively, the air inlet 3 could be located in the first top wall 16 and the pressurized air supply conduit 9 directly connected to the air inlet 3. The communication opening of the air passage regulating device 7 is located in the common wall 14. The first and second diffusers 12, 13 provide respective first and second air passage areas S1, S2 and are configured to direct air in one and the same inclined downwards direction or in different directions taking into account there are two different diffusers 12 and 13. Air circulation is shown by arrows in Figure 10.

[0046] Figure 11 shows a dual plenum according to a seventh embodiment which differs from the sixth embodiment (Figure 10) in that the air inlet 3 is located in the common wall 14 and the pressurized air supply conduit 9 communicates with the air inlet 3 of the first chamber

1 going through the second chamber 2. Alternatively, the air inlet 3 could be located in the first top wall 16. Air circulation is shown by arrows in Figure 11.

[0047] Figures 12 and 13 show a dual plenum according to an eighth embodiment which differs from the first embodiment (Figures 1 to 4) in that the air passage regulating device 7 comprises a one-way valve device 4 associated to the communication opening. The communication opening is located in a vertical flat section of the common wall 14. The one-way valve device 4 comprises a flexible sheet secured at an upper edge thereof to the common wall 14 over the communication opening. The flexible sheet is configured to freely hang by gravity thereby blocking the communication opening when a pressure below a specific threshold exists in the first chamber 1 (Figure 12), and to bend to open the communication opening to a greater or lesser degree in response to a pressure above the specific threshold value exerted on the flexible sheet from the first chamber 1 (Figure 13) thereby allowing a given flow rate of pressurized air to be shunt from the first chamber 1 to the second chamber 2. Air circulation is shown by arrows in Figures 12 and 13. In an alternative embodiment the flexible sheet may be secured by attachment 18 at one side of the communication opening.

[0048] Figure 14 shows a dual plenum according to a ninth embodiment which differs from the fourth embodiment (Figure 7) in that the communication opening is located in any vertical section of the common wall 14 and in that the one-way valve device 4 comprises a sheet connected by a hinge 19 at an upper edge thereof to the common wall 14 over the communication opening. The rigid sheet is biased to freely hang into a closed position (shown in solid lines in Figure 14) blocking the communication opening by the action of its own weight. The sheet has the capacity to pivot about the hinge 19 to open the communication opening to a greater or lesser degree (shown in dashed lines in Figure 14) in response to a pressure above a specific threshold value exerted on the sheet from the first chamber 1 thereby allowing a given flow rate of pressurized air to be shunt from the first chamber 1 to the second chamber 2.

[0049] Figures 15 and 16 show a dual plenum according to a tenth embodiment which differs from the eighth embodiment (Figures 12 and 13) in the first instance in that the first top wall 16 has a perimetral edge connected to the side outer wall 15, the second top wall 17 has a perimetral edge connected to the common wall 14, and a section of the first chamber 1 extends between the first top wall 16 and the second top wall 17 thereby the second top wall 17 is also a wall common to the first and second chambers 1, 2 in addition to the common wall 14.

[0050] Secondly, this tenth embodiment differs from the eighth embodiment in that the communication opening is located in the second top wall 17 common to the first and second chambers 1, 2, and the one-way valve device 4 comprises a sheet connected by a hinge 19 at an edge thereof to the common wall 14 adjacent to the communication opening. The sheet is biased to a closed position (Figure 15) blocking the communication opening by the action of an elastic element 20. The sheet has the capacity to pivot about the hinge 19 to open the communication opening to a greater or lesser degree (Figure 16) in response to a pressure above a specific threshold value exerted on the sheet from the first chamber 1 thereby allowing a given flow rate of pressurized air to be shunt from the first chamber 1 to the second chamber 2. Air circulation is shown by arrows in Figures 15 and 16.

[0051] The elastic element 20, which can be associated to the hinge 19 for example, allows for the one-way valve device 4 to be located in a horizontal wall such as the second top wall 17, and readily lets an accurate calibration of the one-way valve device 4 to the specific pressure threshold value. Alternatively, the one-way valve device 4 could be located in in any other wall common to the first and second chambers 1, 2.

[0052] Figure 17 shows a dual plenum according to an eleventh embodiment which differs from the ninth embodiment (Figure 14) in the first instance in that the first top wall 16 has a perimetral edge connected to the common wall 14, the second top wall 17 has a perimetral edge connected to the side outer wall 15, and a section of the second chamber 2 extends between the first top wall 16 and the second top wall 17 thereby the first top wall 16 is also a wall common to the first and second chambers 1, 2 in addition to the common wall 14.

[0053] Secondly, this eleventh embodiment differs from the ninth embodiment in that the one-way valve device 4 is an automatically actuated mechanical valve device 21 having a movable part which partially opens, closes, or obstructs one or more orifices or conduits associated to the communication opening thereby allowing a given flow rate of pressurized air to be shunt from the first chamber 1 to the second chamber 2. One or more pressure sensors 22 are arranged in the first chamber 1 to sense pressure therein, and an electronic control device 23 operates the mechanical valve device 21 in response to a signal representative of a a pressure above a specific threshold value in the first chamber 1 received from the one or more pressure sensors 22. In this eleventh embodiment, the communication opening and the associated mechanical valve device 21 are located in the first top wall 16, although alternatively they could be located in any other wall common to the first and second chambers 1, 2.

[0054] In any of the first to seventh embodiments described above (Figures 1-11), more than one air passage regulating device 7, each having one or more communication openings, could be placed in one or more of the walls common to the first and second chambers 1, 2. In any of the eighth to eleventh embodiments described above (Figures 12-17), more than one one-way valve device 4, each associated to a communication opening, could be placed in one or more of the walls common to the first and second chambers 1, 2.

[0055] The scope of the invention is defined by the at-

tached claims.

Claims

1. A dual plenum for air distribution comprising:

   a first chamber (1) and a second chamber (2) sharing at least one common wall (14) and further sharing an air outlet (10, 11) having diffusers (12, 13) in an air passage area (S1, S2) configured to direct air within an enclosure in general of a building.
   an air-feed device configured to selectively introduce, through an air supply conduit (9), pressurized air from an air supply source (8) to the first chamber (1) or to both the first chamber and the second chamber (2) in response to a supplied pressurized air flow rate; wherein said first chamber (1) is connected to one first air passage area (S1) of said air outlet (10), and said second chamber (2) is connected to a second air passage area (S2) of said air outlet (11),
   characterized in that the pressurized air supply conduit (9) is connected only to the first chamber (1);
   the common wall (14), includes an air passage regulating device (7) configured to selectively communicate the second chamber (2) to the first chamber (1) in response to an air pressure level in the first chamber (1) caused by the supplied pressurized air flow rate.

2. The dual plenum according to claim 1, wherein the common wall including the air passage regulating device (7) is adjacent to a region of the first chamber (1) directly connected to the first surface area (S1) without interposed constrictions.

3. The dual plenum according to claim 1, wherein the air passage regulating device (7) comprises one or more communication openings in the common wall (14), the one or more communication openings providing a third air passage area (S3). The ratio of the third air passage area (S3) to the first air passage area (S1) being selected to allow a given flow rate of pressurized air to be shunt from the first chamber (1) to the second chamber (2) in response to the air pressure level in the first chamber (1).

4. The dual plenum according to claim 1, wherein the air passage regulating device (7) comprises a one-way valve device (4) associated to a communication opening in the common wall (14), the one-way valve device (4) being configured to open in response to a pressure value inside the first chamber (1) above a specific threshold value thereby allowing a given flow rate of pressurized air to be shunt from the first chamber (1) to the second chamber (2).

5. The dual plenum according to claim 1, 2, 3 or 4, wherein:

   the common wall (14) is a vertical cylindrical or prismatic wall surrounded by a cylindrical or prismatic side outer wall (15) and the second chamber (2) is surrounded by the first chamber (1);
   the first chamber (1) is delimited by the common wall (14), the side outer wall (15), a first top wall (16), and a first bottom wall in which the first air outlet (10) and the first diffusers (12) are located;
   the second chamber (2) is delimited by the common wall (14), a second top wall (17), and a second bottom wall in which the second air outlet (11) and the second diffusers (13) are located; and
   the air inlet (3) is located in the side outer wall (15) or in the first top wall (16).

6. The dual plenum according to claim 1, 2, 3 or 4, wherein:

   the common wall (14) is a vertical cylindrical or prismatic wall surrounded by a cylindrical or prismatic side outer wall (15) and the first chamber (1) is surrounded by the second chamber (2);
   the first chamber (1) is delimited by the common wall (14), a first top wall (16), and a first bottom wall in which the first air outlet (10) and the first diffusers (12) are located;
   the second chamber (2) is delimited by the common wall (14), the side outer wall (15), a second top wall (17), and a second bottom wall in which the second air outlet (11) and the second diffusers (13) are located; and
   the air inlet (3) is located in the common wall (14) and the pressurized air supply conduit (9) communicates with the air inlet (3) of the first chamber (1) going through the second chamber (2); or
   the air inlet (3) is located in the first top wall (16).

7. The dual plenum according to claim 5 or 6, wherein:

   the first top wall (16) has a perimetral edge connected to the side outer wall (15) and an inner edge connected to the common wall (14), and the second top wall (17) has a perimetral edge connected to the common wall (14), or
   the first top wall (16) has a perimetral edge connected to the common wall (14), and the second top wall (17) has a perimetral edge connected to the side outer wall (15) and an inner edge connected to the common wall (14).

8. The dual plenum according to claim 5, wherein the

first top wall (16) has a perimetral edge connected to the side outer wall (15), the second top wall (17) has a perimetral edge connected to the common wall (14), and a section of the first chamber (1) extends between the first top wall (16) and the second top wall (17).

9. The dual plenum according to claim 6, wherein the first top wall (16) has a perimetral edge connected to the common wall (14), the second top wall (17) has a perimetral edge connected to the side outer wall (15), and a section of the second chamber (2) extends between the first top wall (16) and the second top wall (17).

10. The dual plenum according to claim 5, wherein the one or more communication openings of the air passage regulating device (7) are formed in a region of the common wall (14) facing a portion of the side outer wall (15) opposite the air inlet (3).

11. The dual plenum according to claim 6, wherein the one or more communication openings of the air passage regulating device (7) are formed in a region of the common wall (14) opposite the air inlet (3).

12. The dual plenum according to claim 1, 2, 3 or 4, wherein:

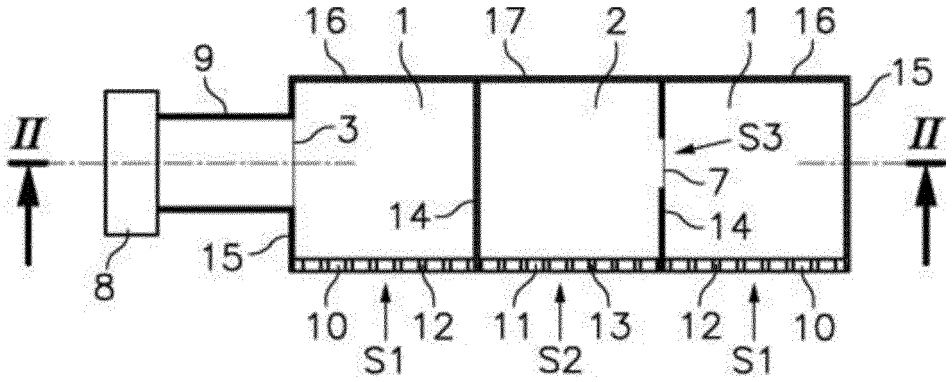
the common wall (14) is a partition wall which is connected inside of a vertical cylindrical or prismatic side outer wall (15a, 15b) and the first and second chambers (1, 2) are arranged adjacent side by side;
the first chamber (1) is delimited by the common wall (14), a first portion of the side outer wall (15a), a first top wall (16), and a first bottom wall in which the first air outlet (10) and the first diffusers (12) are located;
the second chamber (2) is delimited by the common wall (14), a second portion of the side outer wall (15b), a second top wall (17) and a second bottom wall in which the second air outlet (11) and the second diffusers (13) are located; and
the air inlet (3) is located in the first portion of the side outer wall (15a); or
the air inlet (3) is located in the first top wall (16); or
the air inlet (3) is located in the common wall (14) and the pressurized air supply conduit (9) communicates with the air inlet (3) of the first chamber (1) going through the second chamber (2).

13. The mixed plenum according to claim 4, wherein the communication opening is located in a vertical flat section of the common wall (14), and the one-way valve device (4) comprises a sheet secured by an attachment or hinge (19) at an upper or side edge thereof to the common wall (14) over the communication opening with the capacity to block the communication opening by gravity and to bend to open the communication opening to a greater or lesser degree in response to a pressure exerted on the flexible sheet.

14. The mixed plenum according to claim 4, wherein the communication opening is located in any wall common to the first and second chambers (1, 2), and the one-way valve device (4) comprises a sheet connected by a hinge (19) at an edge thereof to the common wall (14) adjacent to the communication opening, the sheet being biased to a closed position blocking the communication opening by the action of an elastic element (20), the sheet having the capacity to pivot to open the communication opening to a greater or lesser degree in response to a pressure exerted on the sheet.

15. The mixed plenum according to claim 4, wherein the communication opening is located in a vertical section of the common wall (14), and the one-way valve device (4) comprises a sheet connected by a hinge (19) at an upper edge thereof to the common wall (14) over the communication opening, the sheet being biased to a closed position blocking the communication opening by the action of its own weight, the sheet having the capacity to pivot to open the communication opening to a greater or lesser degree in response to a pressure exerted on the sheet.

16. The mixed plenum according to claim 4, wherein the communication opening is located in any wall common to the first and second chambers (1, 2), and the one-way valve device (4) is an automatically actuated mechanical valve device (21) having a movable part which partially opens, closes, or obstructs one or more orifices or conduits associated to the communication opening in cooperation with at least pressure sensor (22) and an electronic control device (23).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17
2
1
16
9
15
II
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S3
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7
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12
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13
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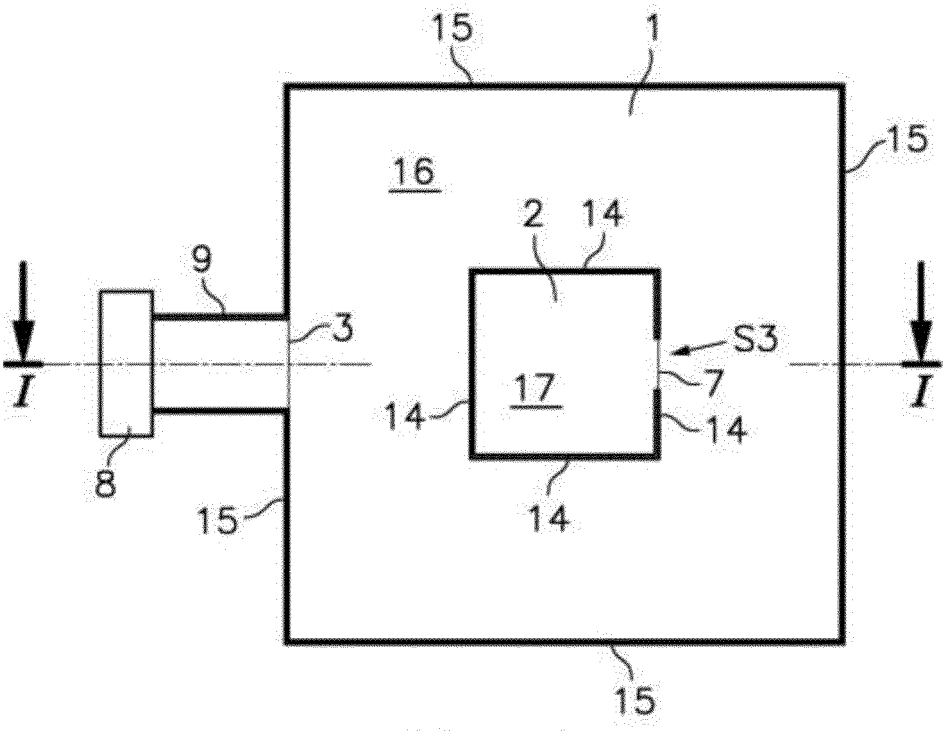
S1
S2
S1

Fig. 1


15
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S3
I
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17
7
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8
15
14
15

Fig. 2

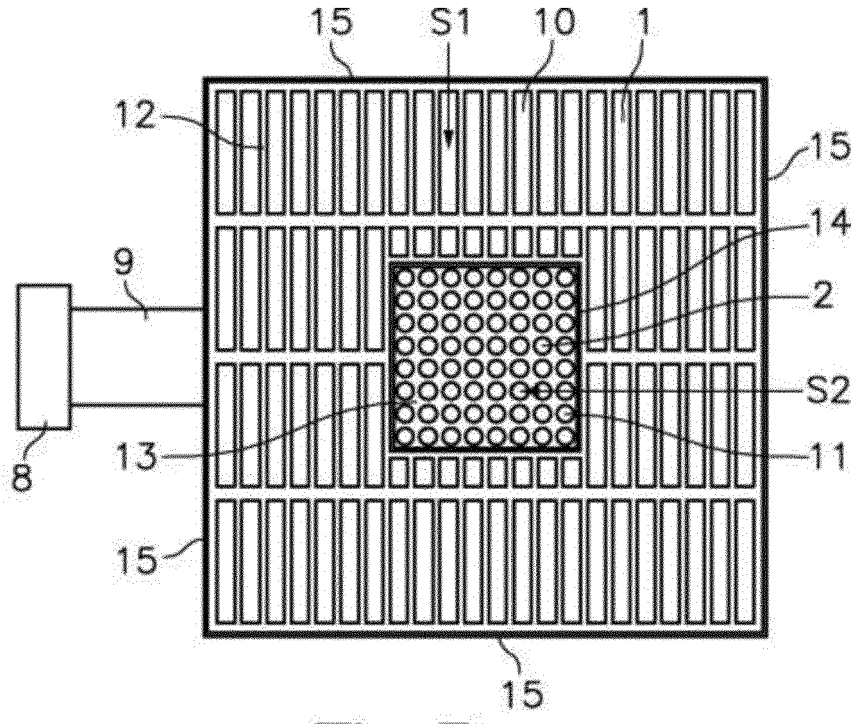

Fig.3

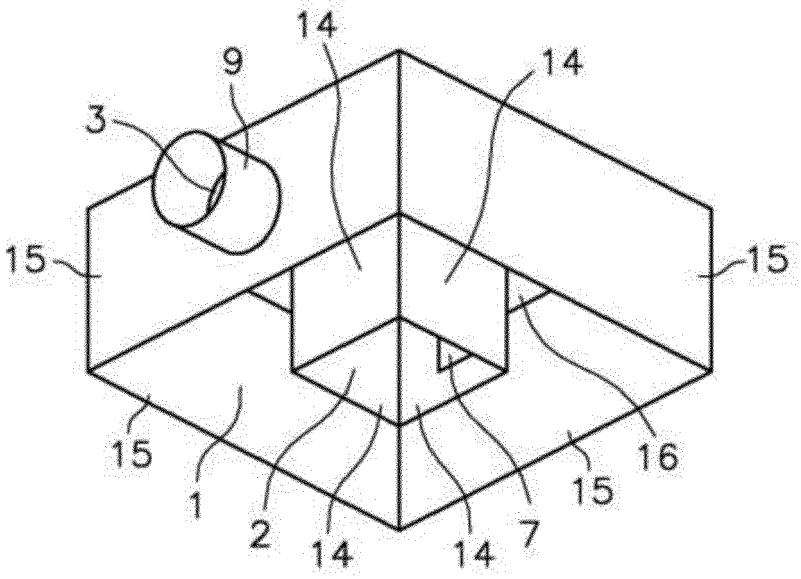

Fig.4

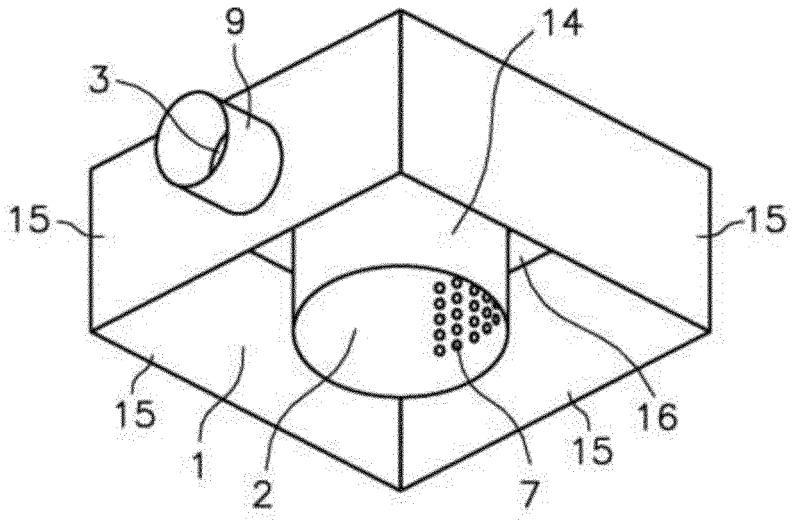

Fig.5

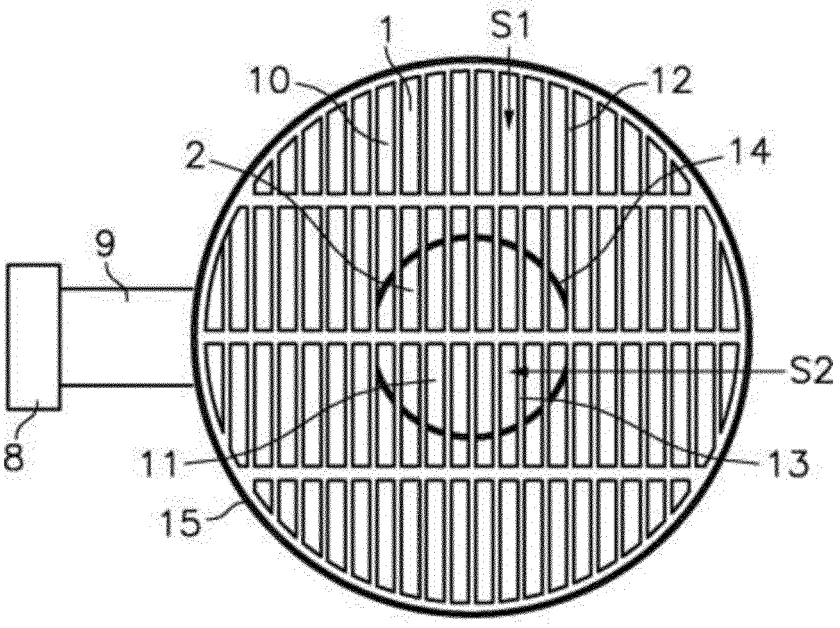

Fig.6

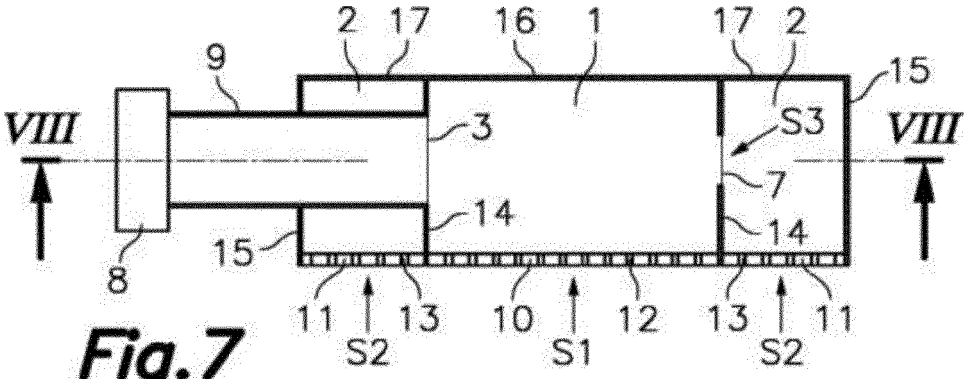

Fig.7

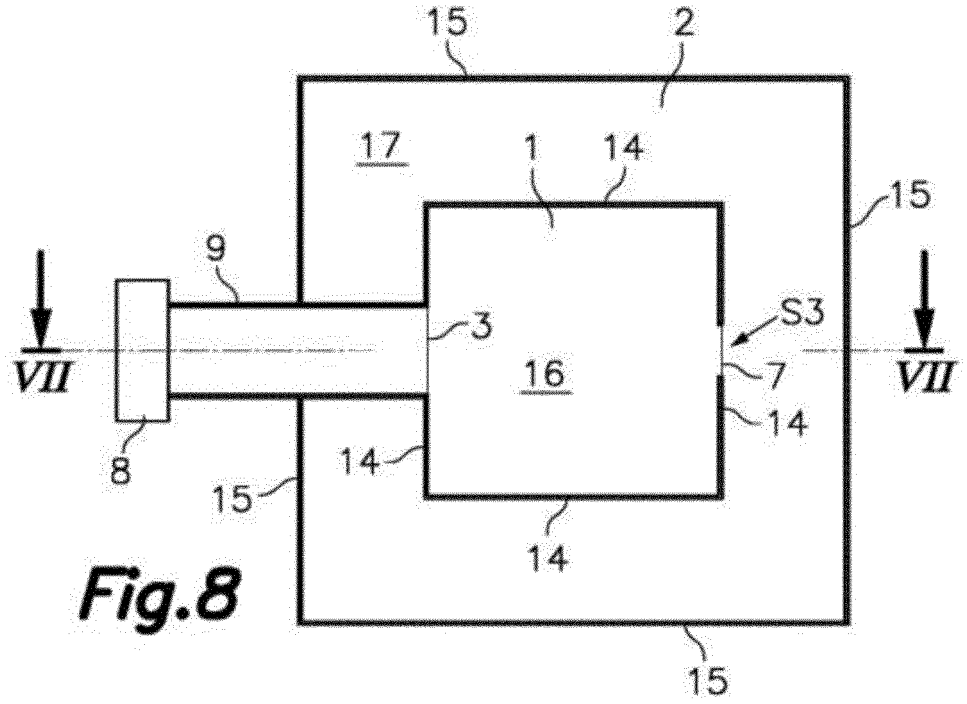

Fig.8

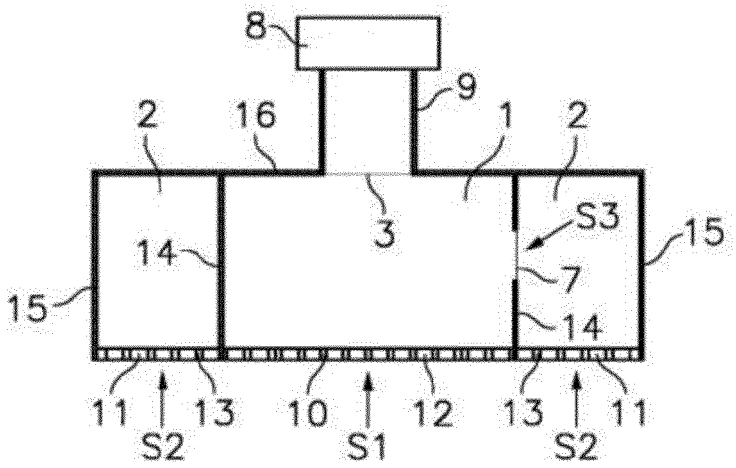

Fig.9

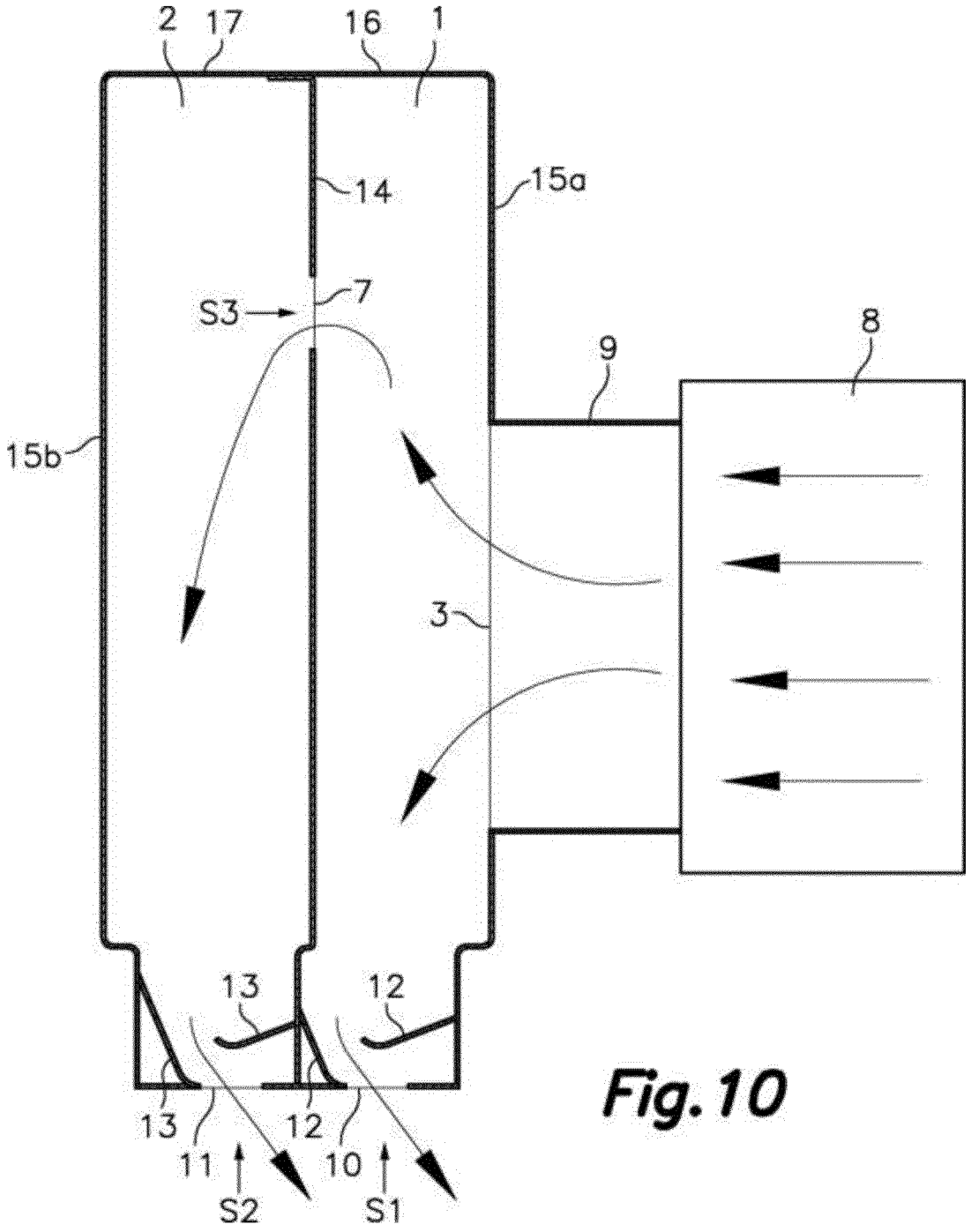

Fig. 10

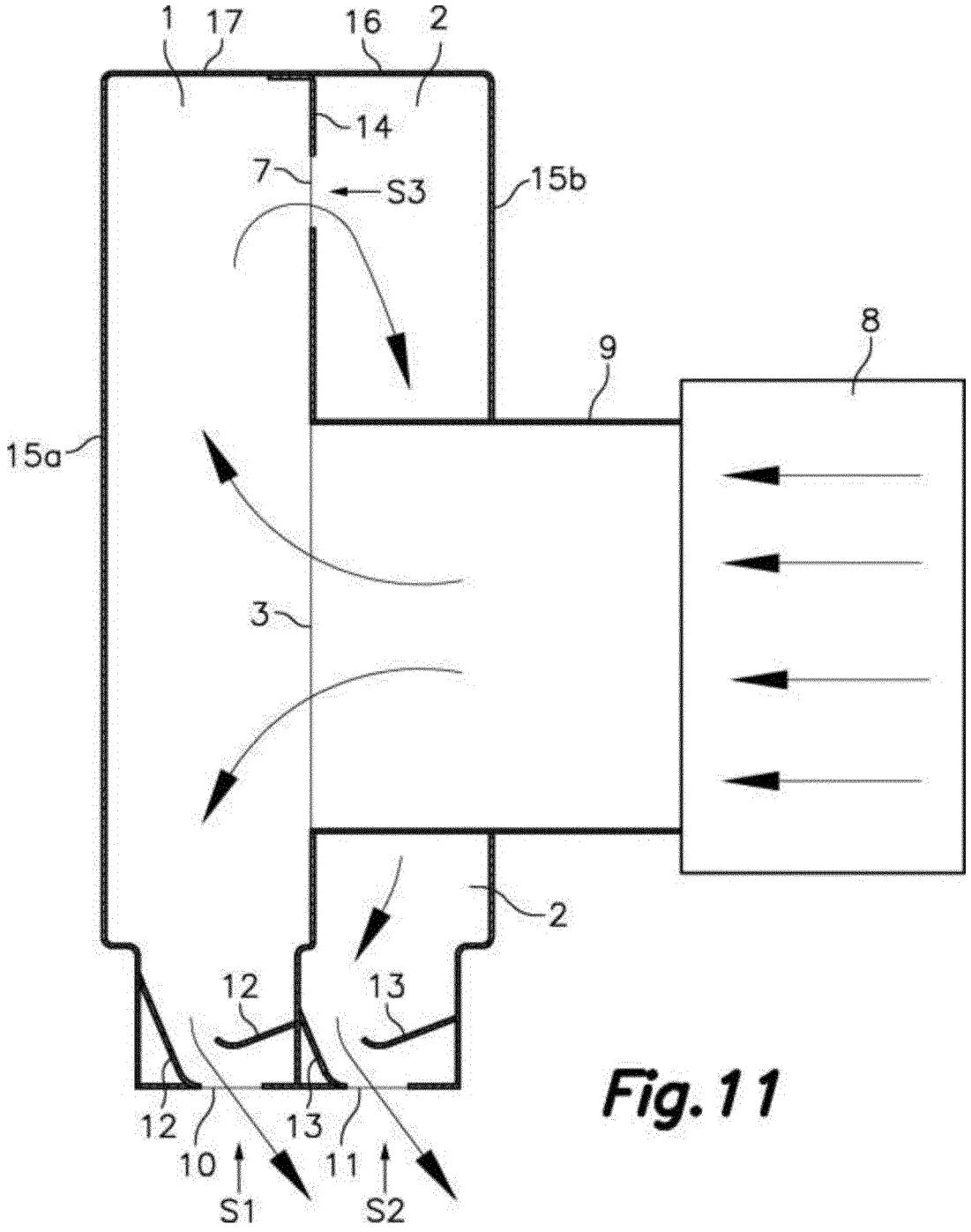

Fig. 11

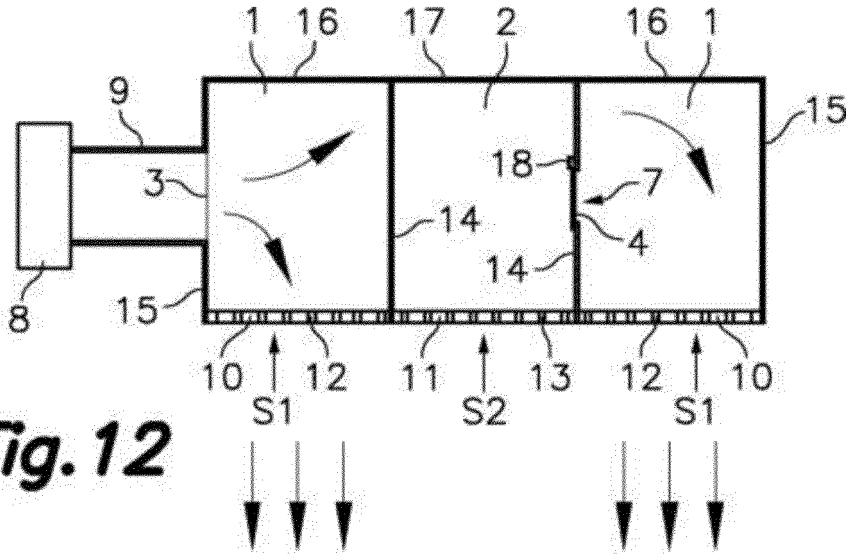

Fig. 12

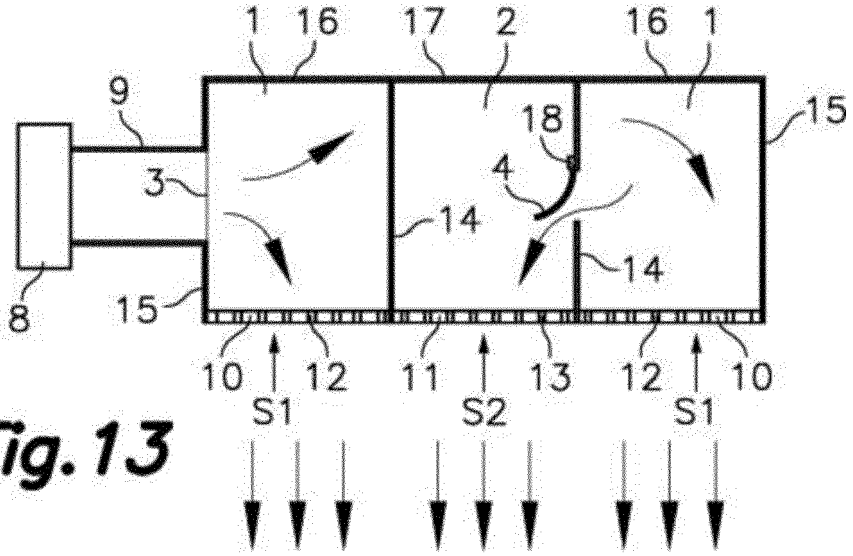

Fig. 13

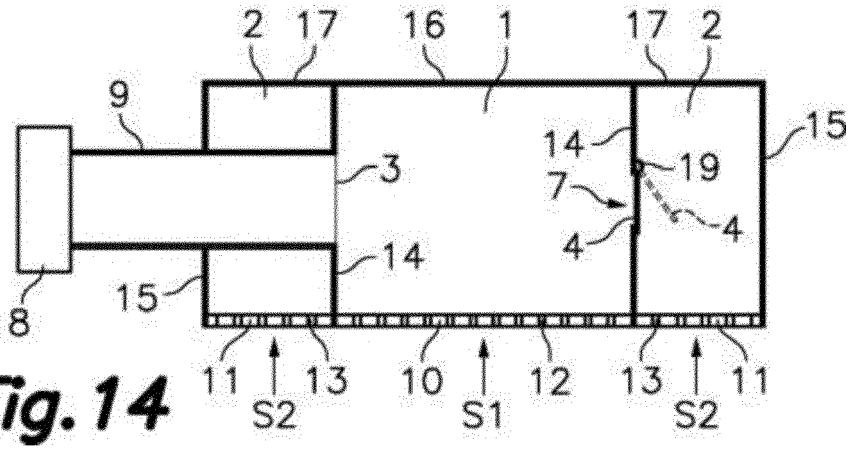

Fig. 14

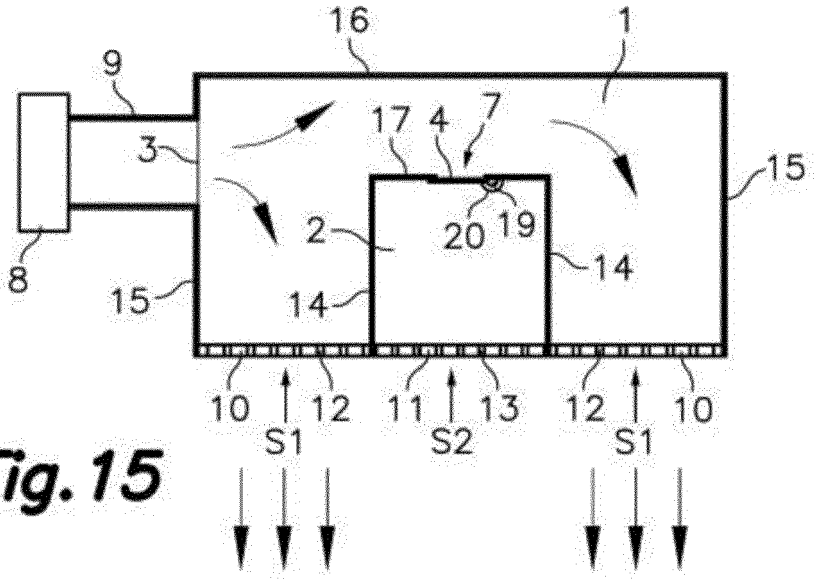

Fig. 15

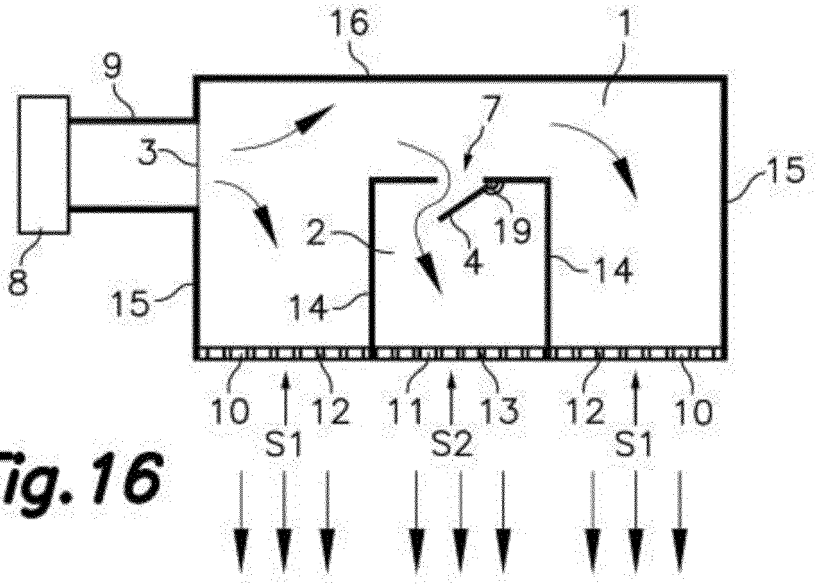

Fig. 16

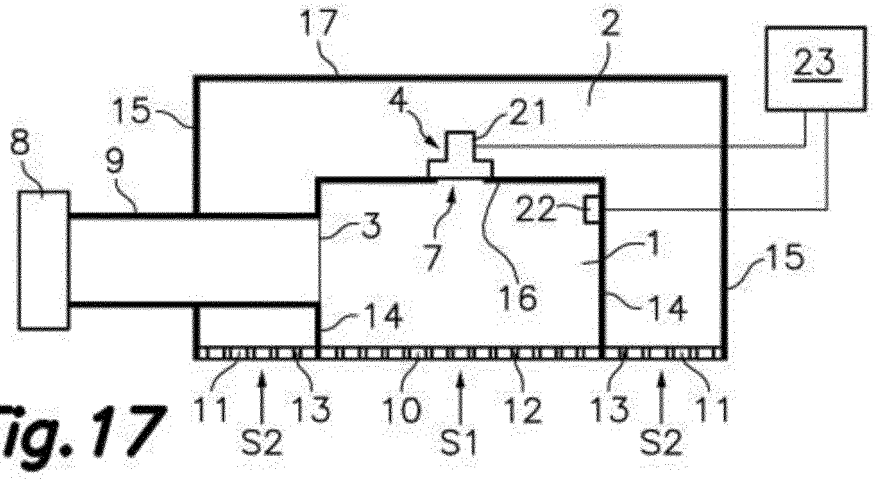

Fig. 17

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Application Number
EP 20 38 2635

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 November 2020	Valenza, Davide

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