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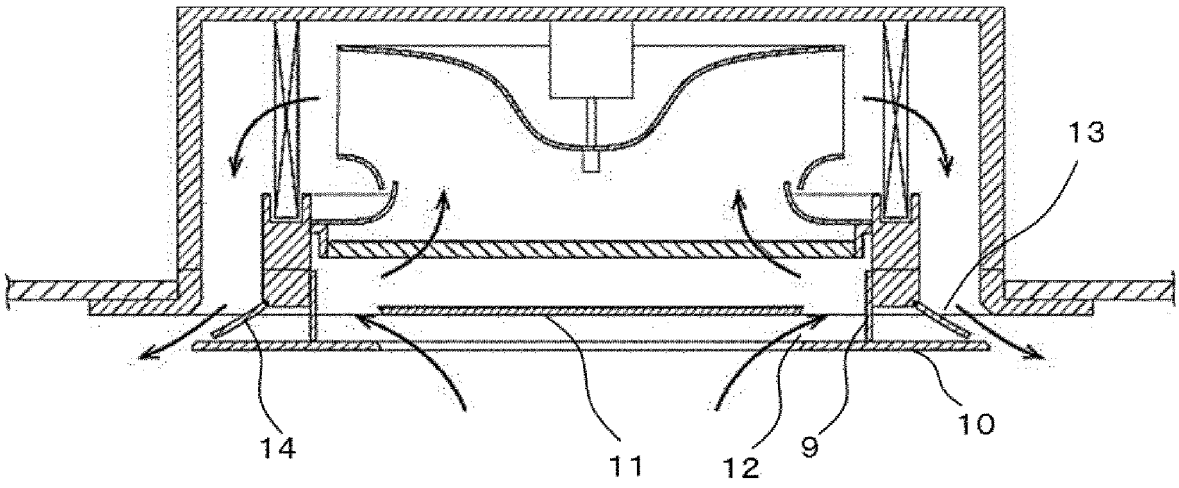
(54) CEILING-EMBEDDED AIR CONDITIONER

(57) An object of the present invention is to provide a ceiling cassette air conditioner with which design deterioration due to wind direction vanes during operation is reduced. The ceiling cassette air conditioner 1 of this invention includes a main body 2 arranged in a ceiling and having a rectangular cross-section opening opens on a room side, a blower fan 5 blowing air taken in from an air inlet 12 to a discharge outlet 13 in the main body 2, a heat exchanger 6 arranged in the main body 2 and downstream of the blower fan 5 and exchanging heat with the air taken in from the air inlet 12, a decorative panel 8 covering the opening to be flush with a ceiling surface, and wind direction vanes 14 arranged in the discharge outlet 13 for adjusting blowing directions. The wind direction vanes 14 are arranged behind the decorative panel 8.

FIG.3



EP 3 309 471 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a ceiling cassette air conditioner having good design properties.

BACKGROUND ART

[0002] Conventionally, there is a ceiling cassette air conditioner that takes in air from a room, and supplies conditioned air into the room. This ceiling cassette air conditioner has four wind direction vanes to adjust blowing directions. The blowing directions toward the room are adjusted by adjusting angles of these wind direction vanes. Further, in this ceiling cassette air conditioner, four wind direction vanes and a decorative panel are flush with a ceiling surface when the ceiling cassette air conditioner is out of operation in order to improve design properties.

CITATION LIST

Patent Literature

[0003] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2012-107864

SUMMARY OF INVENTION

Technical Problem

[0004] However, in operation, each of the four wind direction vanes is fixed at a predetermined angle or is moving to adjust the blowing direction. Therefore, the wind direction vanes which are fixed at predetermined angles or moving are recognized by a user visually. As a result, the design properties are deteriorated.

[0005] The present invention is made in order to solve the above-mentioned problem, and it is therefore an object of the present invention to provide a ceiling cassette air conditioner with which deterioration in design properties during operation due to wind direction vanes is reduced.

Solution to Problem

[0006] A ceiling cassette air conditioner according to the present invention includes: a main body arranged in a ceiling and having a rectangular cross-section opening on a room side of the main body; a blower fan arranged in the main body, and configured to blow air taken in from an air inlet of the main body to a discharge outlet of the main body; a heat exchanger arranged in the main body and downstream of the blower fan, and configured to exchange heat with the air taken in from the air inlet; a decorative panel covering the opening, and arranged to be flush with a ceiling surface; and a wind direction vane arranged in the discharge outlet, and configured to adjust a blowing direction. The wind direction vane is arranged behind the decorative panel.

Advantageous Effects of Invention

[0007] In the ceiling cassette air conditioner according to the present invention, because the wind direction vanes in the discharge outlet are arranged behind the decorative panel, a user in a room cannot visually recognize the wind direction vanes. Therefore, even when the ceiling cassette air conditioner is in operation and each of four wind direction vanes is fixed at a predetermined angle or moving, a user cannot visually recognize the wind direction vanes, and as a result, an effect of avoiding deterioration of design properties can be achieved.

BRIEF DESCRIPTION OF DRAWINGS

[0008]

Fig. 1 is a cross-sectional side view of a ceiling cassette air conditioner according to Embodiment 1 when the ceiling cassette air conditioner is out of operation;

Fig. 2 is an exterior perspective view of the ceiling cassette air conditioner according to Embodiment 1 when the ceiling cassette air conditioner is out of operation;

Fig. 3 is a cross-sectional side view of the ceiling cassette air conditioner according to Embodiment 1 when the ceiling cassette air conditioner is in operation;

Figs. 4A to 4C are diagrams for illustrating a relationship between a blowing amount and an arrangement of a decorative panel in the ceiling cassette air conditioner according to Embodiment 1;

Fig. 5 is a cross-sectional side view of a ceiling cassette air conditioner according to Embodiment 2 when the ceiling cassette air conditioner is out of operation;

Fig. 6 is an exterior plan view of the ceiling cassette air conditioner according to Embodiment 2 viewed from a room side when the ceiling cassette air conditioner is out of operation; and

Fig. 7 is a cross-sectional side view of the ceiling cassette air conditioner according to Embodiment 2 when the ceiling cassette air conditioner is in operation.

DESCRIPTION OF EMBODIMENTS

Embodiment 1

[0009] With reference to Figs. 1 to 4, a configurations of a ceiling cassette air conditioner according to Embodiment 1 of the present invention will be explained. Fig. 1

is a cross-sectional side view of a ceiling cassette air conditioner according to Embodiment 1 when the ceiling cassette air conditioner is out of operation. Fig. 2 is an exterior perspective view of the ceiling cassette air conditioner according to Embodiment 1 when the ceiling cassette air conditioner is out of operation. Fig. 3 is a cross-sectional side view of the ceiling cassette air conditioner according to Embodiment 1 when the ceiling cassette air conditioner is in operation. Figs. 4A to 4C are diagrams for illustrating a relationship between the blowing amount and an arrangement of a decorative panel in the ceiling cassette air conditioner according to Embodiment 1.

[0010] As shown in Fig. 1, a ceiling cassette air conditioner 1 includes: a main body 2 arranged in a ceiling and having a rectangular cross-section opening on a room side thereof; and an exterior case 4 arranged on a room side of the main body 2 and exposed on a ceiling surface 3. Further, in the main body 2 of the ceiling cassette air conditioner 1, a blower fan 5 that blows air taken in from an air inlet 12 (it will be described later) of the main body 2 to a discharge outlet 13 (it will be described later) of the main body 2, a heat exchanger 6 that is arranged downstream of the blower fan 5 and that exchanges heat with the air taken in from the air inlet 12, and a dust collection filter 7 that removes dust from the air taken in into the main body 2 are provided. Further, the ceiling cassette air conditioner 1 includes a decorative panel 8 that is arranged to be flush with the ceiling surface 3 and that covers the opening of the main body 2. The decorative panel 8 is raised and lowered with a lifting device 9 in response to operating conditions of the blower fan 5.

[0011] As shown in Fig. 2, the main body 2 has a rectangular parallelepiped box shape, and is arranged in the ceiling in such a way that the room side thereof is open. The exterior case 4 is attached to the main body 2 to surround the periphery of the opening of the main body 2 as viewed from the room side. That is, the exterior case 4 has a rectangular frame shape, which is a shape of a plate from which a central portion is removed. Furthermore, the exterior case 4 is attached to the ceiling so as to be flush with the ceiling surface 3. Of course, the exterior case 4 may not necessarily be completely flush with the ceiling surface, as long as the exterior case 4 appears to be flush with the ceiling surface at a glance.

[0012] As shown in Fig. 1, the blower fan 5 is provided at a central portion of a bottom part of the main body 2 that has a box shape. When the blower fan 5 rotates, the air in the room is taken in from the air inlet 12 and is discharged from the discharge outlet 13. The heat exchanger 6 is arranged between the blower fan 5 and the discharge outlet 13, and exchanges heat with the air taken in from the air inlet 12 by an operation of the blower fan 5. The dust collection filter 7 is arranged behind the decorative panel 8 as viewed from the room side, between the air inlet 12 and the blower fan 5, and plays a role of removing the dust contained in the air taken in from the air inlet 12 by the operation of the blower fan 5.

[0013] As shown in Fig. 1 and Fig. 2, the decorative panel 8 is provided to fill a central portion of the exterior case 4 that has a rectangular frame shape, and is provided to cover the opening of the main body 2. The decorative panel 8 includes a peripheral panel 10 having a rectangular frame shape, and a central panel 11 having a rectangular plate shape so as to fill a central portion of the peripheral panel 10. The central panel 11 covers the air inlet 12, and the peripheral panel 10 covers the air inlet 12 and the discharge outlet 13. That is, the peripheral panel 10 having a rectangular frame shape is arranged inside the exterior case 4 having a rectangular frame shape, and the central panel 11 having a rectangular plate shape is arranged inside the peripheral panel 10. The exterior case 4, the peripheral panel 10, and the central panel 11 form a single plate shape, and they are arranged so as to be flush with the ceiling surface 3 as viewed from the room side. Of course, the exterior case 4, the peripheral panel 10, and the central panel 11 may not necessarily be completely flush with the ceiling surface 3 as long as they appear to be flush with the ceiling surface at a glance.

[0014] Next, with reference to Fig. 3, arrangement of wind direction vanes 14 will be explained. Note that arrows in Fig. 3 indicate air flow, namely air passages.

[0015] As shown in Fig. 3, the lifting device 9 of the ceiling cassette air conditioner 1 according to Embodiment 1 raises and lowers the decorative panel 8, and in particular, the peripheral panel 10 of the decorative panel. When the ceiling cassette air conditioner 1 starts its operation, rotation of the blower fan 5 starts. In parallel, the lifting device 9 moves the peripheral panel 10 toward the room side. Thereby, air conditioning in the room is started.

[0016] When the lifting device 9 moves the peripheral panel 10 toward the room side, a gap is formed between the peripheral panel 10 and the central panel 11. This gap functions as the air inlet 12 of the ceiling cassette air conditioner 1. Similarly, when the peripheral panel 10 is moved toward the room side, a gap is formed between the peripheral panel 10 and the exterior case 4. This gap functions as the discharge outlet 13 of the ceiling cassette air conditioner 1. That is, when the ceiling cassette air conditioner 1 is out of operation, the exterior case 4, the peripheral panel 10, and the central panel 11 are flush with the ceiling surface 3 and are arranged in such a way that gaps are not formed as shown in Fig. 1. Thus, neither the air inlet 12 nor the discharge outlet 13 is formed. On the other hand, the peripheral panel 10 is moved toward the room side during operation, and as a result, the air inlet 12 and the discharge outlet 13 are formed. That is, one air inlet 12 having a rectangular frame shape is formed, and one discharge outlet 13 having a rectangular frame shape is also formed.

[0017] When the ceiling cassette air conditioner 1 starts its operation, the air in the room is taken in into the main body 2 via the air inlet 12. Then, the air taken in into the main body 2 is conditioned as sequentially passing through the dust collection filter 7, the blower fan 5,

and the heat exchanger 6. After that, the air is discharged from the discharge outlet 13 into the room.

[0018] As shown in Fig. 3, in the ceiling cassette air conditioner 1, the wind direction vanes 14 are further provided on an inner wall surface side of the discharge outlet 13. By adjusting the angles of the wind direction vanes 14, the blowing directions of the air toward the room can be adjusted. Moreover, the wind direction vanes 14 are arranged behind the decorative panel 8, and in particular, behind the peripheral panel 10. Furthermore, an end portions of the wind direction vanes 14 are arranged inside an end portion of the decorative panel 8, and in particular, inside an end portion of the peripheral panel 10.

[0019] As shown in Fig. 1 and Fig. 3, the wind direction vanes 14 are arranged behind the decorative panel 8, and in particular, behind the peripheral panel 10, when the ceiling cassette air conditioner 1 is in operation as well as when it is out of operation. Thus, the users cannot visually recognize the wind direction vanes 14.

[0020] Further, a moving amount, that is, a lowering amount of the peripheral panel 10 toward the room side by the lifting device 9 may be changed depending on the blowing directions of the air toward the room. As shown in Figs. 4A to 4C, for example, Fig. 4A illustrates a case in which the air is blown along the ceiling, Fig. 4C illustrates a case in which the air is blown in such a way that a person in the room can feel airflow, and Fig. 4B illustrates an intermediate case between the case shown in Fig. 4A and the case shown in Fig. 4C. In the case shown in Fig. 4A, since the wind direction vanes 14 become approximately parallel to the ceiling surface 3, it is not necessary to provide a wide movable area for the wind direction vanes 14. Thus, the lowering amount of the peripheral panel 10 by the lifting device 9 can be small. On the other hand, in the case shown in Fig. 4C, it is necessary to provide a wider movable area for the wind direction vanes 14 in order to direct the outer end portions of the wind direction vanes 14 toward a residential area of the room. Thus, the lowering amount of the peripheral panel 10 by the lifting device 9 should be large. When the lowering amount of the peripheral panel 10 is small, it appears to be flatter as viewed from the room side and has good design properties. Thus, if the lowering amount of the peripheral panel is the same for both the case of blowing the air along the ceiling and the case of blowing the air in such a way that a person in the room can feel the airflow, the design properties are deteriorated. Accordingly, it is possible to improve the design properties by adjusting the lowering amount of the peripheral panel 10 depending on the blowing directions.

[0021] As other variations, the lowering amount of the peripheral panel 10 by the lifting device 9 may be changed depending on a blowing amount of the air supplied into the room. For example, Fig. 4A illustrates a case in which the blowing amount corresponds to "small", Fig. 4B illustrates a case in which the blowing amount corresponds to "middle", and Fig. 4C illustrates a case in which the blowing amount corresponds to "large". In the case shown in Fig. 4A, since the blowing amount into the room is small, the size of the discharge outlet 13 can be small. Thus, the lowering amount of the peripheral panel 10 by the lifting device 9 can be small. On the other hand, in the case shown in Fig. 4C, since the blowing amount into the room is large, the size of the discharge outlet 13 should be larger. Thus, the lowering amount of the peripheral panel 10 by the lifting device 9 should be larger. If the lowering amount of the peripheral panel is the same for both the case in which the blowing amount is "small" and the case in which the blowing amount corresponds to "large", the design properties are deteriorated. Accordingly, it is possible to improve the design properties by adjusting the lowering amount of the peripheral panel depending on the blowing amount.

[0022] In the ceiling cassette air conditioner according to Embodiment 1, since the wind direction vanes in the discharge outlet are arranged behind the decorative panel, the wind direction vanes cannot be recognized by a user visually. Therefore, even though four wind direction vanes are fixed at predetermined directions or are moving respectively during an operation, they are not visually recognized by a user. As a result, an effect proper to the present invention of avoiding deterioration of design properties can be achieved.

Embodiment 2

[0023] In Embodiment 1, the central panel of the ceiling cassette air conditioner is a plate having a rectangular shape, the peripheral panel and the central panel are provided separately, and they are separated from each other during operation. On the other hand, a central panel of a ceiling cassette air conditioner according to Embodiment 2 has a rectangular shape with a grating structure, and the peripheral panel and the central panel are formed as an integrated member.

[0024] With reference to Figs. 5 to 7, the ceiling cassette air conditioner according to Embodiment 2 will be explained. Fig. 5 is a cross-sectional side view of a ceiling cassette air conditioner according to Embodiment 2 when the ceiling cassette air conditioner is out of operation. Fig. 6 is an exterior plan view of the ceiling cassette air conditioner according to Embodiment 2 viewed from a room side when the ceiling cassette air conditioner is out of operation. Fig. 7 is a cross-sectional side view of the ceiling cassette air conditioner according to Embodiment 2 when the ceiling cassette air conditioner is in operation. In this Embodiment 2, differences from Embodiment 1 will be explained in detail, and the same configurations and the same effects as those of Embodiment 1 will be omitted from the explanation. Moreover, the same reference numerals are given to the same configurations as Embodiment 1.

[0025] As shown in Fig. 5 and Fig. 6, a decorative panel 17 according to Embodiment 2 is provided so as to fill the central portion of the exterior case 4 that has a rectangular frame shape, and is provided so as to cover the

opening of the main body 2. The decorative panel 17 includes a peripheral panel 16 having a rectangular frame shape, and a central panel 15 having a rectangular shape with a grating structure so as to fill a central portion of the peripheral panel 16, which are formed as an integrated member. The central panel 15 covers an air inlet 18, and the peripheral panel 16 covers a discharge outlet. That is, the peripheral panel 16 having a rectangular frame shape is arranged inside the exterior case 4 having a rectangular frame shape, and the central panel 15 having a rectangular shape with the grating structure is arranged inside the peripheral panel 16. The exterior case 4, the peripheral panel 16, and the central panel 15 form a single plate shape, and they are arranged so as to be flush with the ceiling surface 3 as viewed from the room side. Of course, the exterior case 4, the peripheral panel 16, and the central panel 15 may not necessarily be completely flush with the ceiling surface 3 as long as they appear to be flush with the ceiling surface at a glance.

[0026] As shown in Fig. 7, the lifting device 9 of the ceiling cassette air conditioner 1 according to Embodiment 2 raises and lowers the decorative panel 17, that is, the peripheral panel 16 and the central panel 15 integrally. When the ceiling cassette air conditioner 1 starts its operation, the rotation of the blower fan 5 starts. In parallel, the lifting device 9 moves the decorative panel 17 toward the room side. Thereby, air conditioning in the room is started.

[0027] When the lifting device 9 moves the decorative panel 17 toward the room side, a gap is formed between the peripheral panel 16 and the exterior case 4. This gap functions as the discharge outlet 13 of the ceiling cassette air conditioner 1. That is, when the ceiling cassette air conditioner 1 is out of operation, the exterior case 4, the peripheral panel 16, and the central panel 15 are flush with the ceiling surface 3 and are arranged in such a way that a gap is not formed as shown in Fig. 5, and thus, the discharge outlet 13 is not formed. When the decorative panel 17 is moved toward the room side during operation, the discharge outlet 13 is formed. On the other hand, since the central panel 15 has the grating structure, gaps in the grating structure function as the air inlet 18.

[0028] When the ceiling cassette air conditioner 1 starts its operation, the air in the room is taken in into the main body 2 via the air inlet 18. Then, the air taken in into the main body 2 is conditioned as sequentially passing through the dust collection filter 7, the blower fan 5, and the heat exchanger 6. After that, the air is discharged from the discharge outlet 13 into the room.

[0029] As described above, in the ceiling cassette air conditioner according to Embodiment 2, the peripheral panel and the central panel are integrally moved during operation. Thus, a step is not formed between the peripheral panel and the central panel. Therefore, in addition to the effects according to Embodiment 1, an effect of further improving the design properties is achieved.

REFERENCE SIGNS LIST

[0030] 1: ceiling cassette air conditioner, 2: main body, 3: ceiling surface, 4: exterior case, 5: blower fan, 6: heat exchanger, 7: dust collection filter, 8: decorative panel, 9: lifting device, 10: peripheral panel, 11: central panel, 12: air inlet, 13: discharge outlet, 14: wind direction vane, 15: central panel, 16: peripheral panel, 17: decorative panel, 18: air inlet.

Claims

1. A ceiling cassette air conditioner comprising:

a main body arranged in a ceiling and having a rectangular cross-section opening on a room side of the main body;
a blower fan arranged in the main body, and configured to blow air taken in from an air inlet of the main body to a discharge outlet of the main body;
a heat exchanger arranged in the main body and downstream of the blower fan, and configured to exchange heat with the air taken in from the air inlet;
a decorative panel covering the opening, and arranged to be flush with a ceiling surface; and
a wind direction vane arranged in the discharge outlet, and configured to adjust a blowing direction,
wherein the wind direction vane is arranged behind the decorative panel.

2. The ceiling cassette air conditioner according to claim 1, further comprising a lifting device to raise and lower the decorative panel,
wherein the lifting device lowers the decorative panel when the blower fan is operated.

3. The ceiling cassette air conditioner according to claim 2, wherein the lifting device controls a lowering amount of the decorative panel depending on a rotation frequency of the blower fan.

4. The ceiling cassette air conditioner according to any one of claims 1 to 3, wherein the decorative panel comprises:

a peripheral panel having a rectangular frame shape; and
a central panel having a rectangular shape and arranged to fill a central portion of the peripheral panel.

5. The ceiling cassette air conditioner according to claim 4, further comprising a lifting device to raise and lower the peripheral panel,

wherein the lifting device lowers the peripheral panel when the blower fan is operated.

6. The ceiling cassette air conditioner according to claim 5, wherein the air inlet and the discharge outlet are formed by lowering the peripheral panel with the lifting device.

7. The ceiling cassette air conditioner according to claim 5 or 6, wherein the lifting device controls a lowering amount of the peripheral panel depending on the blowing direction.

8. The ceiling cassette air conditioner according to claim 5 or 6, wherein the lifting device controls a lowering amount of the peripheral panel depending on rotation frequency of the blower fan.

9. The ceiling cassette air conditioner according to any one of claims 4 to 8, wherein the central panel has a grating structure.

10. The ceiling cassette air conditioner according to claim 9, wherein the central panel and the peripheral panel are raised and lowered integrally.

FIG.1

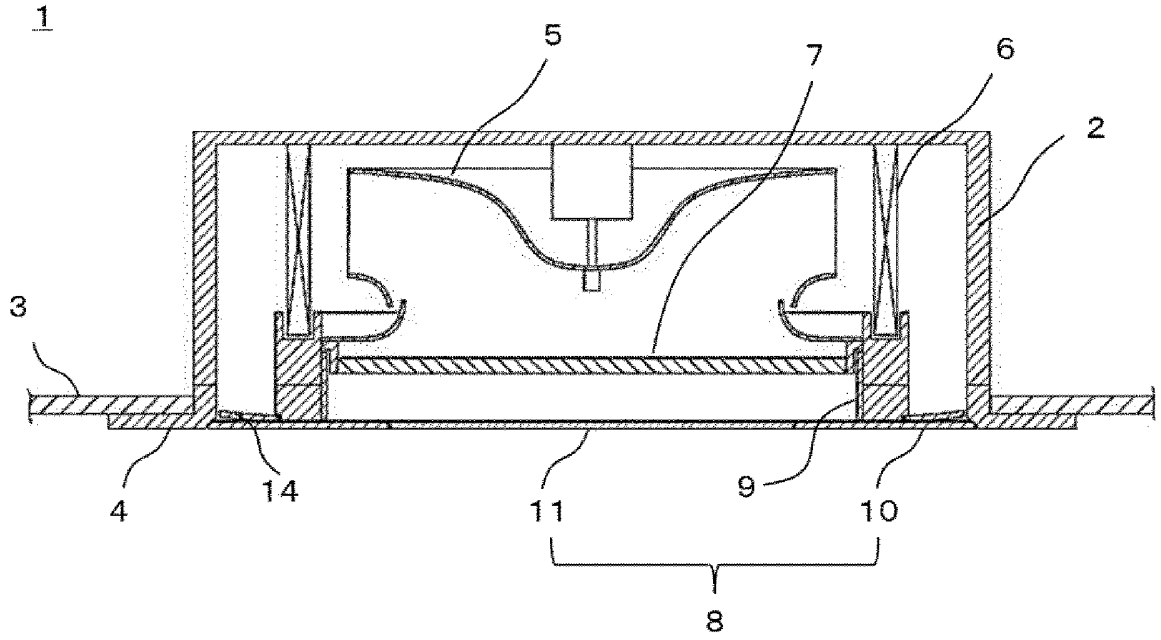


FIG.2

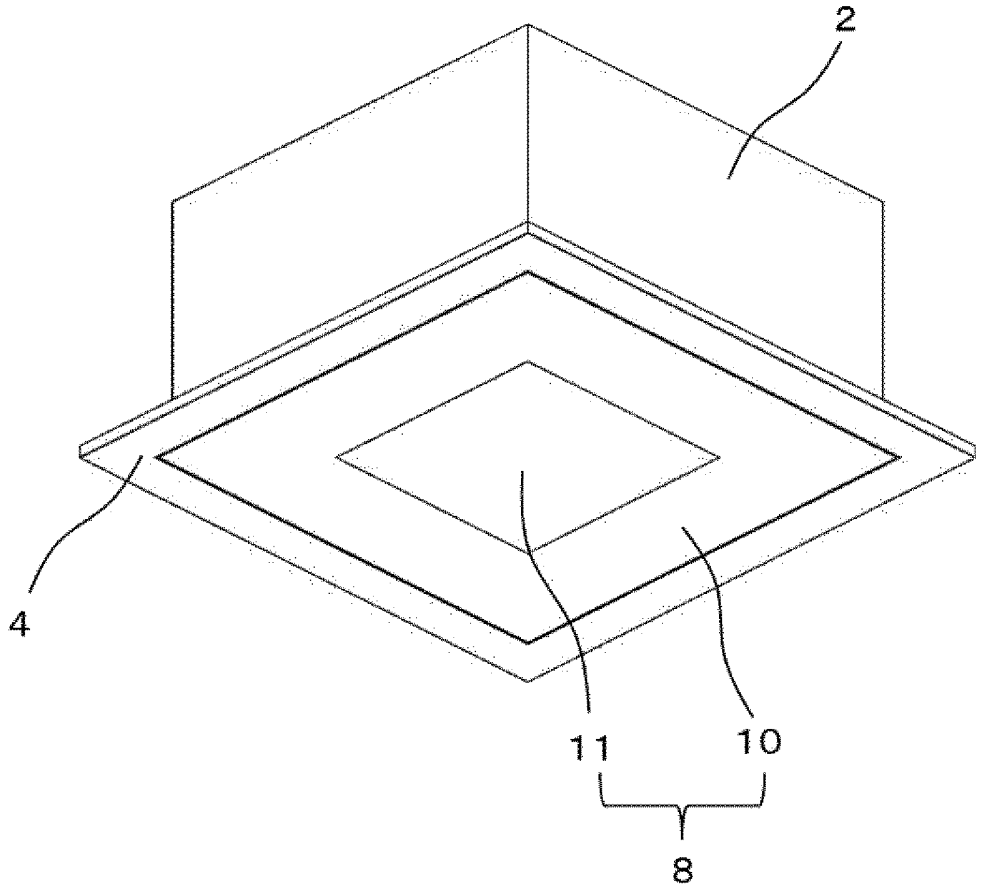


FIG.3

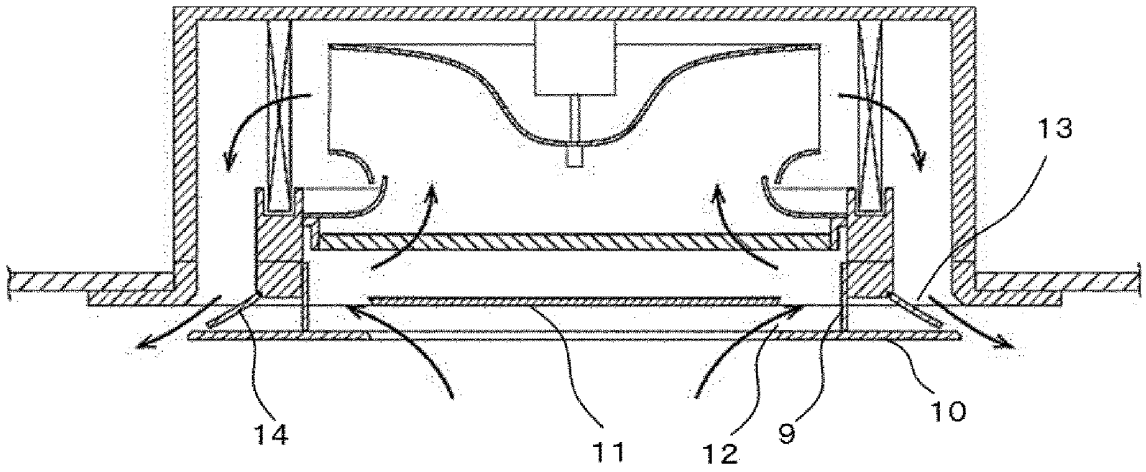


FIG4A

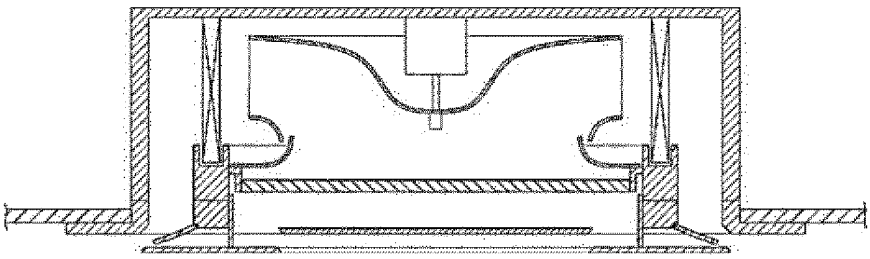


FIG4B

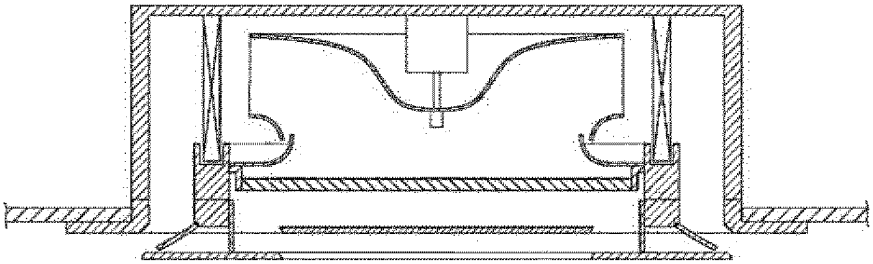


FIG4C

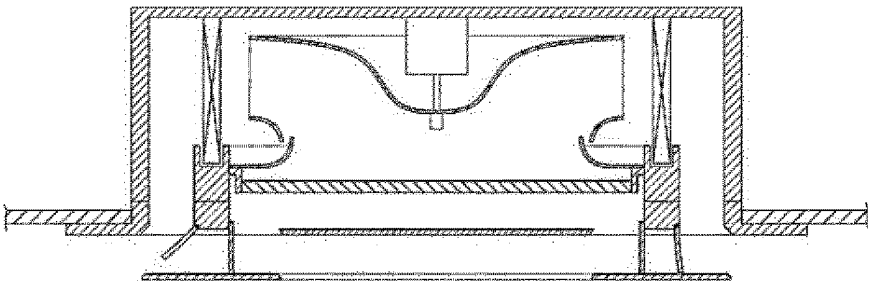


FIG.5

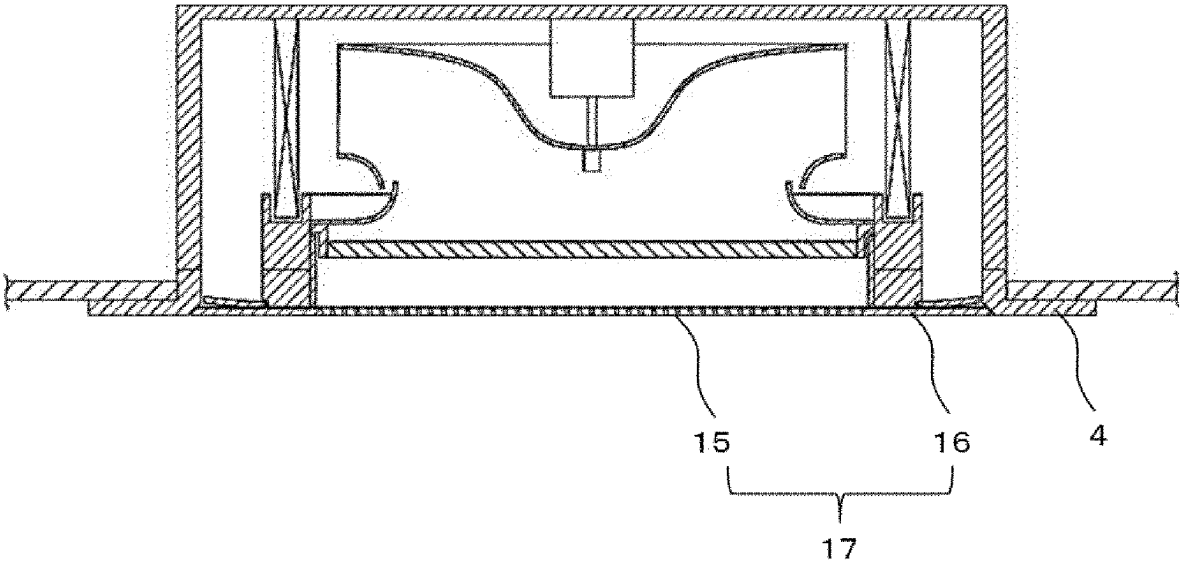


FIG.6

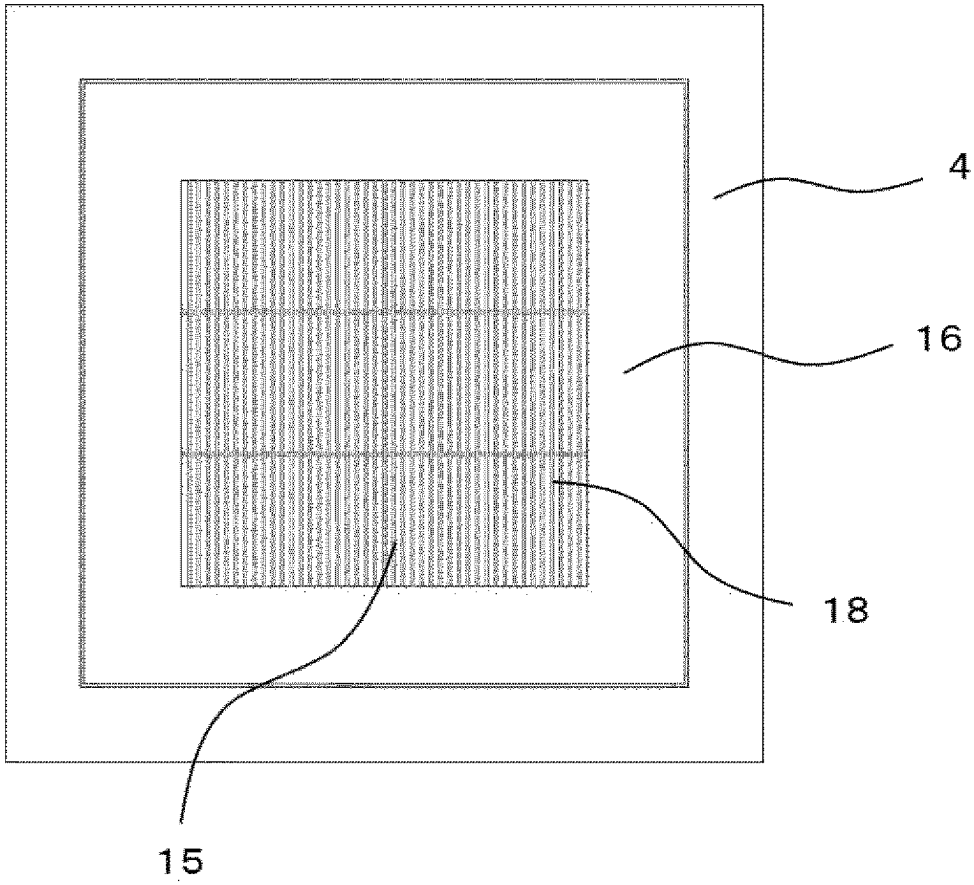
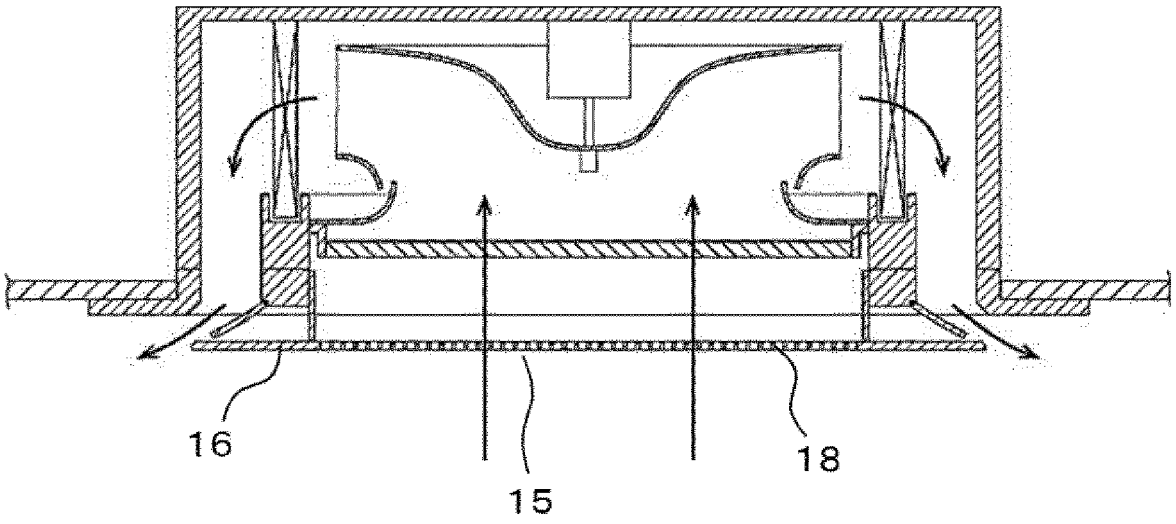


FIG.7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/067027

A. CLASSIFICATION OF SUBJECT MATTER
F24F13/20(2006.01)i, *F24F13/32*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F13/20, F24F13/32

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015
Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2007-285604 A (Daikin Industries, Ltd.), 01 November 2007 (01.11.2007), paragraphs [0004], [0078] to [0096], [0105] to [0107]; fig. 15 to 20, 23 to 24 & US 2009/0098820 A1 & EP 2014997 A1 & KR 10-2008-0110850 A & CN 101421563 A & AU 2007241914 A	1-2,4-6,9-10 3,7-8
Y	JP 2007-155309 A (Daikin Industries, Ltd.), 21 June 2007 (21.06.2007), paragraphs [0029], [0050] to [0056]; fig. 1 to 4 & US 2009/0241576 A1 & EP 1947397 A1 & KR 10-2008-0059317 A & AU 2006313235 A & CN 101297161 A	1-2,4-6,9-10

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

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
25 August 2015 (25.08.15)	08 September 2015 (08.09.15)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/067027

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012/0034862 A1 (LG ELECTRONICS INC.), 09 February 2012 (09.02.2012), paragraphs [0033] to [0092]; fig. 1 to 11 & WO 2010/077047 A2 & EP 2381183 A2 & KR 10-2010-0077734 A & CN 102272529 A	1-10
A	JP 2012-107864 A (Mitsubishi Electric Corp.), 07 June 2012 (07.06.2012), paragraphs [0001] to [0046]; fig. 1 to 15 (Family: none)	1-10
A	JP 2007-285629 A (Daikin Industries, Ltd.), 01 November 2007 (01.11.2007), paragraphs [0003] to [0065]; fig. 1 to 8 & US 2009/0100851 A1 & EP 2009363 A1 & KR 10-2008-0016670 A & CN 101331363 A & AU 2007241895 A	1

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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