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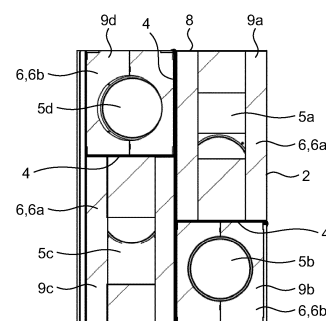
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(54) **MUFFLING DEVICE**

(57) A sound attenuator (2) is to be connected to a duct blower that supplies and exhausts air. The sound attenuator includes a housing (8) having a rectangular parallelepiped box shape, and air passage forming members (6) disposed in the housing (8) and defining, within the housing (8), a supply air suction side chamber (5b) to be connected to a suction air passage on a supply air side of the duct blower, a supply air discharge side chamber (5a) to be connected to a discharge air passage on a supply air side of the duct blower, an exhaust air suction side chamber (5d) to be connected to a suction air passage on an exhaust air side of the duct blower, and an exhaust air discharge side chamber (5c) to be connected to a discharge air passage on the exhaust air side of the duct blower. The air passage forming members (6) include a portion defining the supply air discharge side chamber (5a), and a portion defining the supply air suction side chamber (5b). The portion defining the supply air discharge side chamber (5a) is larger in volume than the portion defining the supply air suction side chamber (5b). The air passage forming members (6) include a portion defining the exhaust air discharge side chamber (5c), and a portion defining the exhaust air suction side chamber (5d). The portion defining the exhaust air discharge side chamber (5c) is larger in volume than the

portion defining the exhaust air suction side chamber (5d).

FIG.4



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## Description

### Field

**[0001]** The present disclosure relates to a sound attenuator that reduces duct noise.

### Background

**[0002]** Duct blowers that supply and discharge air through ducts are widely used for ventilation applications. When a discharge side of such a duct blower is indoors, duct-borne ventilation noise may be perceptibly objectionable, and noise reduction is desired. Additionally, even when the discharge side is outdoors, it is necessary to avoid noise emission to neighboring houses because many houses are built close together in an urban area, and noise reduction is desired as in the case where the discharge side is indoors. For such a purpose, a sound attenuator including a sound absorbing material is used together with a duct blower. The sound attenuator is connected to the middle of the duct or directly mounted on the duct blower.

**[0003]** A heat exchange ventilator that supplies and discharges air at the same time involves achieving sound attenuation in both a supply air duct and an exhaust duct. When sound attenuators are separately installed in the supply air duct and the exhaust duct, the number of steps of installation work increases. Thus, in order to reduce the number of steps, a combined sound attenuator capable of achieving sound attenuation in a plurality of ducts is used in some cases. Patent Literature 1 discloses a combined sound attenuator that achieves sound attenuation in a suction side and a discharge side for each of supply air and exhaust air. The combined sound attenuator is more expensive than a single pipe sound attenuator that achieves sound attenuation in only one duct, but installation work of the combined sound attenuator is easier than in a case where the single pipe sound attenuator is installed in each of a plurality of ducts.

### Citation List

#### Patent Literature

**[0004]** Patent Literature 1: European Patent No. 2642215

### Summary

#### Technical Problem

**[0005]** The combined sound attenuator integrally includes a plurality of air passages and a sound attenuating member that achieves sound attenuation in each air passage, and thus is larger in size than the single pipe sound attenuator. This has led to a problematic difficulty in securing an installation space for a combined sound atten-

uator capable of preventing noise transmission to rooms of a building or outside of the building.

**[0006]** The present disclosure has been made in view of the above, and an object of the present disclosure is to provide a combined type of sound attenuator that has a small increase in its size, and can prevent noise transmission to rooms of a building or outside of the building.

#### Solution to Problem

**[0007]** In order to solve the above-described problem and achieve the object, a sound attenuator according to the present disclosure is a sound attenuator to be connected to a ventilator to supply and discharge air, the sound attenuator comprising: a housing having a rectangular parallelepiped box shape; and air passage forming members disposed within the housing and defining, within the housing, a supply air suction side chamber to be connected to a suction air passage on a supply air side of the ventilator, a supply air discharge side chamber to be connected to a discharge air passage on the supply air side of the ventilator, an exhaust air suction side chamber to be connected to a suction air passage on an exhaust air side of the ventilator, and an exhaust air discharge side chamber to be connected to a discharge air passage on the exhaust air side of the ventilator. The air passage forming members include a portion defining the supply air discharge side chamber and a portion defining the supply air suction side chamber, the portion defining the supply air discharge side chamber being larger in volume than the portion defining the supply air suction side chamber. The air passage forming members include a portion defining the exhaust air discharge side chamber, and a portion defining the exhaust air suction side chamber, the portion defining the exhaust air discharge side chamber being larger in volume than the portion defining the exhaust air suction side chamber.

#### Advantageous Effects of Invention

**[0008]** The blower according to the present disclosure is of a combined type, has a small increase in its size, and can prevent noise transmission to rooms of a building or outside of the building.

#### Brief Description of Drawings

##### [0009]

FIG. 1 is a perspective view of a sound attenuator according to a first embodiment.

FIG. 2 is a perspective view of a duct blower on which the sound attenuator according to the first embodiment is to be mounted.

FIG. 3 is a view illustrating the sound attenuator according to the first embodiment and the duct blower as assembled together.

FIG. 4 is a cross-sectional view of the sound atten-

uator according to the first embodiment.

FIG. 5 is a cross-sectional view of the sound attenuator according to the first embodiment.

FIG. 6 is a cross-sectional view of a sound attenuator according to a second embodiment.

FIG. 7 is a cross-sectional view of a sound attenuator according to a third embodiment.

#### Description of Embodiments

**[0010]** A sound attenuator according to embodiments will be hereinafter described in detail with reference to the drawings.

#### First Embodiment.

**[0011]** FIG. 1 is a perspective view of a sound attenuator according to a first embodiment. A sound attenuator 2 includes a housing 8 having a rectangular parallelepiped box shape. The housing 8 includes a first surface 8a and a second surface 8b facing the first surface 8a. Each of the first surface 8a and the second surface 8b has discharge ports 3a and suction ports 3b. Note that the first surface 8a and the second surface 8b may be an upper surface and a lower surface, of the housing 8, or may be two lateral side surfaces of the housing 8, the two lateral side surfaces facing each other.

**[0012]** FIG. 2 is a perspective view of a duct blower on which the sound attenuator according to the first embodiment is to be mounted. In FIG. 2, outlined arrows represent airflows. A duct blower 1 has, on its one surface, a supply air inlet 1a, a supply air outlet 1b, an exhaust air inlet 1c, and an exhaust air outlet 1d. Air drawn through the supply air inlet 1a is discharged from the supply air outlet 1b. Air drawn through the exhaust air inlet 1c is discharged from the exhaust air outlet 1d.

**[0013]** FIG. 3 is a view illustrating the sound attenuator according to the first embodiment and the duct blower as assembled together. The sound attenuator 2 according to the first embodiment is connected directly to the duct blower 1 that is a ventilator that supplies and discharges air. When the sound attenuator 2 is connected to the duct blower 1, the first surface 8a is in contact with a housing of the duct blower 1. Additionally, although not illustrated, the discharge ports 3a and the suction ports 3b formed on the second surface 8b are connected to a supply air suction duct, a supply air discharge duct, an exhaust air suction duct, and an exhaust air discharge duct. The supply air suction duct, which is a duct for receiving outside air from the outside of a building, defines a suction air passage on a supply air side. The supply air discharge duct, which is a duct for supplying air to rooms of the building, defines a discharge air passage on the supply air side. The exhaust air suction duct, which is a duct for receiving room air, defines a suction air passage on an exhaust air side. The exhaust air discharge duct, which is a duct for discharging air to the outside of the building, defines a discharge air passage on the ex-

haust air side. The sound attenuator 2 dampens noise generated in the duct blower 1, and reduces transmission of the noise to the rooms of the building or the outside of the building through the supply air suction duct, the supply air discharge duct, the exhaust air suction duct, and the exhaust air discharge duct.

**[0014]** FIGS. 4 and 5 are each a cross-sectional view of the sound attenuator according to the first embodiment. FIG. 4 illustrates a cross section of the sound attenuator 2 taken in the direction of arrows IV-IV in FIG. 3. FIG. 5 illustrates a cross section of the sound attenuator 2 taken in the direction of arrows V-V in FIG. 3. Note that although FIG. 5 illustrates a cross section passing through a supply air discharge side chamber 5a and a supply air suction side chamber 5b, a cross section passing through an exhaust air discharge side chamber 5c and an exhaust air suction side chamber 5d is also similar in cross-sectional structure to the cross section illustrated in FIG. 5. The sound attenuator 2 includes partitions 4 that divide the inside of the housing 8 into four rooms 9a, 9b, 9c, and 9d. The rooms 9a, 9b, 9c, and 9d include air passage forming members 6 that define, within the housing 8, the supply air discharge side chamber 5a, the supply air suction side chamber 5b, the exhaust air discharge side chamber 5c, and the exhaust air suction side chamber 5d. Each of the supply air suction side chamber 5b and the exhaust air suction side chamber 5d has the discharge port 3a on the first surface 8a and the suction port 3b on the second surface 8b. Each of the supply air discharge side chamber 5a and the exhaust air discharge side chamber 5c has the suction port 3b on the first surface 8a and the discharge port 3a on the second surface 8b. The room 9a having the supply air discharge side chamber 5a formed therein is larger in capacity than the room 9b having the supply air suction side chamber 5b formed therein. Additionally, the room 9c having the exhaust air discharge side chamber 5c formed therein is larger in capacity than the room 9d having the exhaust air suction side chamber 5d formed therein.

**[0015]** Additionally, the suction port 3b and the discharge port 3a of each of the supply air discharge side chamber 5a and the exhaust air discharge side chamber 5c are at different positions in a plane parallel to the first surface 8a and the second surface 8b. On the other hand, the suction port 3b and the discharge port 3a of each of the supply air suction side chamber 5b and the exhaust air suction side chamber 5d are at the same position in a plane parallel to the first surface 8a and the second surface 8b.

**[0016]** The suction port 3b of the supply air suction side chamber 5b is connected to the supply air suction duct leading to the outside of the building. The discharge port 3a of the exhaust air discharge side chamber 5c is connected to the exhaust air discharge duct leading to the outside of the building. The discharge port 3a of the supply air discharge side chamber 5a is connected to the supply air discharge duct leading into the rooms of the building. The suction port 3b of the exhaust air suction

side chamber 5d is connected to the exhaust air suction duct leading into the rooms of the building. As described above, the sound attenuator 2 is a combined sound attenuator that achieves sound attenuation in the plurality of ducts. The discharge port 3a and the suction port 3b of each of the supply air discharge side chamber 5a, the supply air suction side chamber 5b, the exhaust air discharge side chamber 5c, and the exhaust air suction side chamber 5d have the same air passage areas.

**[0017]** The air passage forming members 6 include first sound attenuating materials 6a defining the supply air discharge side chamber 5a and the exhaust air discharge side chamber 5c, and second sound attenuating materials 6b defining the supply air suction side chamber 5b and the exhaust air suction side chamber 5d. Each of the first sound attenuating materials 6a is a porous sound absorbing material, and each of the second sound attenuating materials 6b is foamed plastic. The second sound attenuating material 6b may be a porous sound absorbing material.

**[0018]** The air passage forming members 6 include a portion defining the supply air discharge side chamber 5a, and a portion defining the supply air suction side chamber 5b. Since the room 9a having the supply air discharge side chamber 5a formed therein is larger in capacity than the room 9b having the supply air suction side chamber 5b formed therein, the portion defining the supply air discharge side chamber 5a is larger in volume than the portion defining the supply air suction side chamber 5b. Moreover, since the discharge port 3a and the suction port 3b of each of the supply air discharge side chamber 5a, the supply air suction side chamber 5b, the exhaust air discharge side chamber 5c, and the exhaust air suction side chamber 5d have the same air passage areas, the following relationship is satisfied:  $(V_a/S) > (V_b/S)$ , where  $V_a$  represents the capacity of the room 9a,  $V_b$  represents the capacity of the room 9b, and  $S$  represents the air passage area of each of the discharge port 3a and the suction port 3b. Thus, the supply air discharge side chamber 5a is better in sound attenuation performance than the supply air suction side chamber 5b.

**[0019]** The air passage forming members 6 further include a portion defining the exhaust air discharge side chamber 5c, and a portion defining the exhaust air suction side chamber 5d. Similarly, since the room 9c having the exhaust air discharge side chamber 5c formed therein is larger in capacity than the room 9d having the exhaust air suction side chamber 5d formed therein, the portion defining the exhaust air discharge side chamber 5c is larger in volume than the portion defining the exhaust air suction side chamber 5d. Moreover, since the discharge port 3a and the suction port 3b of each of the supply air discharge side chamber 5a, the supply air suction side chamber 5b, the exhaust air discharge side chamber 5c, and the exhaust air suction side chamber 5d have the same air passage areas, the following relationship is satisfied:  $(V_c/S) > (V_d/S)$ , where  $V_c$  represents the capacity

of the room 9c,  $V_d$  represents the capacity of the room 9d, and  $S$  represents the air passage area of each of the discharge port 3a and the respective suction port 3b. Thus, the exhaust air discharge side chamber 5c is better in sound attenuation performance than the exhaust air suction side chamber 5d.

**[0020]** Additionally, the portion of the air passage forming member 6, which defines the supply air discharge side chamber 5a, is larger in volume than at least one of the portions of the air passage forming members 6, which define the supply air suction side chamber 5b, the exhaust air discharge side chamber 5c, and the exhaust air suction side chamber 5d. That is, the portion of the air passage forming member 6, which defines the supply air discharge side chamber 5a, is not the smallest in volume of the portions of the air passage forming members 6, which define the other chambers. If the portion of the air passage forming member 6, which defines the supply air discharge side chamber 5a, is the smallest in volume of the portions of the air passage forming members 6, which define the other chambers, the noise generated in the duct blower 1 is likely to be transmitted to the rooms of the building through the supply air discharge side chamber 5a. However, in the sound attenuator 2 according to the first embodiment, such a phenomenon is reduced.

**[0021]** Additionally, the suction port 3b and the discharge port 3a of each of the supply air discharge side chamber 5a and the exhaust air discharge side chamber 5c are at different positions in a plane parallel to the first surface 8a and the second surface 8b, thereby preventing direct passage of the noise generated in the duct blower 1 through the supply air discharge side chamber 5a or the exhaust air discharge side chamber 5c. That is, the noise generated in the duct blower 1 is easily dampened in the supply air discharge side chamber 5a or the exhaust air discharge side chamber 5c.

**[0022]** Each of the supply air discharge side chamber 5a and the exhaust air discharge side chamber 5c has a straight air passage between the suction port 3b and the discharge port 3a. Since the supply air discharge side chamber 5a or the exhaust air discharge side chamber 5c has the straight air passage between the suction port 3b and the discharge port 3a, the amount of the first sound attenuating materials 6a disposed in the rooms 9a and 9c divided by the partitions 4 can be increased to improve sound attenuation performance, and the rapid expansion and rapid contraction of the air passage area can be reduced to obtain a low pressure loss in the air passage within the chamber.

**[0023]** Additionally, each of the supply air suction side chamber 5b and the exhaust air suction side chamber 5d has a constant cross-sectional area of the air passage between the suction port 3b and the discharge port 3a. Since each of the supply air suction side chamber 5b and the exhaust air suction side chamber 5d has the constant cross-sectional area of the air passage between the suction port 3b and the discharge port 3a, the amount of the second sound attenuating materials 6b disposed in the

rooms 9b and 9d divided by the partitions 4 can be increased to improve sound attenuation performance, and the rapid expansion and rapid contraction of the air passage area can be reduced to obtain a low pressure loss in the air passage within the chamber.

**[0024]** Note that it suffices for the air passage forming members 6 to be disposed at least in the room 9a having the supply air discharge side chamber 5a formed therein and the room 9c having the exhaust air discharge side chamber 5c formed therein.

**[0025]** In the sound attenuator 2 according to the first embodiment, the air passage forming members 6 have the portion defining the supply air discharge side chamber 5a downstream of the duct blower 1 as a noise source in a direction of airflows generated by the duct blower 1, and the portion defining the supply air suction side chamber 5b upstream of the duct blower 1 in the direction of airflows. The portion defining the supply air discharge side chamber 5a is larger in volume than the portion defining the supply air suction side chamber 5b. This can improve the sound attenuation properties of the supply air discharge side chamber 5a in which the noise travels in the same direction as the direction of the airflows. As for the exhaust air side, similarly, the air passage forming members 6 have the portion defining the exhaust air discharge side chamber 5c downstream of the duct blower 1 as a noise source in a direction of airflows generated by the duct blower 1, and the portion defining the exhaust air suction side chamber 5d upstream of the duct blower 1 in the direction of airflows. The portion defining the exhaust air discharge side chamber 5c is larger in volume than the portion defining the exhaust air suction side chamber 5d. This can improve the sound attenuation properties of the exhaust air discharge side chamber 5c in which the noise travels in the same direction as the direction of the airflows.

**[0026]** If the air passage forming members 6 of all the rooms 9a, 9b, 9c, and 9d have the same sizes, the attempt to prevent noise transmission to rooms of the building or outside of the building through the supply air discharge side chamber 5a and the exhaust air discharge side chamber 5c causes excessive sound attenuation performance in the supply air suction side chamber 5b and the exhaust air suction side chamber 5d and causes excessive increase in a size of the housing 8. On the other hand, if the supply air discharge side chamber 5a and the exhaust air discharge side chamber 5c have the same sound attenuation performance as the sound attenuation performance that prevents the noise transmission to rooms of the building or outside of the building through the supply air suction side chamber 5b and the exhaust air suction side chamber 5d, the sound attenuation performance in the supply air discharge side chamber 5a and the exhaust air discharge side chamber 5c is insufficient, which causes the noise transmission to the rooms of the building or the outside of the building. In the sound attenuator 2 according to the first embodiment, the portions of the air passage forming members 6, which

define the discharge side chambers downstream of the duct blower 1 as a noise source in the direction of the airflows, are larger in volume than the portions of the air passage forming members 6, which define the suction side chambers upstream of the duct blower 1 in the direction of the airflows. This can reduce an increase in the size of the sound attenuator 2, and prevent noise transmission to rooms of the building or outside of the building, as compared with the case where the air passage forming members 6 of all the rooms 9a, 9b, 9c, and 9d have the same sizes.

**[0027]** Note that the above description has been made taking an example in which the sound attenuator 2 includes the suction side chamber and the discharge side chamber for each of the supply air and the exhaust air. In another example, the sound attenuator 2 may include the suction side chamber and the discharge side chamber for only one of the supply air and the exhaust air. That is, the sound attenuator 2 may include at least one suction side chamber and at least one discharge side chamber.

#### Second Embodiment.

**[0028]** FIG. 6 is a cross-sectional view of a sound attenuator according to a second embodiment. A sound attenuator 2 according to the second embodiment is different from the sound attenuator 2 according to the first embodiment in that the individual air passage forming members 6 having constant thicknesses along inner walls of the supply air discharge side chamber 5a and the exhaust air discharge side chamber 5c. The other parts are similar to those of the sound attenuator 2 according to the first embodiment, and thus redundant description is omitted.

**[0029]** As with the sound attenuator 2 according to the first embodiment, the sound attenuator 2 according to the second embodiment has a small increase in its size and can prevent noise transmission to rooms of the building or outside of the building, as compared with the case where the air passage forming members 6 of all the rooms 9a, 9b, 9c, and 9d have the same sizes.

#### Third Embodiment.

**[0030]** FIG. 7 is a cross-sectional view of a sound attenuator according to a third embodiment. A sound attenuator 2 according to the third embodiment is different from the sound attenuator 2 according to the first embodiment in that a perforated plate 7 is disposed on each of surfaces of the individual air passage forming members 6 within the supply air discharge side chamber 5a and the exhaust air discharge side chamber 5c. The other parts are similar to those of the sound attenuator 2 according to the first embodiment, and thus redundant description is omitted.

**[0031]** The perforated plate 7 is a resonator sound absorbing material having a plurality of holes at regular in-

tervals. The perforated plate 7 dissipates sound of a specific frequency determined by a hole diameter. The sound attenuator 2 according to the third embodiment has a sound attenuation effect greater than that of the sound attenuator 2 according to the first embodiment in terms of sound of a specific frequency determined by the hole diameter of the perforated plate 7.

**[0032]** The configurations described in the above embodiments merely illustrate examples of the contents of the present invention. The configurations may be combined with other well-known techniques, and some of the configurations may be omitted or changed without departing from the scope of the invention.

#### Reference Signs List

**[0033]** 1 duct blower; 1a supply air inlet; 1b supply air outlet; 1c exhaust air inlet; 1d exhaust air outlet; 3a discharge port; 3b suction port; 2 sound attenuator; 4 partition; 5a supply air discharge side chamber; 5b supply air suction side chamber; 5c exhaust air discharge side chamber; 5d exhaust air suction side chamber; 6 air passage forming member; 6a first sound attenuating material; 6b second sound attenuating material; 7 perforated plate; 8 housing; 8a first surface; 8b second surface; and 9a, 9b, 9c, 9d room.

#### Claims

1. A sound attenuator to be connected to a ventilator to supply and discharge air, the sound attenuator comprising:

a housing having a rectangular parallelepiped box shape; and

air passage forming members disposed within the housing and defining, within the housing, a supply air suction side chamber to be connected to a suction air passage on a supply air side of the ventilator, a supply air discharge side chamber to be connected to a discharge air passage on the supply air side of the ventilator, an exhaust air suction side chamber to be connected to a suction air passage on an exhaust air side of the ventilator, and an exhaust air discharge side chamber to be connected to a discharge air passage on the exhaust air side of the ventilator, wherein

the air passage forming members include a portion defining the supply air discharge side chamber and a portion defining the supply air suction side chamber, the portion defining the supply air discharge side chamber being larger in volume than the portion defining the supply air suction side chamber, and

the air passage forming members include a portion defining the exhaust air discharge side

chamber, and a portion defining the exhaust air suction side chamber, the portion defining the exhaust air discharge side chamber being larger in volume than the portion defining the exhaust air suction side chamber.

2. The sound attenuator according to claim 1, wherein

the supply air discharge side chamber has a suction port and a discharge port each of which is formed on a corresponding one of two surfaces of the housing, the two surfaces facing each other, and

the suction port and the discharge port of the supply air discharge side chamber are at different positions in a plane parallel to the two surfaces.

3. The sound attenuator according to claim 2, wherein

the exhaust air discharge side chamber has a suction port and a discharge port each of which is formed on a corresponding one of the two surfaces, and

the suction port and the discharge port of the exhaust air discharge side chamber are at different positions in a plane parallel to the two surfaces.

4. The sound attenuator according to claim 3, wherein

each of the exhaust air suction side chamber and the supply air suction side chamber has a suction port and a discharge port, the suction port and the discharge port each being formed on a corresponding one of the two surfaces, and the suction port and the discharge port of each of the exhaust air suction side chamber and the supply air suction side chamber are at a same position in a plane parallel to the two surfaces.

5. The sound attenuator according to any one of claims 1 to 4, wherein each of the supply air suction side chamber and the exhaust air suction side chamber has a constant cross-sectional area of an air passage between a suction port and a discharge port.

6. The sound attenuator according to any one of claims 1 to 5, wherein each of the supply air discharge side chamber and the exhaust air discharge side chamber has a straight air passage between a suction port and a discharge port.

7. The sound attenuator according to any one of claims 1 to 6, wherein the portion defining the supply air discharge side chamber is a porous sound absorbing material.

8. The sound attenuator according to any one of claims 1 to 6, wherein

the air passage forming members include a first sound attenuating material defining the supply air discharge side chamber and the exhaust air discharge side chamber, and a second sound attenuating material defining the supply air suction side chamber and the exhaust air suction side chamber,  
the first sound attenuating material is a porous sound absorbing material, and  
the second sound attenuating material is foamed plastic.

9. The sound attenuator according to any one of claims 1 to 8, wherein at least the supply air discharge side chamber includes a resonator sound absorbing material.

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FIG.1

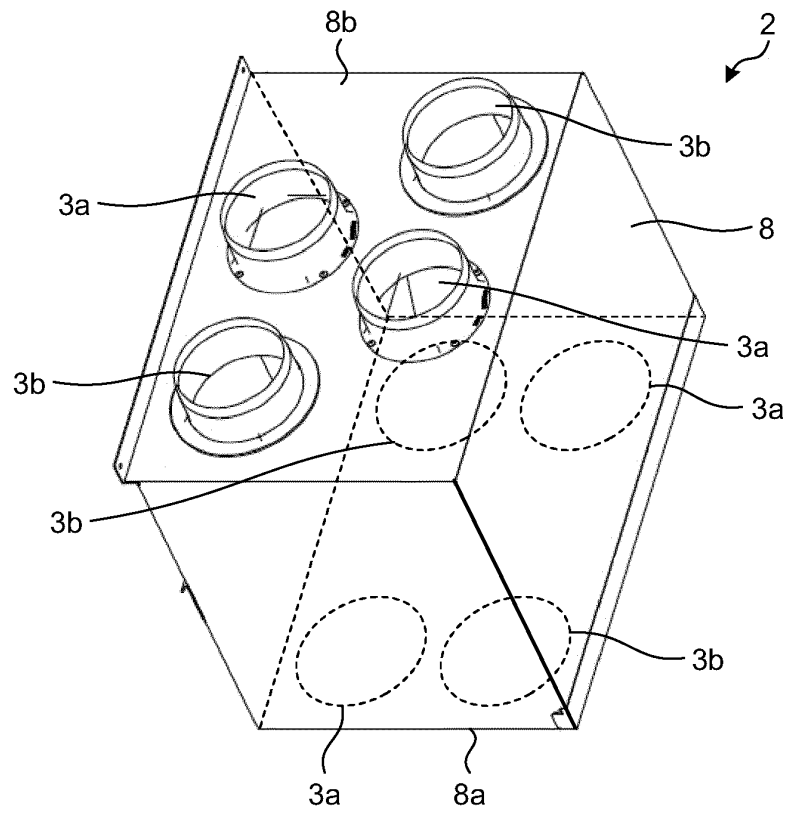


FIG.2

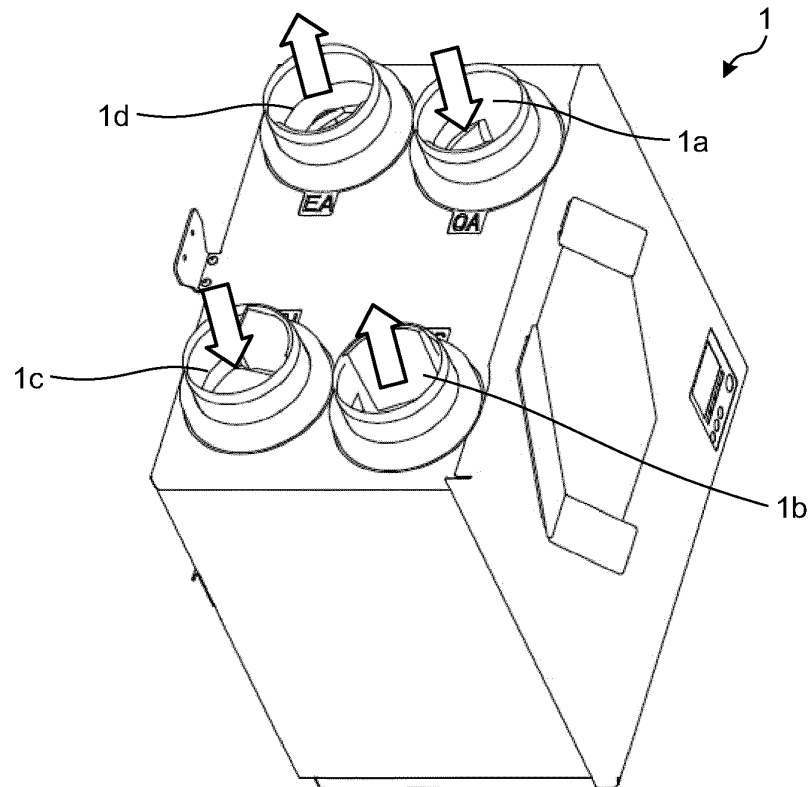


FIG.3

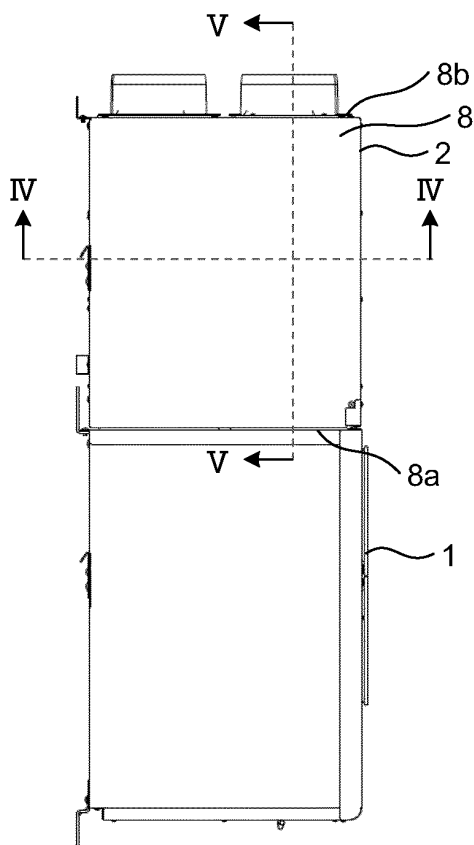


FIG.4

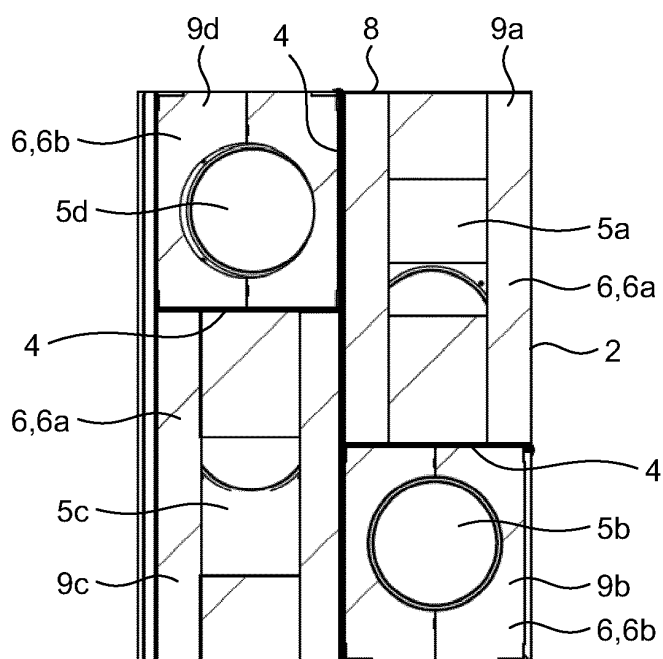


FIG.5

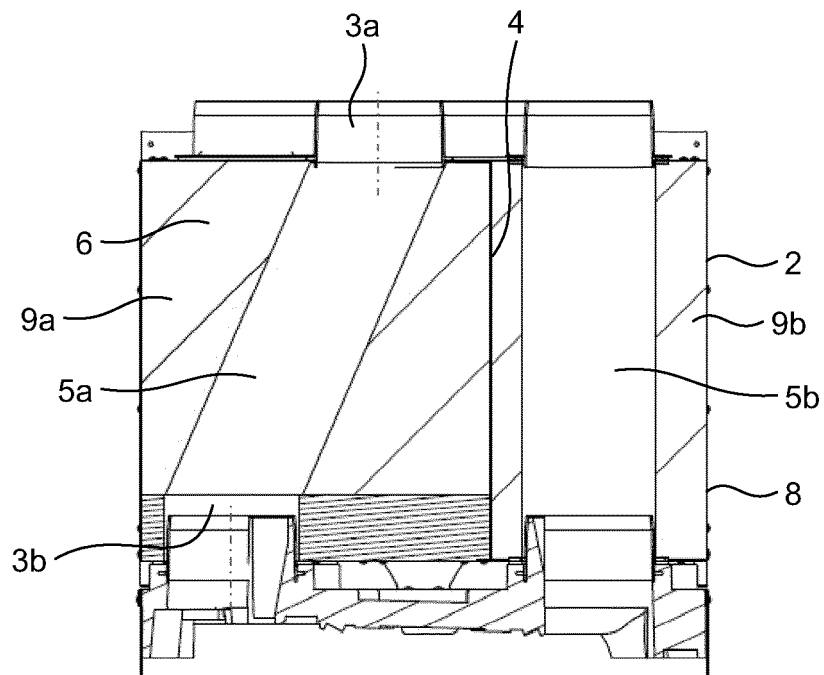
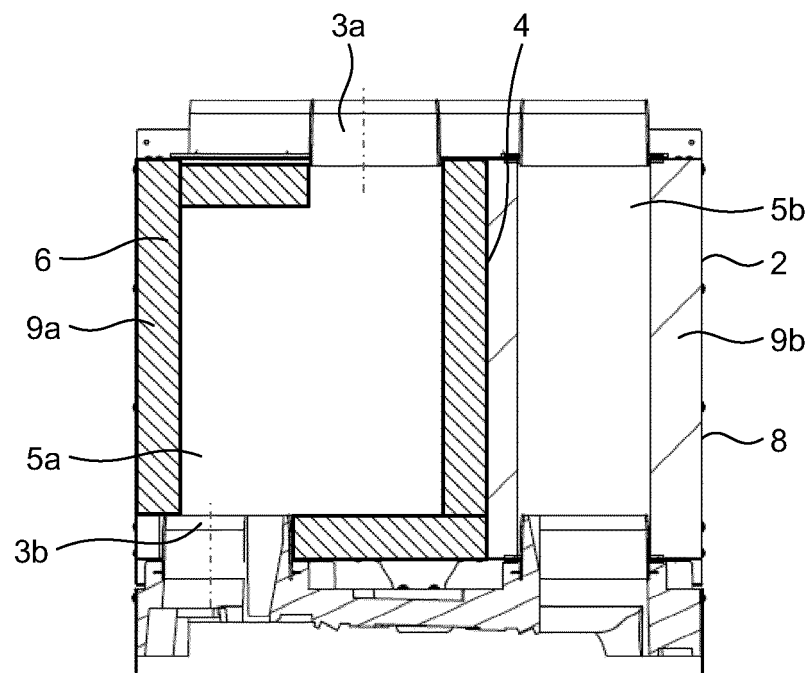
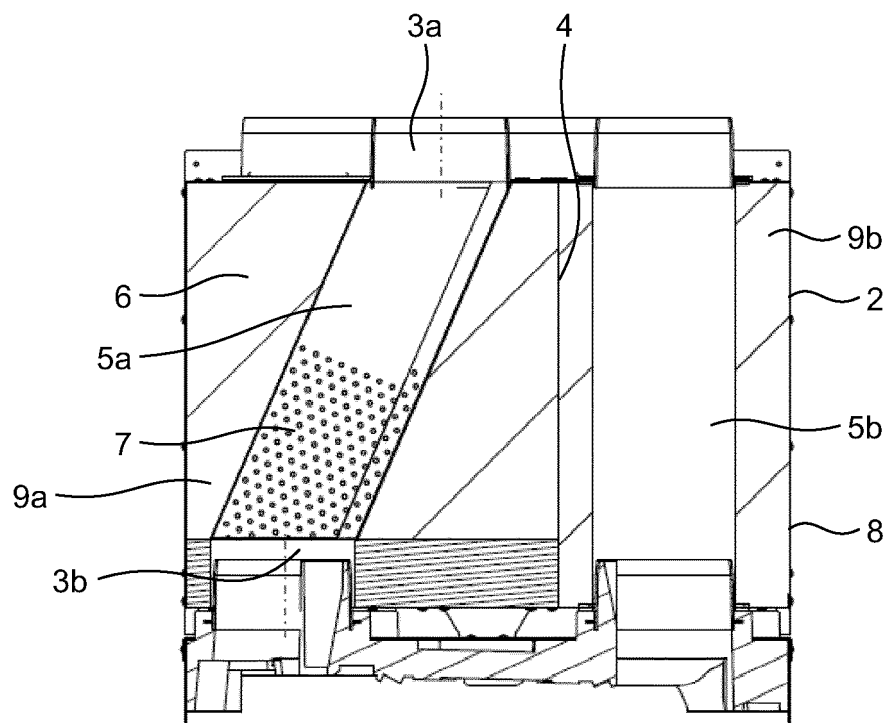


FIG.6



**FIG.7**



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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/002649

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## A. CLASSIFICATION OF SUBJECT MATTER

F24F 13/14 (2006.01) i

FI: F24F13/14

According to International Patent Classification (IPC) or to both national classification and IPC

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## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F13/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2021

Registered utility model specifications of Japan 1996-2021

Published registered utility model applications of Japan 1994-2021

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                | Relevant to claim No. |
|-----------|---------------------------------------------------------------------------------------------------|-----------------------|
| X         | WO 2015/033215 A1 (ZEHNDER GROUP INTERNATIONAL AG)                                                | 1                     |
| Y         | 12 March 2015 (2015-03-12) page 1, line 2 to page 8, line 26, fig. 1-6                            | 2-9                   |
| Y         | EP 3543622 A1 (HOVAL AKTLENGESELLSCHAFT) 25 September 2019 (2019-09-25) fig. 8-16                 | 2-9                   |
| Y         | EP 2306108 A1 (OSTBERG, Hans) 06 April 2011 (2011-04-06) fig. 5-6                                 | 2-9                   |
| Y         | JP 2002-089228 A (HAYASHIZAKI, Masakatsu) 27 March 2002 (2002-03-27) paragraphs [0019]-[0020]     | 7-9                   |
| Y         | JP 05-026492 A (MITSUBISHI ELECTRIC CORP.) 02 February 1993 (1993-02-02) paragraph [0017], fig. 4 | 9                     |

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☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search  
25 March 2021 (25.03.2021)Date of mailing of the international search report  
06 April 2021 (06.04.2021)

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Telephone No.

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/002649

| C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                                                                                                                                      |                       |
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| Category*                                             | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                   | Relevant to claim No. |
| 10 A                                                  | JP 03-263537 A (DAIKIN INDUSTRIES, LTD.) 25 November 1991 (1991-11-25) entire text, all drawings                                                                                                                                     | 1-9                   |
| 15 A                                                  | Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 112283/1987 (Laid-open No. 016545/1989) (KIMURA KOHKI CO., LTD.) 27 January 1989 (1989-01-27) entire text, all drawings | 1-9                   |
| 20                                                    |                                                                                                                                                                                                                                      |                       |
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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

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**REFERENCES CITED IN THE DESCRIPTION**

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