(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 436 995 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.04.2012 Bulletin 2012/14

(51) Int Cl.:
F24F 1/00 *(2011.01)* ***F24F 13/28*** *(2006.01)*

(21) Application number: **11193859.3**

(22) Date of filing: **29.01.2009**

(84) Designated Contracting States:
ES GB

(30) Priority: **30.06.2008 JP 2008169829**
29.09.2008 JP 2008250390

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
09250236.8 / 2 141 421

(71) Applicant: **Mitsubishi Electric Corporation**
Tokyo 100-8310 (JP)

(72) Inventors:
- **Furuta, Tatsuo**
  Tokyo (JP)
- **Moriya, Yoshiki**
  Tokyo (JP)
- **Edayoshi, Atsushi**
  Tokyo (JP)
- **Suzuki, Kazutaka**
  Tokyo (JP)
- **Kubo, Kazuya**
  Tokyo (JP)

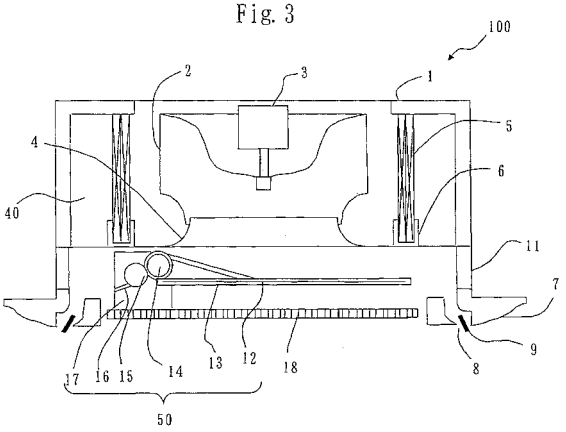
(74) Representative: **Hopkin, Tobias J.B.**
J.A. Kemp & Co.
14 South Square
Gray's Inn
London
WC1R 5JJ (GB)

Remarks:
•This application was filed on 15-12-2011 as a divisional application to the application mentioned under INID code 62.
•A request for correction of claim 15 has been filed pursuant to Rule 139 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).

(54) Ceiling-embedded type air-conditioner

(57) A ceiling-embedded type air-conditioner includes: a casing having an opening on a bottom face; an air blower provided in the casing; a decorative panel provided on the bottom face of the casing and having a suction opening for sucking air; and an automatic filter cleaning mechanism provided between the decorative panel and the air blower. The automatic filter cleaning mechanism includes:
(1) a filter 12 for catching a floating object in the air sucked;
(2) a filter guide 13 having a filter rail groove 21 of U-turn system;
(3) a filter roller 14 for driving the filter 12;
(4) a brush 15 for scraping off the floating object caught by the filter 12;
(5) a comb 16 for scraping off the floating object scraped off by the brush 15; and
(6) a dust box for containing the floating object scraped off by the brush 15 and the comb 16.

Fig. 3



EP 2 436 995 A1

Description

[0001] The present invention relates to a ceiling-embedded type air-conditioner, in particular, to an automatic filter cleaning mechanism of the ceiling-embedded type air-conditioner.

[0002] Conventionally, a ceiling-embedded type air-conditioner (indoor unit) sucks indoor air with a fan from a suction opening to the inside, indoor temperature is adjusted by a heat exchanger, and the air whose temperature is adjusted is discharged from an air outlet to the indoor space,

[0003] A filter is provided at the suction opening for preventing invasion of floating objects such as dust, etc. existing in the indoor air into the ceiling-embedded type air-conditioner. Continuous operation of the ceiling-embedded type air-conditioner causes gradual accumulation of floating objects in the indoor air on the filter. Because of this, an air resistance of the filter increases, which causes a problem that the operation efficiency may be degraded and energy saving property decreased. Therefore, it is necessary to remove floating objects such as dust, etc. in the air, which is attached to the filter and accumulated there.

[0004] Further, since the ceiling-embedded type air-conditioner is often provided at a high place, when the filter is cleaned, it is a difficult work by using a stepladder, etc. Therefore, a lot of technical proposals have been made for cleaning the filter.

[0005] For example, it is necessary to clean and exchange air filters for maintaining good operation of the air-conditioner; however, in case of the air-conditioner of ceiling embedded type, etc., exchanging and cleaning work requires a lot of manpower and time. Therefore, an air-conditioner that automatically clean the filter is proposed, in which an endless air filter is moved by a driving motor to slide between an airflow passage part and a non-airflow passage part. A cum is rotated with this sliding movement, a reciprocating arm provided at the non passage part is driven, push-up and release of the endless air filter are repeated to vibrate the endless air filter, and dust collected by the endless air filter is removed (refer to Patent Document 1, for example).

LIST OF REFERENCE

[0006]

[Patent Document 1] JP 10-9660

[0007] The air-conditioner disclosed in the above Patent Document 1 automatically clean the filter by moving the endless air filter to slide between the air passage part and the non-airflow passage part, however, the endless air filter has the following problems;

(1) since tensional force in the horizontal direction is required for rolls provided at both ends of the endless air filter, mechanical strength is necessary, so that the structural component need to have thickness, which leads to shortening of the life of endless air filter.
(2) since the endless air filter is doubled in the height direction, the automatic cleaning unit becomes bulky.
(3) since the endless air filter itself is doubled, the pressure loss of the air passage may be increased.

[0008] The present invention is made to solve the above problems and proposes a ceiling-embedded type air-conditioner having an automatic filer cleaning unit, in which no tensional force is worked on the filter like the case of the endless filter, which can resolve the increase of the pressure loss of the air passage because of the double structure of the filter.

[0009] According to the present invention, a ceiling-embedded type air-conditioner includes: a casing provided at a ceiling and having an opening on a bottom face; an air blower provided in the casing; a decorative panel provided on the bottom face of the casing and having a suction opening for sucking air; and an automatic filter cleaning mechanism provided between the decorative panel and the air blower, and the automatic filter cleaning mechanism includes: (1) a filter of an almost rectangular plate shape in planar view having flexibility for catching a floating object in the air sucked from the suction opening; (2) a filter guide for containing the filter and having a filter rail groove of U-turn system which allows the filter to slide on an outward passage and a homeward passage in case of automatic cleaning; (3) a filter roller for driving the filter; (4) a brush for scraping off the floating object caught by the filter; (5) a comb for scraping off the floating object scraped off by the brush; and (6) a dust box for containing the floating object scraped off by the brush and the comb.

[0010] The ceiling-embedded type air-conditioner further includes a casement for containing the automatic filter cleaning mechanism between the casing and the decorative panel.

[0011] The filter rail groove of U-turn system of the filter guide is made to form a shape of number 6 including a common filter rail groove and a double filter rail groove.

[0012] The ceiling-embedded type air-conditioner further includes a frame catch provided at the filter guide so as to be slidable in a direction being parallel to the filter rail groove within a predetermined range, and the frame catch includes a U-shape part which opens to the casing and a filter pressing part which extends to an inner side and is provided at an opposite side of the U-shape part for functioning as a presser of the filter by contacting with an upper part of the filter.

[0013] The first arc gears are formed on circumferences of both ends of the filter roller, second arc gears are formed over whole lengths of frames of both ends of the filter in a direction perpendicular to the filter roller, the first arc gears and the second arc gears are engaged, and the filter is driven by a motor connected to the filter roller.

[0014] In the automatic filter cleaning mechanism, the brush is provided below the filter roller, the comb below the brush, and the dust box below the comb.

[0015] The filter roller includes a filter roller rotation axis, the brush includes a brush rotation axis, and the filter roller rotation axis and the brush rotation axis are placed with a predetermined offset in a vertical direction.

[0016] When an end at an opposite side of a top contacted to the brush is a point of support, the comb is inserted between two tangential lines connecting the point of support and the brush.

[0017] The filter guide includes an upper grid and a lower grid to form a first grid shape, the filter forms a second grid shape including a vertical frame and a horizontal frame which intersect each other, and the first grid shape and the second grid shape overlap when the filter is almost completely inserted to the filter guide.

[0018] The filter guide includes an upper grid and a lower grid, and a part of the lower grid of the filter guide is able to open/close, so that the filter is made attachable/removable to/from the filter guide.

[0019] The decorative panel includes a grill at a suction opening, the dust box is attached to the grill, and the ceiling-embedded type air-conditioner further includes a lifting/lowering device for lifting/lowering the grill in the casing.

[0020] The dust box is vertically divided into two parts including an upper dust box part and a lower dust box part, the lower dust box part is fixed to a side of the grill, and the upper dust box part is fixed to the casing.

[0021] According to another aspect of the invention, a ceiling-embedded type air-conditioner includes: a casing provided at a ceiling and having an opening on a bottom face; an air blower provided in the casing; a decorative panel provided on the bottom face of the casing and having a suction opening for sucking air; and an automatic filter cleaning mechanism provided between the decorative panel and the air blower, and the automatic filter cleaning mechanism includes: (1) a filter of an almost rectangular plate shape in planar view having flexibility for catching a floating object in the air sucked from the suction opening; (2) a filter guide for containing the filter and having a filter rail groove of U-turn system which allows the filter to slide on an outward passage and a homeward passage in case of automatic cleaning; (3) a filter roller for driving the filter; (4) a brush for scraping off the floating object caught by the filter; (5) a comb for scraping off the floating object scraped off by the brush in case of positive rotation of the brush; (6) an auxiliary comb for scraping off the floating object scraped off by the brush in case of negative rotation of the brush; and (7) a dust box for containing the floating object scraped off by the brush, the comb, and the auxiliary comb.

[0022] In the automatic filter cleaning mechanism, the brush is provided below the filter roller, the comb below the brush, the auxiliary comb almost directly below the brush, and the dust box below the comb and the auxiliary comb.

[0023] The auxiliary comb is located directly below the brush, so that an edge of the auxiliary comb is directed to a side of the brush, and the of the auxiliary comb is arranged so as to contact with a tip of the brush.

[0024] The brush is able to perform positive/negative rotation, and the floating object entangled to the comb when the floating object is scraped off from the brush by the comb is scraped off by the auxiliary comb by rotating the brush inversely.

[0025] A complete appreciation of the present invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Fig. 1 shows the first embodiment and is a perspective view of a ceiling-embedded type air-conditioner 100 (indoor unit) provided to a ceiling of a room 45 viewed from the room 45;

Fig. 2 shows the first embodiment and is a horizontal cross sectional view of the ceiling-embedded type air-conditioner 100;

Fig. 3 shows the first embodiment and is a vertical cross sectional view of the ceiling-embedded type air-conditioner 100;

Fig. 4 shows the first embodiment and is an exploded perspective view of the ceiling-embedded type air-conditioner 100;

Fig. 5 shows the first embodiment and is an exploded perspective view of an automatic filter cleaning mechanism 50 when removed from a casement 11;

Fig. 6 shows the first embodiment and is a perspective view of the automatic filter cleaning mechanism 50 when a filter 12 is removed and viewed from the above;

Fig. 7 shows the first embodiment and is an exploded perspective view of the automatic filter cleaning mechanism 50;

Fig. 8 shows the first embodiment and is a perspective view showing the operation to insert the filter 12 to an automatic filter cleaning unit; for a

Figs. 9A through 9C show the first embodiment and are drawings for a case in which a frame catch 20 is removed from the casement 11 (Fig. 9A is a side view when the frame catch 20 is attached to the casement 11; Fig. 9B is a side view when the frame catch 20 is made to slide inwardly; and Fig. 9C is a side view when the automatic filter cleaning mechanism 50 is removed from the casement 11);

Figs. 10A through 10E show the first embodiment and are cross sectional views showing the operation of the filter 12 when the automatic filter cleaning mechanism 50 works;

Fig. 11 shows the second embodiment and is a vertical cross sectional view of the ceiling-embedded type air-conditioner 100;

Fig. 12 shows the second embodiment and is a vertical cross sectional view of a dust box 17 of the automatic filter cleaning mechanism 50;

Fig. 13 shows the third embodiment and is a vertical cross sectional view of the ceiling-embedded type air-conditioner 100;

Figs. 14A through 14E show the third embodiment and are cross sectional views showing the operation of the filter 12 when the automatic filter cleaning mechanism 50 works;

Fig. 15 shows the third embodiment and is a front view of a comb 16; and

Fig. 16 shows the third embodiment and is a front view of an auxiliary comb 25.

Embodiment 1.

[0026] Figs. 1 through 10A-10E show the first embodiment; Fig. 1 is a perspective view of a ceiling-embedded type air-conditioner 100 (indoor unit) provided to a celling of a room 45 viewed from the room 45; Fig. 2 is a horizontal cross sectional view of the ceiling-embedded type air-conditioner 100; Fig. 3 is a vertical cross sectional view of the ceiling-embedded type air-conditioner 100; Fig. 4 is an exploded perspective view of the ceiling-embedded type air-conditioner 100; Fig. 5 is an exploded perspective view of an automatic filter cleaning mechanism 50 when removed from a casement 11; Fig. 6 is a perspective view of the automatic filter cleaning mechanism 50 when a filter 12 is removed and viewed from above; Fig. 7 is an exploded perspective view of the automatic filter cleaning mechanism 50; Fig. 8 is a perspective view showing the operation to insert the filter 12 to an automatic filter cleaning unit; Figs. 9A through 9C are drawings for a case in which a frame catch 20 is removed from the casement 11 (Fig. 9A is a side view when the frame catch 20 is attached to the casement 11; Fig. 98 is a side view when the frame catch 20 is made to slide inwardly; and Fig. 9C is a side view when the automatic filter cleaning mechanism 50 is removed from the casement 11); and Figs. 10A through 10E are cross sectional views showing the operation of the filter 12 when the automatic filter cleaning mechanism 50 works

[0027] As shown in Fig. 1, the ceiling-embedded type air-conditioner 100 (indoor unit) is embedded in the ceiling of the room 45 so that an almost rectangular decorative panel 7 provided at the lower part of the ceiling-embedded type air-conditioner 100 appears. Around the center of the decorative panel 7, an almost rectangular grill 18 (suction opening) communicating to a suction opening of the air of the ceiting-embedded type air-conditioner 100 and outlets 8 (four outlets) communicating to an outlet 40 of the main body (refer to Fig. 3) formed along each line (four lines) of the decorative panel 7 are provided, and further a vane 9 for controlling an air direction of blowing air is provided at each of the air outlets 8.

[0028] A general structure of the ceiling-embedded type air-conditioner 100 (indoor unit) will be explained with reference to Figs. 2 through 4.

[0029] A unit casing 1 (defined as a casing) is placed at the ceiling and has a box shape of which a plane of the bottom part (bottom face) opens.

[0030] As shown in Fig. 4, the ceiling-embedded type air-conditioner 100 can be classified:

(1) the unit casing 1 (including a heat exchanger 5, an air blower having a fan motor 3 for driving a fan 2 and so on; the air blower is placed at an almost center part of the unit casing 1);
(2) an automatic filter cleaning mechanism 50 (contained in a casement 11);
(3) a decorative panel 7; and
(4) a grill 18.

[0031] However, Fig. 4 is one of examples; the automatic filter cleaning mechanism 50 can be provided at the unit casing 1 or at the decorative panel 7.

[0032] If the automatic filter cleaning mechanism 50 is contained in the casement 11 which is a separate body from the unit casing 1 and the decorative panel 7, the automatic filter cleaning mechanism 50 can be attached to the existing ceiling-embedded type air-conditioner 100 afterwards (as an optiona),

[0033] As shown in Fig. 3, at the almost center part of the unit casing 1, the fan 2 (turbo fan) which has an inlet at the lower side and an air blower (centrifugal fan) having the fan motor 3 for driving the fan 2 are placed. As well as the fan motor 3 attached to the ceiling side of the unit casing 1, a bell mouse 4 for introducing air to the fan 2 is placed at the lower part of the fan 2.

[0034] Further, the heat exchanger 5 (almost C shaped) is placed in an almost circular manner so as to surround the fan 2, and a drain pan 6 is provided below the heat exchanger 5. The heat exchanger 5 forms a refrigerating cycle with a compressor of an outdoor unit, not illustrated, for compressing refrigerant. In the heat exchanger 5, the room air sucked from the grill 18 by the fan 2 is heat exchanged with the refrigerant of the refrigerating cycle to generate cool air or warm air.

[0035] At the outside along each line of the drain pan 6, a main body outlet 40 for communicating between a secondary side of the heat exchanger 5 and indoor is provided and is communicated with the air outlet 8 of the decorative panel 7.

[0036] The air outlet 8 is provided with a vane 9, which enables to adjust a blowing direction of cool or warm air generated by the heat exchanger 5. The shape of the vane 9 is almost the same as the air outlet 8, which is designed to almost cover the air outlet 8 while the vane 9 is closed, with considering a good design.

[0037] An almost rectangular grill 18 is provided at the almost center opening of the decorative panel 7. The grill 18 is engaged with the decorative panel 7 by, for example, a click, etc. However, in case of ascending/descending the grill 18 by a lifting/lowering device which will be discussed later, the grill 18 is lifted by a wire without being engaged with the decorative panel 7.

[0038] Further, at the lower part of the unit casing 1, a casement 11, of which the upper face and the lower face are opened, is attached and an automatic filter cleaning mechanism 50 is placed inside of the casement 11 (refer to Fig. 5). However, another embodiment in which the automatic filter cleaning mechanism 50 is placed inside of the unit casing 1, and it is not essential that the structure includes the casement 11 as a separate body from the unit casing 1.

[0039] The structure of the automatic filter cleaning mechanism 50 will be explained with reference to Figs. 6 and 7. Here, although the attachment of a gear box 19 in Fig. 6 is at the opposite side to the case of Fig. 7, the gear box 19 can be attached to either side.

[0040] The automatic filter cleaning mechanism 50 is provided with the following components:

(1) a filter 12;
(2) a filter guide 13;
(3) a filter roller 14;
(4) a brush 15;
(5) a comb 16;
(6) a dust box 17;
(7) a gear box 19;
(8) a frame catch 20;
(9) a filter rail groove 21; and
(10) a filter sensor 22.
Here, (8) through (10) are provided at the filter guide 13.

[0041] The filter guide 13 is an almost quadrate frame shape when viewed from the upper side. Inside of two parallel facing sides out of four sides which form the almost quadrate shape, the filter 12 for catching floating objects in the air sucked from the grill 18 is contained and the filter rail groove 21 which enables the filter 12 to slide is provided. The filter guide 13 includes an upper grid 13a and a lower grid 13b with the filter rail groove 21 provided between the grids, and the filter 12 is inserted to the filter guide 13. The upper grid 13a and the lower grid 13b are almost parallel to the ceiling when the ceiling-embedded type air-conditioner 100 is placed at the ceiling. The filter 12 catches floating objects in the air sucked from the grill 18 (suction opening), is an almost rectangular plate in planar view, and has flexibility (refer to Fig. 7).

[0042] A grid shape (defined as the first grid shape) of the upper grid 13a and the lower grid 13b of the filter guide 13 has an almost same shape as a grid shape (defined as the second grid shape) formed by a vertical frame 12a and a horizontal frame 12b, which intersect each other, of the filter 12. Accordingly, when the filter 12 is contained in the filter guide 13, the grid parts of the upper grid 13a and the lower grid 13b of the filter guide 13 are overlapped with the vertical frame 12a and the horizontal frame 12b of the filter 12. Therefore, the filter 12 can be pressed by the filter guide 13, so that the filter 12 is contained stably. Further, since nothing is provided to interrupt the sucked air at the filter part of the filter 12, the air resistance can be reduced. Further, there is little possibility to get scratches on the filter part of the filter 12.

[0043] A cylindrical filter roller 14 is provided above one side of the filter guide 13 other than the side with the filter rail groove 21. The filter roller 14 drives the filter 12.

[0044] Next to the filter roller 14, a brush 15 is provided obliquely below the filter roller 14. The brush 15 is placed so as to be in parallel to the filter roller 14. The brush 15 is formed by, for example, coiling an implanted hair tape 24 on an aluminum pipe 23 (refer to Fig. 10A). The brush 15 scrapes off the floating objects caught by the filter 12.

[0045] A comb 16 is provided obliquely below the brush 15 at the opposite side of the filter roller 14, The comb 16 is provided obliquely below the brush 15 at the opposite side of the filter 12 and in parallel to'the brush 15, and further the end of the comb 16 should be contacted with the tip of the brush 15. The comb 16 is placed so that the top of the comb 16 should intersect with an axis of the brush 15.

[0046] When the end of the comb 16 being opposite to the top which is contacted with the brush 15 works as a point

of support, the comb 16 is placed to be inserted between two tangential lines connecting the point of support and the brush 15.

[0047] A preferable location (angle) of the comb 16 is a little lower than a line connecting between the point of support of the comb 16 and a brush rotation axis 33 (refer to Fig. 7) of the brush 15. In this status, the comb 16 can efficiently scrape off the attachment scraped by the brush 15.

[0048] Below the comb 16, an almost rectangular solid dust box 17 is attached. It is located so as to receive objects fallen from the filter 12 or the brush 15.

[0049] One end of a filter roller rotation axis (not illustrated) of the filter roller 14 and one end of the brush rotation axis 33 of the brush 15 are connected to motors 26a and 26b, respectively, through a plurality of gears (not illustrated), The filter roller rotation axis and the brush rotation axis 33 are placed in the vertical direction with a predetermined offset.

[0050] The filter roller 14 is driven by the motor 26a through the gear.

[0051] The brush 15 is driven by the motor 26b through the gear.

[0052] The gear is covered by a gear box 19, and the motors 26a and 26b are provided outside the gear box 19.

[0053] A detail operation of attachment of the automatic filter cleaning mechanism 50 to the casement 11 will be explained. At the time of setting the ceiling-embedded type air-conditioner 100, an electric component box of the automatic filter cleaning mechanism 50 and the unit casing 1 should be contacted electrically. When this electrical connecting operation is done, the automatic filter cleaning mechanism 50 need to removed, or the operation is prohibited by the filter 12. Accordingly, the operation of attaching the automatic filter cleaning mechanism 50 to the casement 11 is always done on site. Since the ceiling-embedded type air-conditioner 100 is attached to the ceiling, the workability should be considered.

[0054] It is assumed that the casement 11 is fixed to the unit casing 1, and the electric connecting operation of the electric component box of the automatic filter cleaning mechanism 50 and the unit casing 1 has been completed. First, the end of the automatic filter cleaning mechanism 50 at the side of the dust box 17 is hitched to the casement 11. Next, using frame catches 20 (two frame catches, refer to Fig. 6) of the filter guide 13, the end of the automatic filter cleaning mechanism 50 at the opposite side of the dust box 17 is engaged with the casement 11, and they are temporarily fixed. In this status, a worker can release his hand from the automatic filter cleaning mechanism 50. Then, the automatic filter cleaning mechanism 50 is fixed to the casement 11 using a screw, etc.

[0055] As shown in Figs. 9A through 9C, the frame catch 20 has a U-shape unit 20a which is opened to the outside (the side of the casement 11) at the end of the filter guide 13 which is opposite to the side at which the filter roller 14 is provided. The frame catch 20 is provided so as to be slidable within a range determined by a positioning unit (not illustrated) to a direction parallel to the filter rail groove 21 (refer to Fig. 7).

[0056] Further, the frame catch 20 has a filter pressing unit 20b which contacts the upper part of the filter 12 and functions as a presser of the filter 12 at the opposite side of the U-shape unit 20a.

[0057] It is preferable to provide the frame catches 20 at two locations which divide the filter 12 into three almost equally. At the side of the casement 11, a projected part 11a is formed so as to be engaged with the frame catch 20. By sliding the frame catch 20 to the side of the casement 11 and fitting the U-shape unit 20a of the frame catch 20 to the projected part 11a of the casement 11, the automatic filter cleaning mechanism 50 can be temporarily fixed inside of the casement 11 (refer to Fig. 9A).

[0058] Further, at the time of inserting the filter 12 into the filter rail groove 21, the frame catch 20 also supports the filter 12 in the filter guide 13.

[0059] The automatic filter cleaning mechanism 50 is sometimes removed for the maintenance of the ceiling-embedded type air-conditioner 100. In such a case, first the screw by which the automatic filter cleaning mechanism 50 is fixed to the casement 11 is removed. Next, the frame catch 20 provided slidably is removed from the projected part 11a of the casement 11 by sliding the frame catch 20 to the inside (refer to Fig. 9B). Further, by removing the end of the automatic filter cleaning mechanism 50 at the side of the dust box 17 latched by the casement 11, the automatic filter cleaning mechanism 50 can be removed from the casement 11 (refer to Fig. 9C).

[0060] A detailed mechanism of feeding the filter 12 by the filter roller 14 will be explained. Arc gears (defined as the first arc gears, not illustrated) are formed on the circumferences of both ends of the filter roller 14.

[0061] Arc gears 12c (defined as the second arc gears, refer to Fig. 7) are formed over the whole lengths of frames of both ends of the filter 12 in the direction perpendicular to the filter roller 14. The arc gears on the circumferences of the both ends of the filter roller 14 and the arc gears 12c of the filter 12 are engaged, and the filter 12 is driven by the motor 26a which is connected via a plurality of gears (not illustrated) to the filter roller 14.

[0062] The filter guide 13 includes the upper grid 13a and the lower grid 13b with the filter rail groove 21 for feeding the filter 12 provided at the center, and the filter 12 is inserted between the upper grid 13a and the lower grid 13b.

[0063] As shown in Figs. 7 and 8, a part (at the side of the filter roller 14) of the lower grid 13b of the filter guide 13 is able to open/close. The lower grid 13b opens/closes with an almost center as the point of support.

[0064] The lower grid 13b of the filter guide 13 is partially opened, and the filter 12 is inserted to the filter guide 13. The filter 12 is inserted from the side of the filter roller 14 in the direction of the frame catch 20.

[0065] This structure makes the filter 12 able to attach/remove to/from the filter guide 13. By this capability, it is possible to remove the filter 12 from the filter guide 13 for maintenance or positioning of the filter 12 according to the necessity.

[0066] When the filter 12 is inserted almost completely to the filter guide 13, as has been discussed, the grid shape of the upper grid 13a and the lower grid 13b of the filter guide 13 is almost the same as the grid shape formed by the vertical frame 12a and the horizontal frame 12b of the filter 12 which intersect each other. Accordingly, when the filter 12 is contained in the filter guide 13, the grid parts of the upper grid 13a and the lower grid 13b of the filter guide 13 are overlapped with the vertical frame 12a and the horizontal frame 12b of the filter 12.

[0067] Further, when the filter 12 is inserted almost completely to the filter guide 13, the engagement of the arc gears at the both ends of the circumference of the filter roller 14 with the arc gear 12c of the filter 12 is set to 1.5 to 3.5 (4, at most) teeth. This facilitates setting of the filter 12.

[0068] With reference to Figs. 10A through 10E, the operation of the automatic filter cleaning mechanism 50 will be explained. A movable passage of the filter 12 (the filter rail groove 21) fed by the filter roller 14 is a U-turn system having a shape of number 6 as shown in Figs. 10A through 10E.

[0069] The filter rail groove 21 has a common filter rail groove 21a, which is used commonly for both outward and homeward passages of the filter 12, at the opposite side of the filter roller 14 (the side of the frame catch).

[0070] Further, the movable passage of the filter 12 at the side of the filter roller 14 is formed around the filter roller 14 to become a double filter rail groove 21b which is closed at the contacting point with the common filter rail groove 21a. The length of the double filter rail groove 21b is made longer than the length of the filter 12 in the movable direction. This structure enables U-turn having the shape of number 6.

[0071] The status of Fig. 10A is the same as the one at the time of operating the ceiling-embedded type air-conditioner 100, in which the whole filter 12 is placed flatly on the filter rail groove 21. When the ceiling-embedded type air-conditioner 100 stops and the automatic filter cleaning mechanism 50 starts operation, in Fig. 10A, the filter roller 14 and the brush 15 start to rotate and the outward passage of the filter 12 starts to move. At this time, the filter roller 14 rotates clockwise by the motor 26a (in Figs. 10A through 10E). Further, the brush 15 rotates counterclockwise by the motor 26b (in Figs. 10A through 10E). Since the arc gear provided at the filter roller 14 is engaged with the arc gear 12c of the filter 12, the filter 12 starts to move on the outward passage by the rotation of the filter roller 14. At this point, the brush 15 does not scrape the attachment from the filter 12 yet. Only the operation of moving the filter 12 is done by both of the filter roller 14 and the brush 15.

[0072] Next, when the frame which is the top of the outward passage of the filter 12 has passed for a predetermined length (this length can be an almost entire length of the filter 12 and is determined so as not to effect the scraping of the attachment) between the filter roller 14 and the brush 15, the direction of rotating the brush 15 is reversed. As shown in Fig. 10B, the brush 15 is rotated counterclockwise similarly to the filter 12 (in Figs. 10A through 10E).

[0073] By rotating the brush 15 clockwise, the brush 15 starts to scrape the attachment from the filter 12 fed by the filter roller 14. The floating objects scraped by the brush 15 are combed off by the comb 16 provided below the brush 15, and fallen down into the dust box 17.

[0074] After the filter 12 finishes moving on the outward passage, and the filter 12 reaches the end of the outward passage of the filter rail groove 21, a filter sensor 22 (a micro-switch, etc., for example) provided around the end of the filter rail groove 21 at the opposite side of the filter roller 14 detects the filter 12, which causes to stop the filter roller 14 and the brush 15 (Fig. 10C).

[0075] Next, only the filter roller 14 starts to rotate counterclockwise, and the homeward passage of the filter 12 starts. At this time, the brush 15 halts. The brush 15 halts not to return the attachment attached to the brush 15 back to the filter 12.

[0076] From the status shown in Fig. 10D, the homeward passage of the filter 12 moves further, the filter 12 finishes the moving on the homeward passage as shown in Fig. 10E, the filter sensor 22 provided around the end of the filter rail groove 21 at the opposite side of the filter roller 14 detects the filter 12 and stops the rotation of the filter roller 14, and the operation of the automatic filter cleaning mechanism 50 terminates.

[0077] The following shows one of examples of time periods which are required for the operation of the automatic filter cleaning mechanism 50:

(1) a time period required for the operation between the start of operation of Fig. 10A to Fig. 10B: approximate 2.5 minutes;
(2) a time period required for the operation between the start of operation of Fig. 10A to Fig. 10C (the required time for the outward passage): approximate 4 minutes;
(3) a time period required for the operation between the start of operation of Fig. 10A to Fig. 10D (the required time for the outward passage): approximate 6.5 minutes; and
(4) a time period required for the operation between the start of operation of Fig. 10A to Fig. 10E (the required time for the outward and homeward passages): approximate 8 minutes.

[0078] In order to solve the problems of the conventional endless air filter, the movable passage of the filter 12 (the

filter rail groove 21) fed by the filter roller 14 is made to form the U-turn system having the shape of number 6 as shown in Figs. 10A through 10E. This structure prevents the tensional force in the horizontal direction worked on the filter 12, so that the life of the filter 12 can be extended.

[0079] Further, the endless air filter needs two filter rail grooves; however, by forming the U-turn system having the shape of number of 6, the side of the filter rail groove 21 being opposite to the filter roller 14 (the side of the frame catch) can be the common filter rail groove 21a which can be used commonly for the outward and homeward passages of the filter 12, which enables to downsize the automatic filter cleaning mechanism 50. Further, the number of components can be reduced (reduction of the filter rail groove 21, the number of filter sensors 22, etc.). In addition, it is possible to reduce the increase of pressure loss of the air passage due to the double structure of the filter.

[0080] Here, though the filter rail groove 21 has been the U-turn system having the shape of number 6, the filter rail groove 21 can be simply a U-turn system having a shape of U.

[0081] As has been discussed, the setting location of each component of the automatic filter cleaning mechanism 50 is the filter roller 14, the brush 15, the comb 16, and the dust box 17 in order from the top. Therefore, the brush 15 scrapes the attachment from the filter 12 fed by the filter roller 14, the attachment scraped by the brush 15 is further scraped off by the comb 16, and fallen down into the dust box 17.

[0082] When the brush 15 scrapes the floating objects attached to the filter 12, the brush 15 is made to move in the opposite direction to the filter 12 fed to the filter roller 14, so that the brush 15 can scrape the floating objects attached to the filter 12 with a stronger reaction force.

[0083] Since the dust box 17 is provided below the contacting part of the filter 12 and the brush 15, the brush 15, and the comb 16 so as to receive the scraped attachment, it is possible to contain in the dust box 17 the floating objects without falling indoors when the brush 15 scrapes the floating objects.

[0084] Further, by providing the scraping member such as the brush 15, the comb 16, etc. at the end of the filter 12, it is possible to reduce the suction pressure loss of the ceiling-embedded type air-conditioner 100 at the time of operation.

[0085] Agglomerate of floating objects accumulated in the dust box 17 can be discarded by removing the dust box 17. By removing the grill 18 provided at the suction opening of the decorative panel 7 and sliding a dust box stopper (not illustrated) provided at the filter guide 13, the dust box 17 can be easily removed.

[0086] The dust box stopper is a drivable cylindrical knob (not illustrated) located in parallel to the long side of the rectangle of the dust box 17, and is structured so as to fit to a circular hole (not illustrated) of the filter guide 13.

[0087] Next, a controlling unit to control the operation of the automatic filter cleaning mechanism 50 according to the present embodiment will be explained. The control unit is configured by a micro-computer in which a predetermined operation program is installed.

[0088] The control unit carries out the operation of the automatic filter cleaning mechanism 50 in the following manner, for example. However, the following is merely one of examples, and the operation of the control unit is not limited to this.

(1) operate the automatic filter cleaning mechanism 50 once a day in principle;
(2) operate the automatic filter cleaning mechanism 50 after the operation of the ceiling-embedded type air-conditioner 100 in of ordinary use (in case of 8 to 10 hours a day, mainly daytimes);
(3) in case of continuous operation of the ceiling-embedded type air-conditioner 100 (a convenience store, etc.), operate the automatic filter cleaning mechanism 50 by stopping the fan 2 at the time of stopping the compressor due to the thermoregulation according to the time instructed by the remote control. Further, in case no instruction is received from the remote control, operate the automatic filter cleaning mechanism 50 by stopping the fan 2 at the time of stopping the compressor due to the thermoregulation after 24 hours since the last operation of the automatic filter cleaning mechanism 50.

[0089] In the automatic filter cleaning mechanism 50 according to the present embodiment, in order to solve the problems of the conventional endless air filter, the movable passage of the filter 12 (the filter rail groove 21) fed by the filter roller 14 is made the U-turn system having the shape of number 6, so that no tensional force is worked on the filter 12 in the horizontal direction, which extends the life of the filter 12.

[0090] Further, though the endless air filter needs two filter rail grooves 21, by forming the U-turn system having the shape of number 6, the side of the filter rail groove 21 being opposite to the filter roller 14 (the side of frame catch) becomes the common filter rail groove 21a which is commonly used for the outward and homeward passages of the filter 12, so that the automatic filter cleaning mechanism 50 can be downsized.

[0091] Further, the number of components can be reduced (the reduction of the filter rail groove 21, the number of the filter sensors 22, etc.)

[0092] Further, it is possible to reduce the increase of the pressure loss of the air passage due to the double structure of the filter.

[0093] Since the grid shape of the upper grid 13a and the lower grid 13b of the filter guide 13 is almost the same as the grid shape formed by the vertical frame. 12a and the horizontal frame 12b of the filter 12 which intersect each other,

when the filter 12 is contained in the filter guide 13, the grid parts of the upper grid 13a and the lower grid 13b of the filter guide 13 are overlapped with the vertical frame 12a and the horizontal frame 12b of the filter 12. Accordingly, the filter 12 can be pressed by the filter guide 13, and the filter 12 can be contained stably. Further, since nothing interrupts the suction air at the filter part of the filter 12, the air resistance can be decreased. Further, there is little possibility to have a scratch on the filter part of the filter 12.

[0094] Further, the embodiment contains the automatic filter cleaning mechanism 50 in the casement 11 which is a separate body from the unit casing 1 and the decorative panel 7, it is possible to attach the automatic filter cleaning mechanism 50 to the existing ceiling-embedded type air-conditioner afterwards (as an option).

[0095] When the end of the comb 16 being opposite to the top which is contacted with the brush 15 works as a point of support, the comb 16 is placed to be inserted between two tangential lines connecting the point of support and the brush 15; and by setting the location (angle) of the comb 16 to be a little lower than a line connecting between the point of support of the comb 16 and a brush rotation axis 33 of the brush 15, the comb 16 can efficiently scrape off the attachment scraped by the brush 15.

[0096] By structuring the frame catch 20 so as to be slidable in the parallel direction to the filter rail groove 21 within a range determined by the positioning unit, the automatic filter cleaning mechanism 50 is able to attach/remove to/from the casement 11, and further, it is possible to facilitate the operation of attachment/removal of the automatic filter cleaning mechanism 50 to/from the casement 11 at a high place.

[0097] Further, the frame catch 20 has a filter pressing unit 20b which contacts the upper part of the filter 12 and functions as a presser of the filter 12 at the opposite side of the U-shape unit 20a, so that when the filter 12 is inserted into the filter rail groove 21, the frame catch 20 can support the filter 12 in the filter guide 13.

[0098] The air-conditioner of the present invention, by providing the automatic filter cleaning mechanism to automatically clean the filter, can resolve the clogging of the filter to prevent the increase of the pressure loss, and can be made maintenance-free. Further, by forming the shape of the filter rail groove of the automatic filter cleaning mechanism into the U-turn system, no tensional forte is worked on the filter like the of the endless roll filter, which can resolve the increase of the pressure loss of the air passage because of the double structure of the filter.

Embodiment 2.

[0099] A basic structure of the ceiling-embedded type air-conditioner 100 according to the present embodiment is the same as the one of the first embodiment; however, the present embodiment differs from the first embodiment in that a lifting/lowering device 35 (to lift/lower the grill 18 and the dust box 17) is newly provided and that a structure of the dust box 17 is changed accordingly, so that these difference will be discussed in detail and the explanation of the other structure will be omitted.

[0100] Figs. 11 and 12 show the second embodiment. Fig. 11 is a vertical cross sectional view of the ceiling-embedded type air-conditioner 100; and Fig. 12 is a vertical cross sectional view of the dust box 17 of the automatic filter cleaning mechanism 50.

[0101] As shown in Fig. 11, the ceiling-embedded type air-conditioner 100 of the present embodiment is provided with a lifting/lowering device 35 inside of the casement 11, and the lifting/lowering device 35 lifts/lowers the grill 18 and the dust box 17. The dust box 17 is attached to the grill 18.

[0102] This operation is done only when the ceiling-embedded type air-conditioner 100 stops its operation, and the operation is used for the maintenance of the dust box 17. Without the lifting/lowering device 35, it is necessary to work at a high place using a stepladder, etc; however, by lifting/lowering the dust box 17 together with the grill 18, it is possible to easily carry out the maintenance of the dust box 17. Further, it is possible to avoid danger associated with the work at a high place.

[0103] By reeling out a wire 36 from the lifting/lowering device 35 and lowering the grill 18 and the dust box 17 to hand, it is possible to work at a low place. After the work such as the maintenance of the dust box 17, etc. is done, the wire 36 is rewound up by the lifting/lowering device 35, and the grill 18 and the dust box 17 can be lifted to the normal position.

[0104] The dust box 17 of the present embodiment is lifted/lowered by the lifting/lowering device 35 as discussed above, and the dust box 17 is structured to have two vertically divided parts (an upper dust box part 37 and a lower dust box part 38) as shown in Fig. 11.

[0105] As shown in Fig. 12, by fixing one of the lower dust box part 38 to the grill 18 side, and the upper dust box part 37 to the casement 11, it is possible to open/close the dust box 17 having the upper dust box part 37 and the lower dust box part 38 together with opening/dosing of the grill 18 at the time of starting lifting/lowering.

[0106] Since the brush 15 and the comb 16 are fixed inside the upper dust box part 37, it is possible to avoid dislocation of the relationship of positions between cleaning parts such as the filter 12, the brush 15, the comb 16, etc. and the dust box 17 at each time of lifting/lowering of the dust box 17.

[0107] As discussed above, according to the present embodiment, the lifting/lowering device 35 is provided inside the casement 11 so as to lift/lower the grill 18 and the dust box 17, so that by lifting/lowering the dust box 17 together with

the grill 18, it is possible to easily carry out the maintenance of the dust box 17. Further, it is possible to avoid danger accompanied to the work at a high place.

[0108] Further, the dust box 17 is structured to have two vertically divided parts including the upper dust box part 37 and the lower dust box part 38, the lower dust box part 38 is fixed to the grill 18 side, and the upper dust box part 37 is fixed to the casement 11, and thus it is possible to open/close the dust box 17 having the upper dust box part 37 and the lower dust box part 38 together with opening/closing of the grill 18 at the time of starting lifting/lowering.

[0109] Further, since the brush 15 and the comb 16 are fixed inside the upper dust box part 37, it is possible to avoid dislocation of the relationship of positions between cleaning parts such as the filter 12, the brush 15, the comb 16, etc. and the dust box 17 at each time of lifting/lowering of the dust box 17.

Embodiment 3.

[0110] In the above first and second embodiments, the structural component for scraping off the dust from the brush 15 to the dust box 17 is only the comb 16; the third embodiment, in which an auxiliary comb 25 is provided below the brush 15, will be explained.

[0111] Figs. 13 through 16 show the third embodiment. Fig. 13 is a vertical cross sectional view of the ceiling-embedded type air-conditioner 100; Figs. 14A through 14E are cross sectional views showing the operation of the filter 12 when the automatic filter cleaning mechanism 50 works; Fig. 15 is a front view of the comb 16; and Fig. 16 is a front view of an auxiliary comb 25.

[0112] In the structure of the ceiling-embedded type air-conditioner 100 shown in Fig. 13 according to the present embodiment, only different point from Fig. 3 of the first embodiment will be explained.

[0113] As shown in Fig. 13, an auxiliary comb 25 is added to the automatic filter cleaning mechanism 50 in addition to the structure of the first embodiment shown in Fig. 3.

[0114] Accordingly, the automatic filter cleaning mechanism 50 includes the following components:

(1) the filter 12;
(2) the filter guide 13;
(3) the filter roller 14;
(4) the brush 15;
(5) the comb 16;
(6) the dust box 17;
(7) the gear box 19;
(8) the frame catch 20:
(9) the filter rail groove 21;
(10) the filter sensor 22; and
(11) an auxiliary comb 25.

Here, (8) through (10) are provided at the filter guide 13.

[0115] The auxiliary comb 25 is provided directly below the brush 15. The relationship of the position of the auxiliary comb 25 is that the edge is directed to the side of the brush 15 so as to contact with the tip of the brush 15.

[0116] The comb 16 and the auxiliary comb 25 have forms as shown in Figs. 15 and 16, respectively. Namely, the auxiliary comb 25 is rougher than the comb 16.

[0117] The comb 16 is attached to the brush 15 so as to bite into the brush 15 by around 5mm.

[0118] On the other hand, the auxiliary comb 25 is located so that the edge should contact with the tip of the brush 15.

[0119] Since the auxiliary comb 25 is located so that the edge should contact with the tip of the brush 15, at the time of ordinary operation (in case of positive rotation of the brush 15), the auxiliary comb 25 does not scrape the attachment of the brush 15.

[0120] Here, the positive rotation and the negative rotation of the brush 15 are defined. The rotation direction of the filter roller 14 on the outward passage when the automatic filter cleaning mechanism 50 works, which will be discussed below, is defined to be the positive rotation. In Figs. 14A through 14E, the clockwise direction is the positive rotation.

[0121] Further, the rotation direction of the filter roller 14 on the homeward passage when the automatic filter cleaning mechanism 50 works is defined to be the negative rotation. In Figs. 14A through 14E, the counterclockwise direction is the negative rotation.

[0122] With reference to Figs. 14A through 14E, the operation of the automatic filter cleaning mechanism 50 will be discussed. The operation of the automatic filter cleaning mechanism 50 is basically the same as the one of the first

embodiment, and the explanation of the same part will be omitted.

[0123] After the movement of the filter 12 on the outward passage is finished and the filter 12 reaches the end of the outward passage of the filter rail groove 21, the filter sensor 22 (a micro-switch, etc., for example) provided near the end of the filter rail groove 21 at the opposite side of the filter roller 14 detects the filter 12, and the filter roller 14 stops for about 15 seconds. Then, for about 10 seconds out of the 15 seconds, the brush 15 is made inversely rotated (Fig. 14C).

[0124] While the filter roller 14 stops, by inversely rotating the brush 15 for about 10 seconds, the brush 15 rotates clockwise (positive rotation) in case of Fig. 14B; and when the floating objects are not scraped by the comb 16, but on the contrary, the floating objects are entangled in the brush 15 or the comb 16, it is possible to comb off the floating objects entangled in the brush 15 or the comb 16 by the auxiliary comb 25 and allow the floating objects to fall down into the dust box 17.

[0125] Like this, by providing the auxiliary comb 25 which is rougher than the comb 16 so that the edge should contact with the tip of the brush 15, at the time of normal operation (at the time of positive rotation of the brush 15), the auxiliary comb 25 does not scrape the attachment of the brush 15. After the movement of the filter 12 on the outward passage is finished and the filter 12 reaches the end of the outward passage of the filter rail groove 21, the filter roller 14 stops for about 15 seconds. Out of the 15 seconds, by inversely rotating the brush 15 for about 10 seconds, the brush 15 is made to rotate clockwise (the positive rotation) in case of Fig. 14B, and when the floating objects are not scraped by the comb 16, but on the contrary, the floating objects are entangled in the brush 15 or the comb 16, it is possible to comb off the floating objects entangled in the brush 15 or the comb 16 by the auxiliary comb 25 and allow the floating objects to fall down into the dust box 17.

[0126] Having thus described several particular embodiments of the present invention, various alterations, modifications, and improvements will readily occur to those skilled in the art. Such alterations, modifications, and improvements are intended to be part of this disclosure, and are intended to be within the spirit and scope of the present invention. Accordingly, the foregoing description is by way of example only, and is not intended to be limiting. The present invention is limited only as defined in the following claims and the equivalents thereto.

[0127] The following are teh claims of the parent application as filed and are included as part of the description of the present divisional application.

1. A ceiling-embedded type air-conditioner (100) comprising:

a casing (1) provided at a ceiling and having an opening on a bottom face;
an air blower provided in the casing (1);
a decorative panel (7) provided on the bottom face of the casing (1) and having a suction opening for sucking air; and
an automatic filter cleaning mechanism (50) provided between the decorative panel (7) and the air blower,
wherein the automatic filter cleaning mechanism (50) includes:

(1) a filter (12) of an almost rectangular plate shape in planar view having flexibility for catching a floating object in the air sucked from the suction opening;
(2) a filter guide (13) for containing the filter (12) and having a filter rail groove (21) of U-turn system which allows the filter (12) to slide on an outward passage and a homeward passage in case of automatic cleaning;
(3) a filter roller (14) for driving the filter (12);
(4) a brush (15) for scraping off the floating object caught by the filter (12);
(5) a comb (16) for scraping off the floating object scraped off by the brush (15); and
(6) a dust box (17) for containing the floating object scraped off by the brush (15) and the comb (16).

2. The ceiling-embedded type air-conditioner (100) of claim 1 further comprising a casement (11) for containing the automatic filter cleaning mechanism (50) between the casing (1) and the decorative panel (7).

3. The ceiling-embedded type air-conditioner (100) of claim 1 or 2,
wherein the filter rail groove (21) of U-turn system of the filter guide (13) is made to form a shape of number 6 including a common filter rail groove (21a) and a double filter rail groove (21b).

4. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 3 further comprising a frame catch (20) provided at the filter guide (13) so as to be slidable in a direction being parallel to the filter rail groove (21) within a predetermined range,
wherein the frame catch (20) includes a U-shape part (20a) which opens to the casing (1) and a filter pressing part (20b) which extends to an inner side and is provided at an opposite side of the U-shape part (20a) for functioning as a presser of the filter (12) by contacting with an upper part of the filter (12).

5. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 4,
wherein first arc gears are formed on circumferences of both ends of the filter roller (14), and second arc gears (12c)

are formed over whole lengths of frames of both ends of the filter (12) in a direction perpendicular to the filter roller (14), wherein the first arc gears and the second arc gears (12c) are engaged,
and
wherein the filter (12) is driven by a motor (26a) connected to the filter roller (14).

6. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 5,
wherein in the automatic filter cleaning mechanism (50), the brush (15) is provided below the filter roller (14), the comb (16) below the brush (15), and the dust box (17) below the comb (16).

7. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 6,
wherein the filter roller (14) includes a filter roller rotation axis, wherein the brush (15) includes a brush rotation axis (33), and wherein the filter roller rotation axis and the brush rotation axis (33) are placed with a predetermined offset in a vertical direction.

8. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 7,
wherein when an end at an opposite side of a top contacted to the brush (15) is a point of support, the comb (16) is inserted between two tangential lines connecting the point of support and the brush (15).

9. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 8,
wherein the filter guide (13) includes an upper grid (13a) and a lower grid (13b) to form a first grid shape,
wherein the filter (12) forms a second grid shape including a vertical frame (12a) and a horizontal frame (12b) which intersect each other, and
wherein the first grid shape and the second grid shape overlap when the filter (12) is almost completely inserted to the filter guide (13).

10. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 9,
wherein the filter guide (13) includes an upper grid (13a) and a lower grid (13b), and
wherein a part of the lower grid (13b) of the filter guide (13) is able to open/close, so that the filter (12) is made attachable/removable to/from the filter guide (13).

11. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 10,
wherein the decorative panel (7) includes a grill (18) at a suction opening, wherein the dust box (17) is attached to the grill (18), and
wherein the ceiling-embedded type air-conditioner (100) further includes a lifting/lowering device (35) for lifting/lowering the grill (18) in the casing (1).

12. The ceiling -embedded type air-conditioner (100) of claim 11,
wherein the dust box (17) is vertically divided into two parts including an upper dust box (37) part and a lower dust box (38) part, and
wherein the lower dust box (38) part is fixed to a side of the grill (18), and the upper dust box (37) part is fixed to the casing (1).

13. A ceiling-embedded type air-conditioner (100) comprising:

a casing (1) provided at a ceiling and having an opening on a bottom face;
an air blower provided in the casing (1);
a decorative panel (7) provided on the bottom face of the casing (1) and having a suction opening for sucking air; and
an automatic filter cleaning mechanism (50) provided between the decorative panel (7) and the air blower,
wherein the automatic filter cleaning mechanism (50) includes:

(1) a filter (12) of an almost rectangular plate shape in planar view having flexibility for catching a floating object in the air sucked from the suction opening;
(2) a filter guide (13) for containing the filter (12) and having a filter rail groove (21) of U-turn system which allows the filter (12) to slide on an outward passage and a homeward passage in case of automatic cleaning;
(3) a filter roller (14) for driving the filter (12);
(4) a brush (15) for scraping off the floating object caught by the filter (12);
(5) a comb (16) for scraping off the floating object scraped off by the brush (15) in case of positive rotation of the brush (15);
(6) an auxiliary comb (25) for scraping off the floating object scraped off by the brush (15) in case of negative rotation of the brush (15); and
(7) a dust box (17) for containing the floating object scraped off by the brush (15), the comb (16), and the auxiliary comb (25).

14. The ceiling-embedded type air-conditioner (100) of claim 13,
wherein in the automatic filter cleaning mechanism (50), the brush (15) is provided below the filter roller (14), the

comb (16) below the brush (15), the auxiliary comb (25) almost directly below the brush (15), and the dust box (17) below the comb (16) and the auxiliary comb (25).

15. The ceiling-embedded type air-conditioner (100) of claim 13 or 14,
wherein the auxiliary comb (25) is located directly below the brush (15), so that an edge of the auxiliary comb (25) is directed to a side of the brush (15), and the edge of the auxiliary comb (25) is arranged so as to contact with a tip of the brush (15).

16. The ceiling-embedded type air-conditioner (100) of one of claims 13 through 15,
wherein the brush (15) is able to perform positive/negative rotation, and the floating object entangled to the comb (16) when the floating object is scraped off from the brush (15) by the comb (16) is scraped off by the auxiliary comb (25) by rotating the brush (15) inversely.

Claims

1. A ceiling-embedded type air-conditioner (100) comprising:

a casing (1) provided at a ceiling and having an opening on a bottom face;
an air blower provided in the casing (1);
a decorative panel (7) provided on the bottom face of the casing (1) and having a suction opening for sucking air; and
an automatic filter cleaning mechanism (50) provided between the decorative panel (7) and the air blower,
characterized in that the automatic filter cleaning mechanism (50) includes:

(1) a filter (12) of an almost rectangular plate shape in planar view having flexibility for catching a floating object in the air sucked from the suction opening;
(2) a filter guide (13) for containing the filter (12) and having a filter rail groove (21) of U-turn system which allows the filter (12) to slide on an outward passage and a homeward passage in case of automatic cleaning;
(3) a filter roller (14) for driving the filter (12);
(4) a brush (15) for scraping off the floating object caught by the filter (12);
(5) a comb (16) for scraping off the floating object scraped off by the brush (15); and
(6) a dust box (17) for containing the floating object scraped off by the brush (15) and the comb (16);
wherein the automatic filter cleaning mechanism is configured such that, in use, the filter roller (14) and the brush (15) initially rotate in opposite directions and the outward passage of the filter starts; after a frame which is a top of the outward passage of the filter (12) has passed for a predetermined length between the filter roller and the brush, the direction of rotation of the brush is reversed to start to scrape off the floating object; and, on the homeward passage of the filter (12), the brush (15) is halted and only the filter roller (14) is rotated.

2. The ceiling-embedded type air-conditioner (100) of claim 1 further comprising a casement (11) for containing the automatic filter cleaning mechanism (50) between the casing (1) and the decorative panel (7).

3. The ceiling-embedded type air-conditioner (100) of claim 1 or 2, wherein the filter rail groove (21) of U-turn system of the filter guide (13) is made to form a shape of number 6 including a common filter rail groove (21 a) and a double filter rail groove (21b).

4. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 3 further comprising a frame catch (20) provided at the filter guide (13) so as to be slidable in a direction being parallel to the filter rail groove (21) within a predetermined range,
wherein the frame catch (20) includes a U-shape part (20a) which opens to the casing (1) and a filter pressing part (20b) which extends to an inner side and is provided at an opposite side of the U-shape part (20a) for functioning as a presser of the filter (12) by contacting with an upper part of the filter (12).

5. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 4,
wherein first arc gears are formed on circumferences of both ends of the filter roller (14), and second arc gears (12c) are formed over whole lengths of frames of both ends of the filter (12) that are oriented in a direction perpendicular to the axis of rotation of the filter roller (14),
wherein the first are gears and the second arc gears (12c) are engaged, and
wherein the filter (12) is driven by a motor (26a) connected to the filter roller (14).

6. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 5,
wherein in the automatic filter cleaning mechanism (50), the brush (15) is provided below the filter roller (14), the comb (16) below the brush (15), and the dust box (17) below the comb (16).

7. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 6,
wherein the filter roller (14) includes a filter roller rotation axis,
wherein the brush (15) includes a brush rotation axis (33), and
wherein the filter roller rotation axis and the brush rotation axis (33) are placed with a predetermined offset in a vertical direction.

8. The ceiling-embedded type air-conditioner (100) of one of claims I through 7,
wherein an end of the comb (16) opposite to that contacting the brush (15) is a point of support of the comb; and the comb (16) is arranged between two tangential lines connecting the point of support and the brush (15).

9. The ceiling-embedded type air-conditioner (100) of one of claims I through 8,
wherein the filter guide (13) includes an upper grid (13a) and a lower grid (13b) to form a first grid shape,
wherein the filter (12) forms a second grid shape including a vertical frame (12a) and a horizontal frame (12b) which intersect each other, and
wherein the first grid shape and the second grid shape overlap when the filter (12) is almost completely inserted to the filter guide (13).

10. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 9,
wherein the filter guide (13) includes an upper grid (13a) and a lower grid (13b), and
wherein a part of the lower grid (13b) of the filter guide (13) is able to open/close, so that the filter (12) is made attachable/removable to/from the filter guide (13).

11. The ceiling-embedded type air-conditioner (100) of one of claims 1 through 10,
wherein the decorative panel (7) includes a grill (18) at a suction opening, wherein the dust box (17) is attached to the grill (18), and
wherein the ceiling-embedded type air-conditioner (100) further includes a lifting/lowering device (3 5) for lifting/lowering the grill (18) in the casing (1);
wherein, optionally, the dust box (17) is vertically divided into two parts including an upper dust box (37) part and a lower dust box (38) part, and
wherein the lower dust box (3 8) part is fixed to a side of the grill (18), and the upper dust box (37) part is fixed to the casing (1).

12. The ceiling-embedded type air-conditioner (100) according to claim 1,
wherein the automatic filter cleaning mechanism (50) is configured such that the comb (16) scrapes off the floating object scraped off by the brush (15) in case of positive rotation of the brush (15); and
the automatic filter cleaning mechanism (50) includes:

an auxiliary comb (25) for scraping off the floating object scraped off by the brush (15) in case of negative rotation of the brush (15);
wherein, optionally, in the automatic filter cleaning mechanism (50), the brush (15) is provided below the filter roller (14), the comb (16) below the brush (15), the auxiliary comb (25) almost directly below the brush (15), and the dust box (17) below the comb (16) and the auxiliary comb (25);
optionally, the brush (15) is provided next to the filter roller (14) and obliquely below the filter roller (14), and
the automatic filter cleaning mechanism (50) is configured such that, before use, the filter (12) is not located between the filter roller (14) and the brush (15); when the outward passage of the filter (12) finishes, the filter roller (14) stops for a predetermined time period, the negative rotation of the brush (15) is performed for a predetermined time period, and the auxiliary comb (25) scrapes off the floating object entangled in the brush (15) or the comb (16); and then the homeward passage of the filter (12) starts; and
optionally, the auxiliary comb (25) is located directly below the brush (15), so that an edge of the auxiliary comb (25) is directed to a side of the brush (15), and the edge of the auxiliary comb (25) is arranged so as to contact with a tip of the brush (15).

13. The ceiling-embedded type air-conditioner (100) of claim 12,
wherein the brush (15) is able to perform positive/negative rotation, and

the floating object entangled to the comb (16) when the floating object is scraped off from the brush (15) by the comb (16) is scraped off by the auxiliary comb (25) by rotating the brush (15) inversely.

14. The ceiling-embedded type air-conditioner (100) of claim 1,
wherein the brush (15) is provided next to the filter roller (14) and obliquely below the filter roller (14), and
wherein the automatic filter cleaning mechanism (50) is configured such that, before use, the filter (12) is not located between the filter roller (14) and the brush (15).

15. The ceiling-embedded type air-conditioner (100) of claim 2 further comprising a frame catch (20) provided at the filter guide (13) so as to be slidable in a direction being parallel to the filter rail groove (21) within a predetermined range, wherein the frame catch (20) includes a U-shape part (20a) which is provided at an end of the filter qulde (13) which is opposite to a side at which the filter roller (14) is provided and opens to the casement (11) and a filter pressing part (20b) which extends to an inner side and is provided at an opposite side of the U-shape part (20a) for functioning as a presser of the filter (12) by contacting with an upper part of the filter (12).

Fig. 1

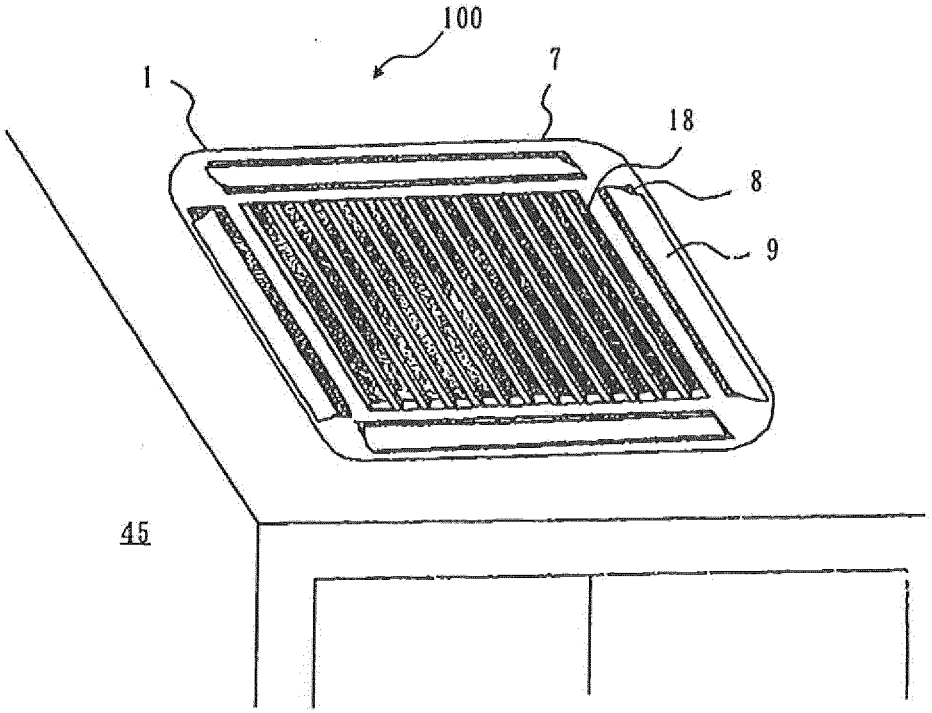


Fig. 2

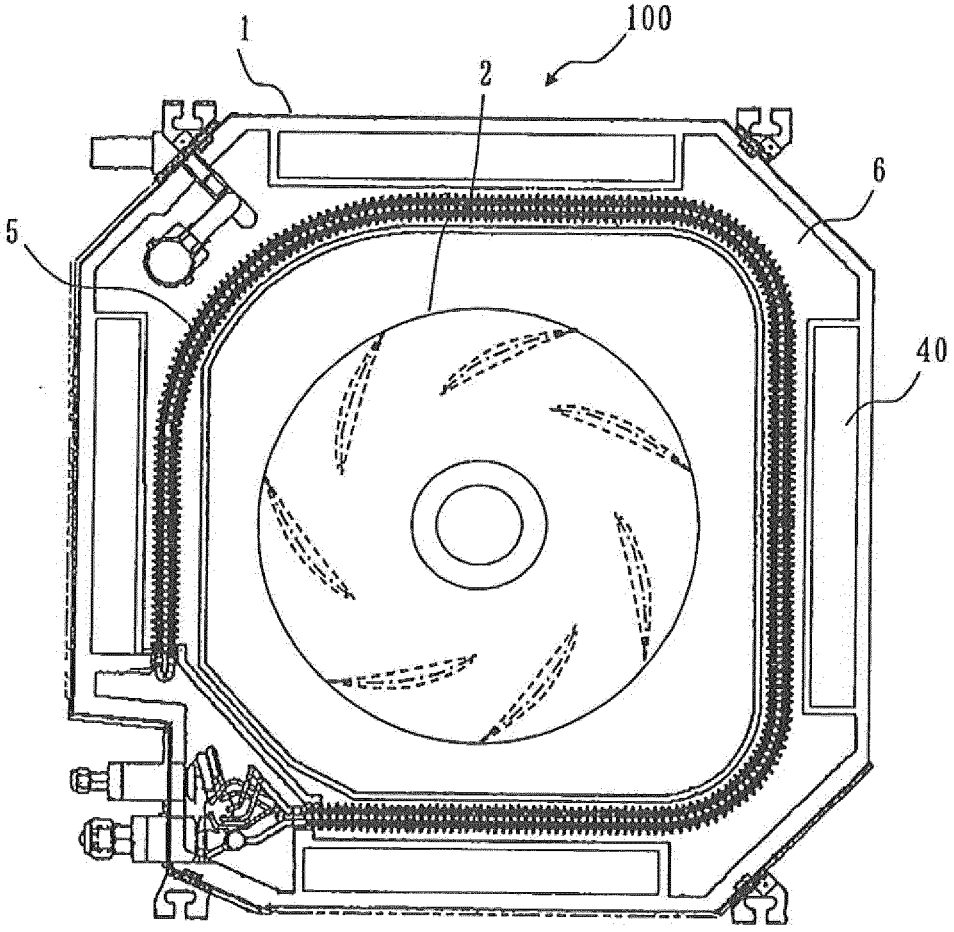


Fig. 3

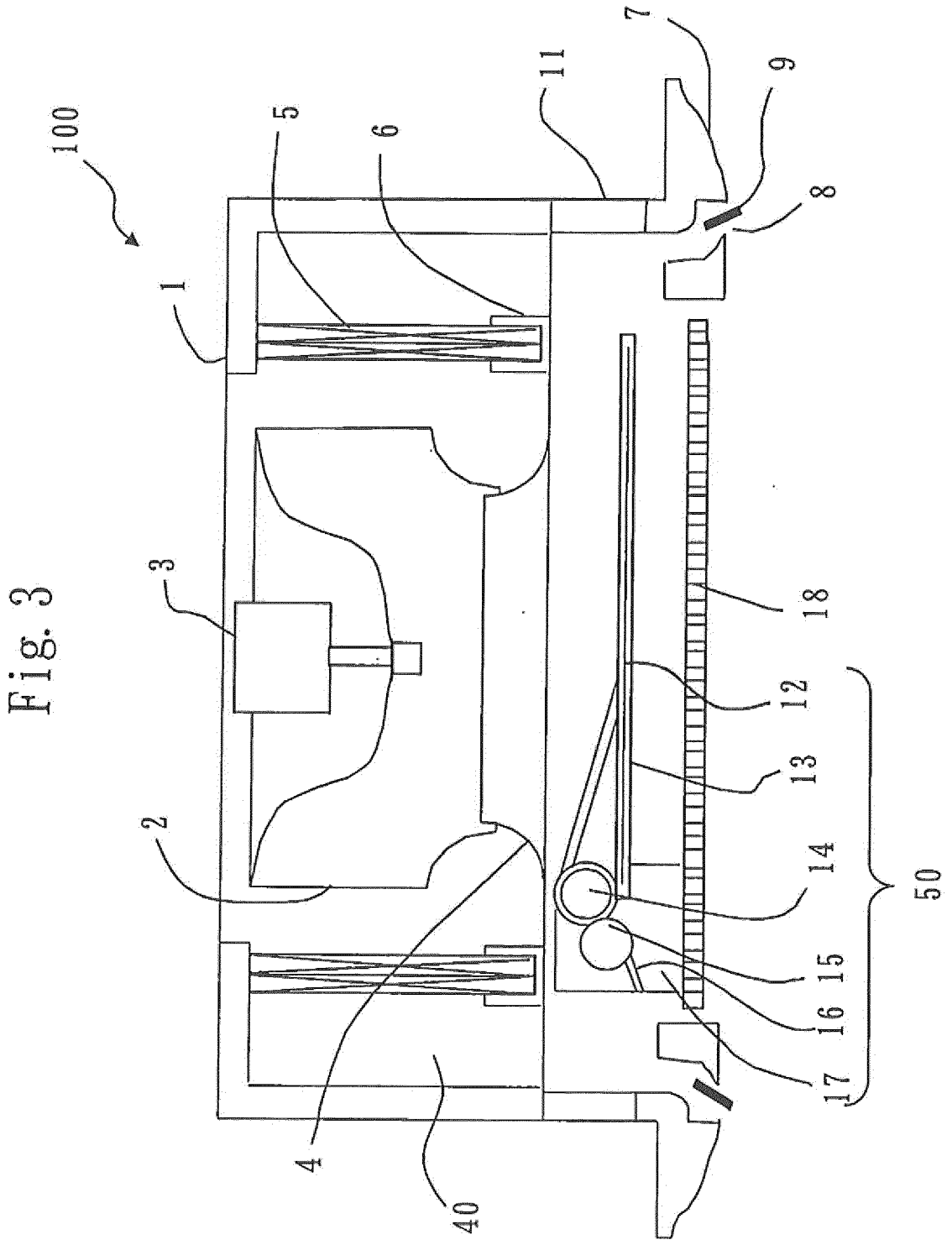


Fig. 4

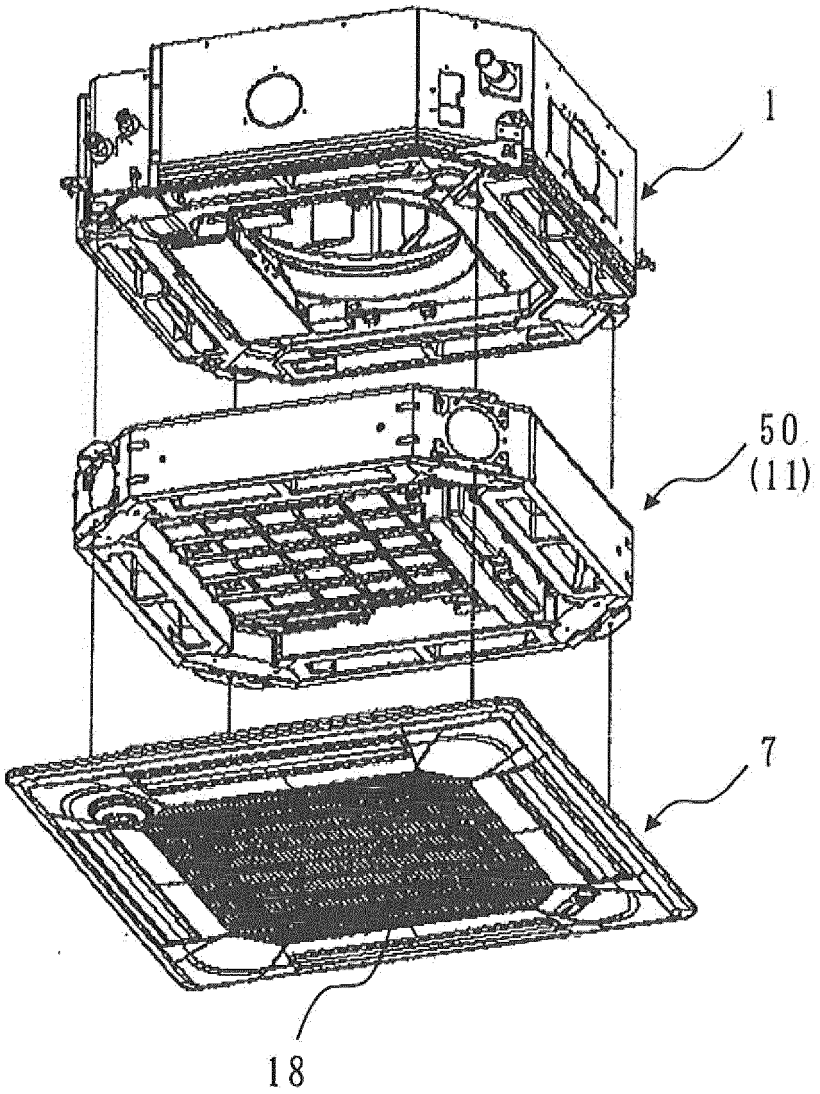


Fig. 5

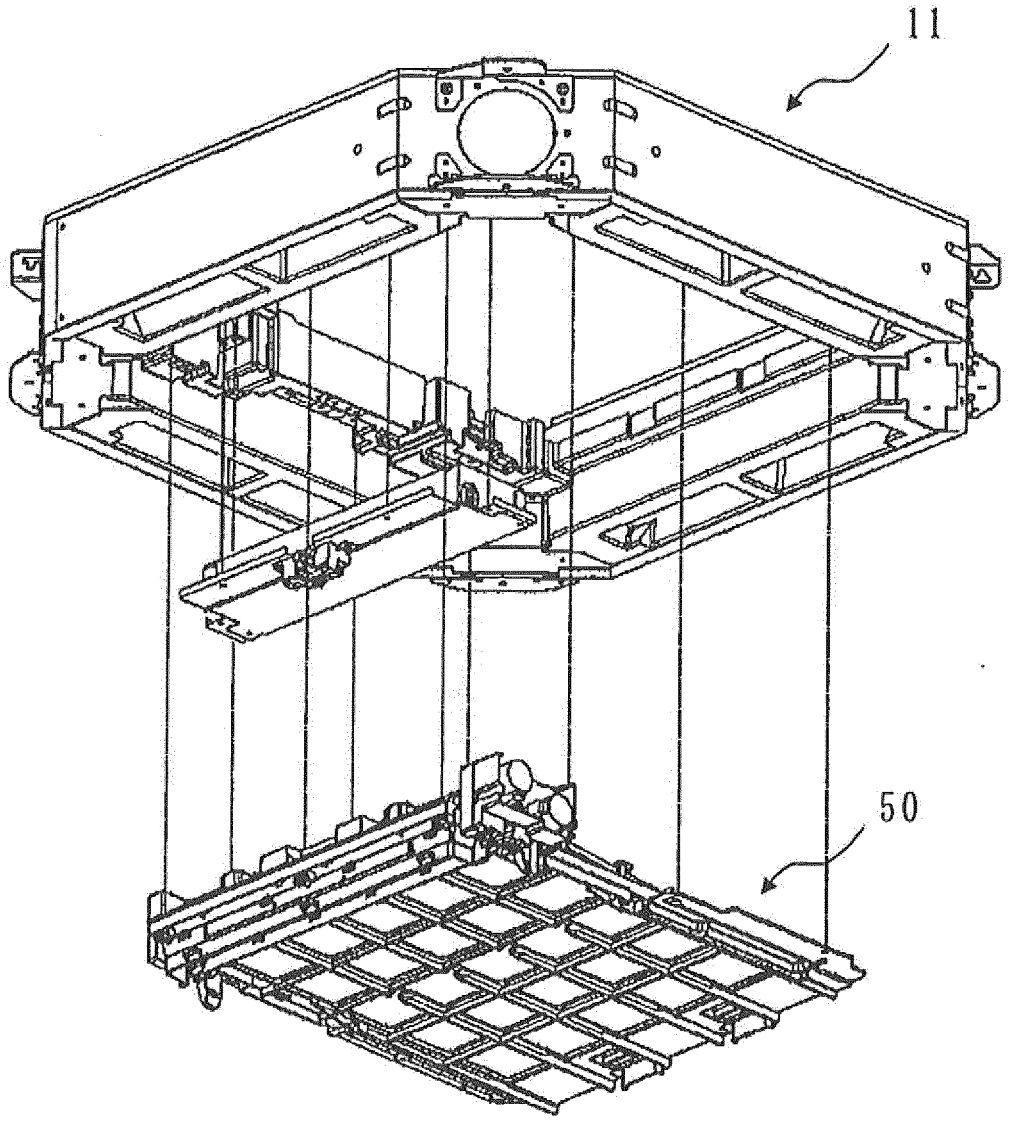


Fig. 6

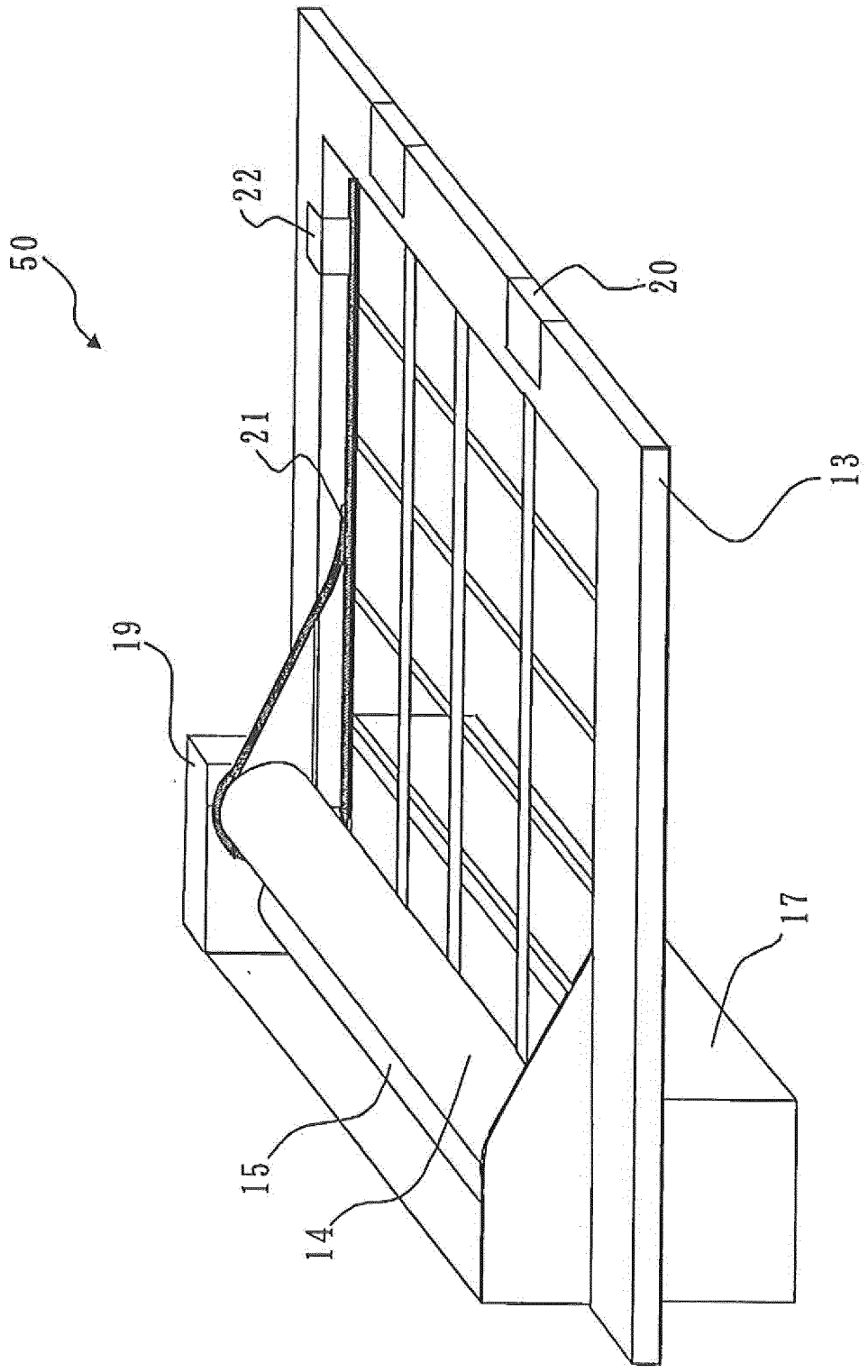


Fig. 7

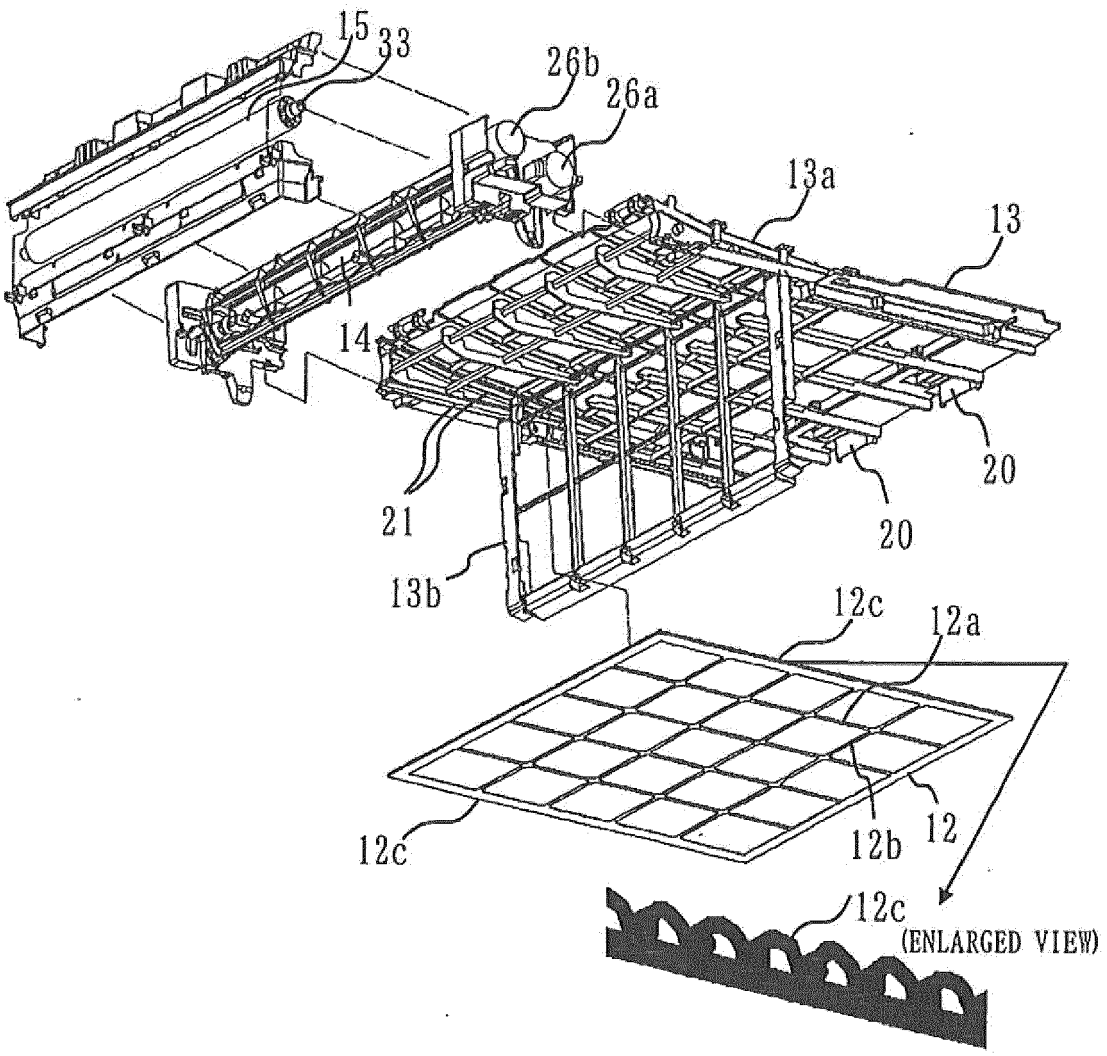

15
33
26b
26a
13a
13
14
21
20
20
13b
12c
12a
12c
12b
12
12c
(ENLARGED VIEW)

Fig. 8

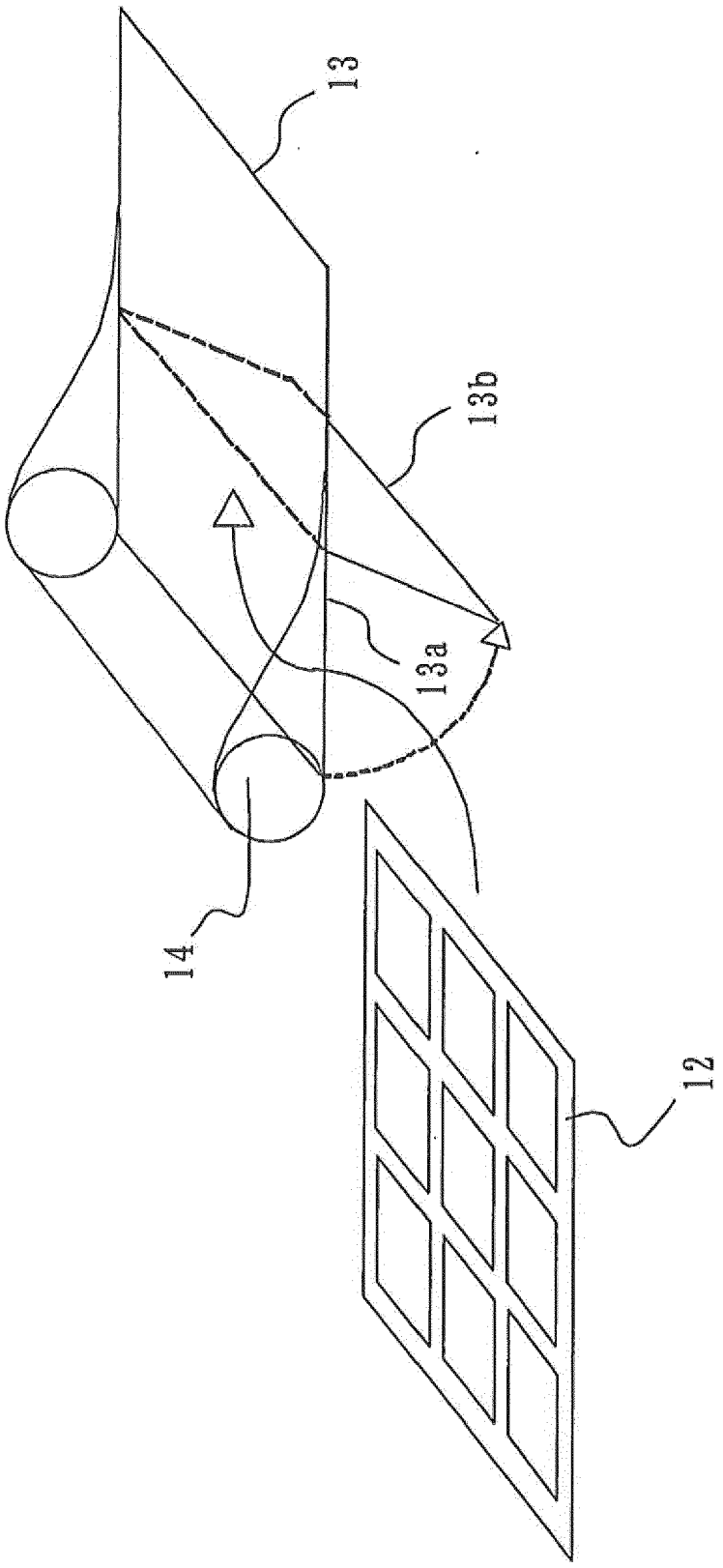


Fig. 9A

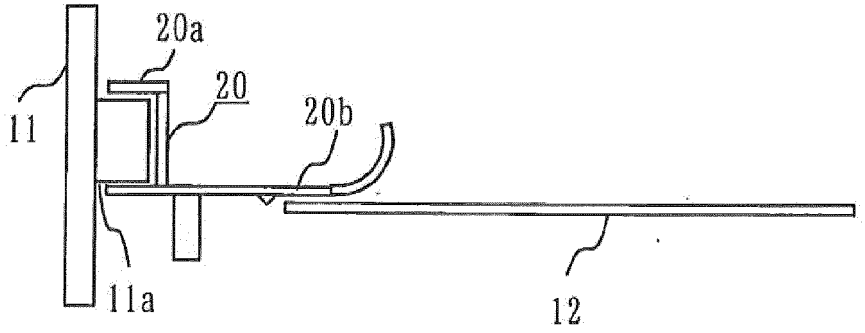


Fig. 9B

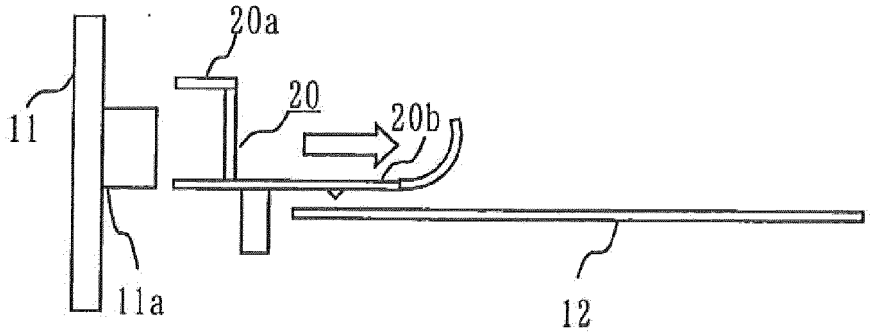


Fig. 9C

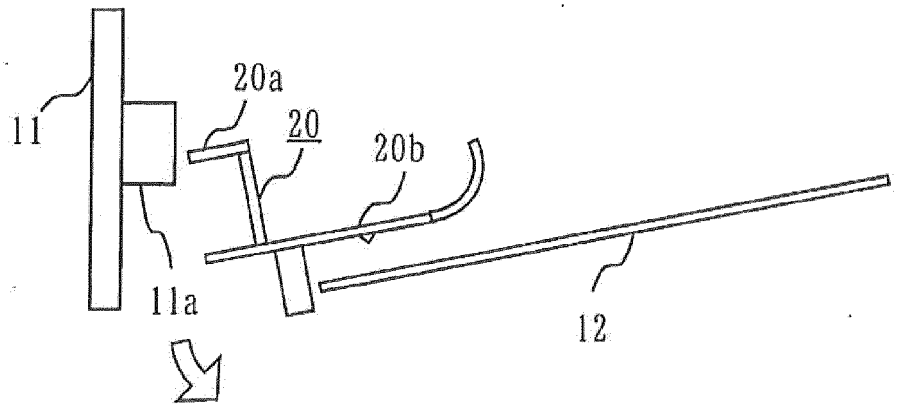


Fig. 10A

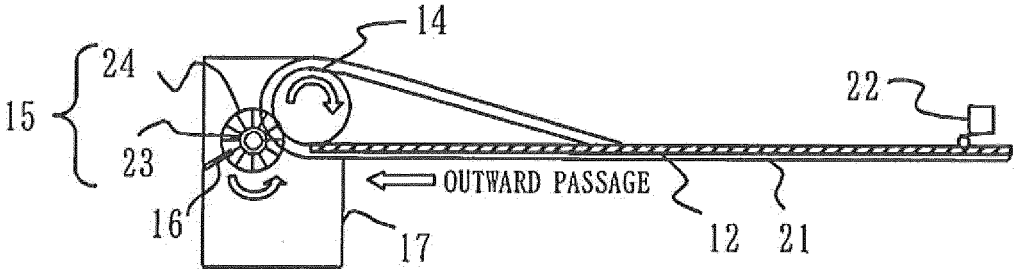


Fig. 10B

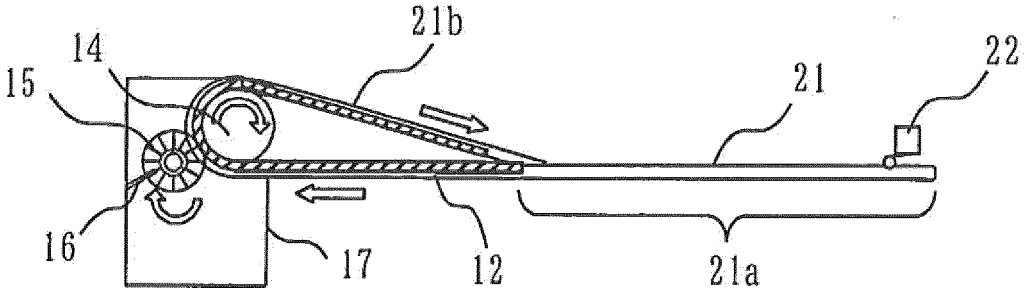


Fig. 10C

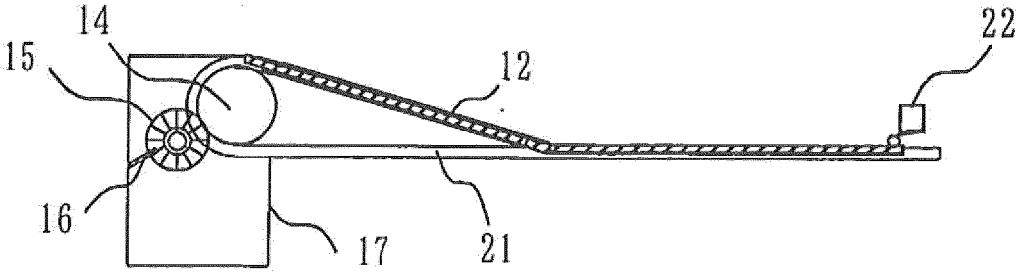


Fig. 10D

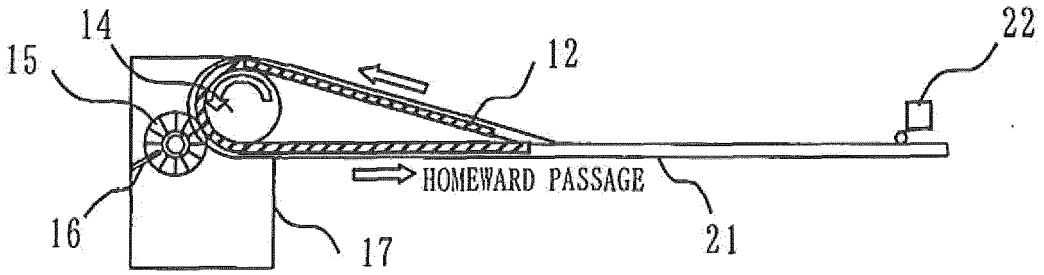


Fig. 10E

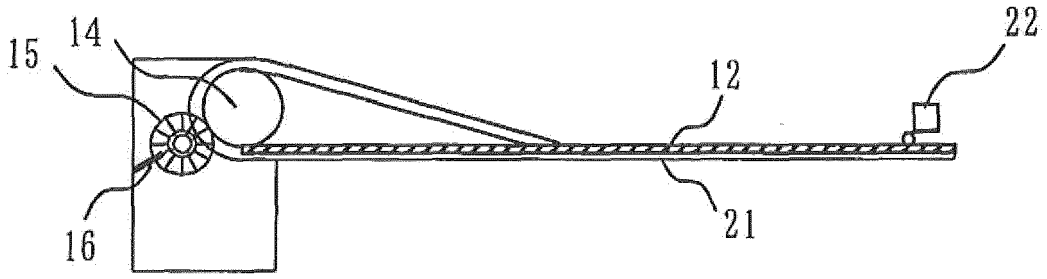


Fig. 11

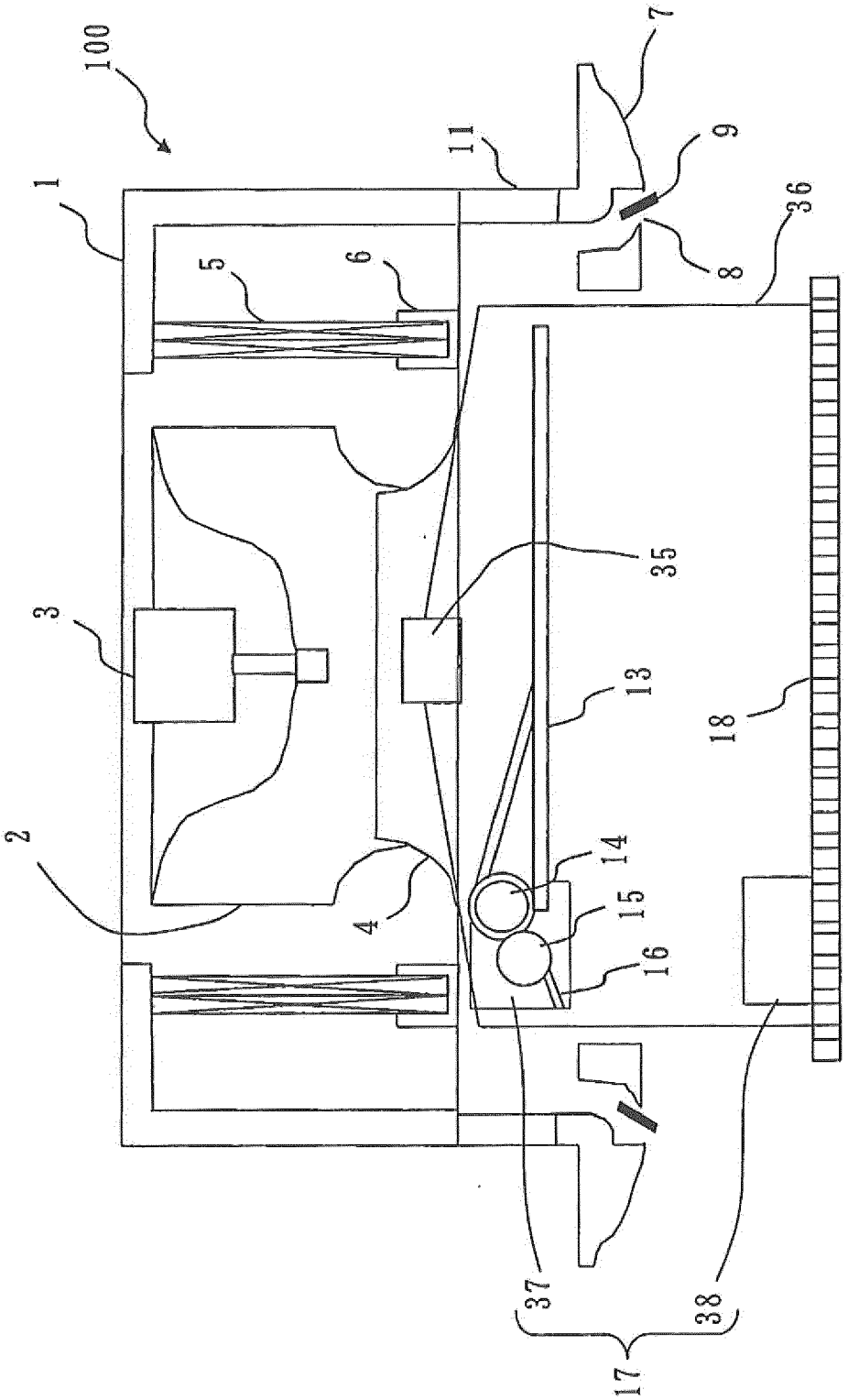


Fig. 12

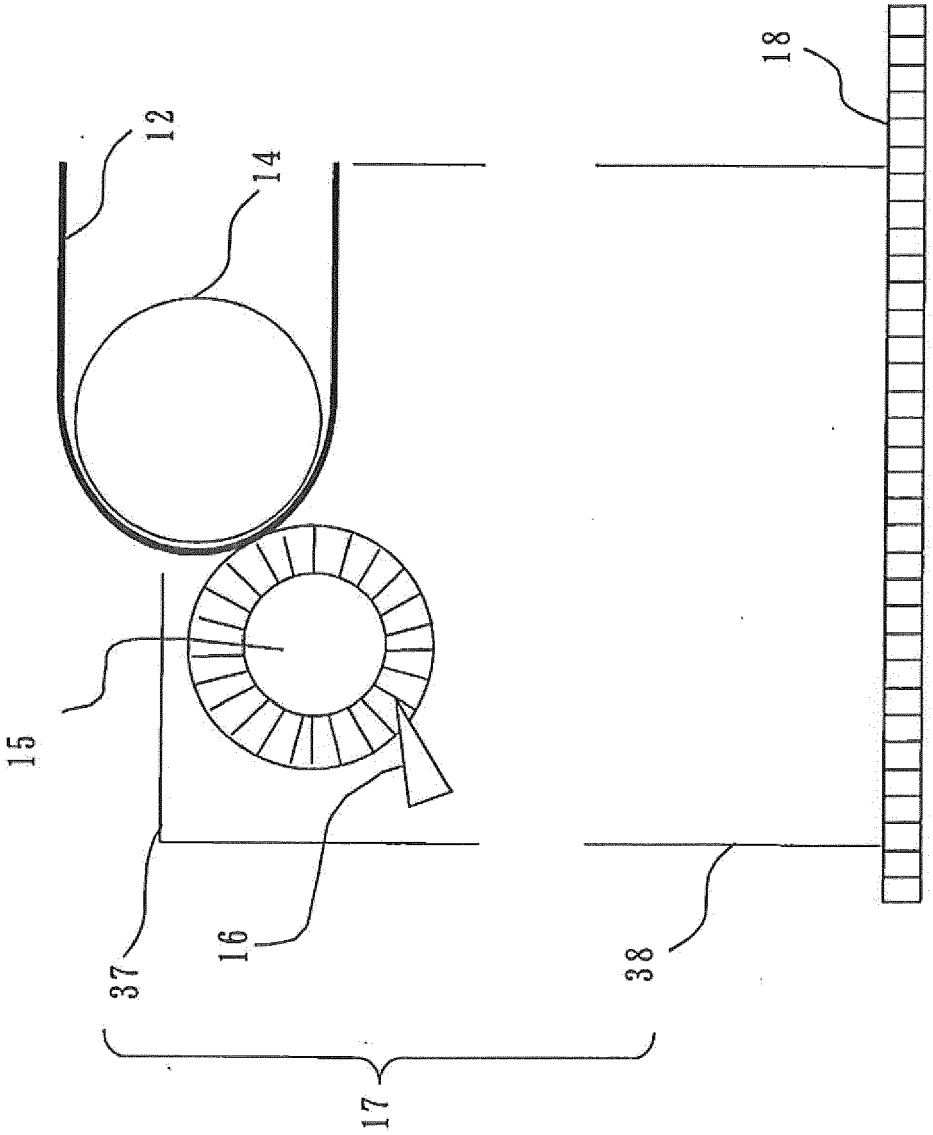


Fig. 13

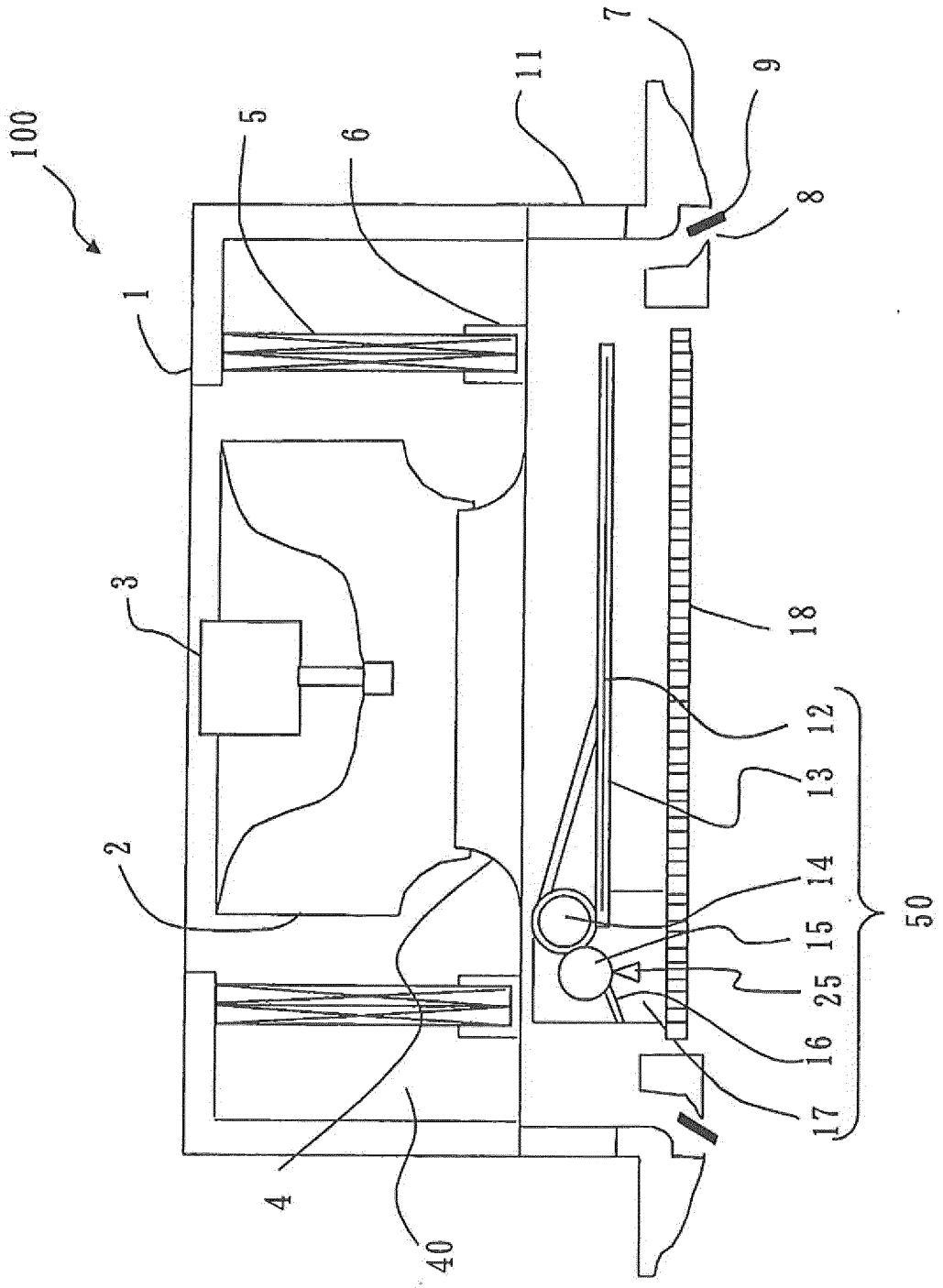


Fig. 14A

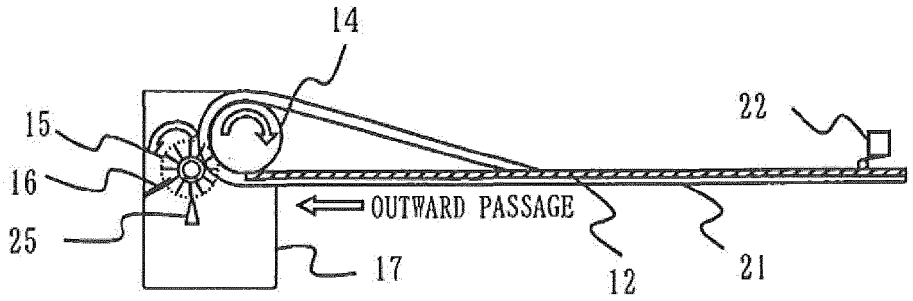


Fig. 14B

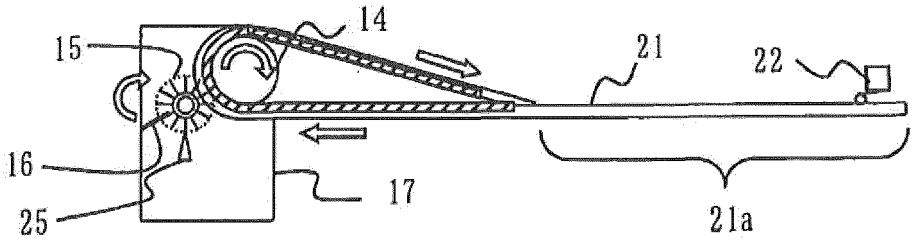


Fig. 14C

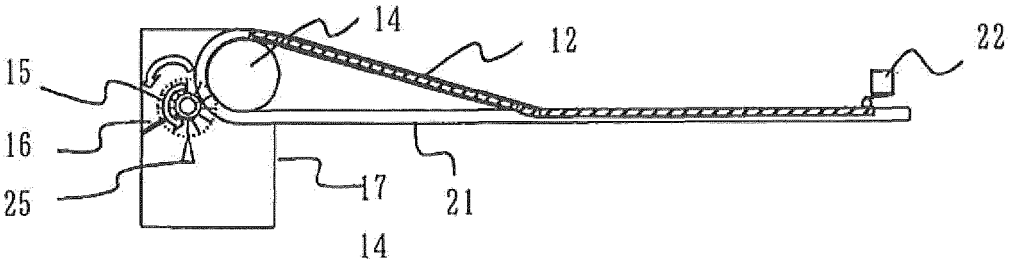


Fig. 14D

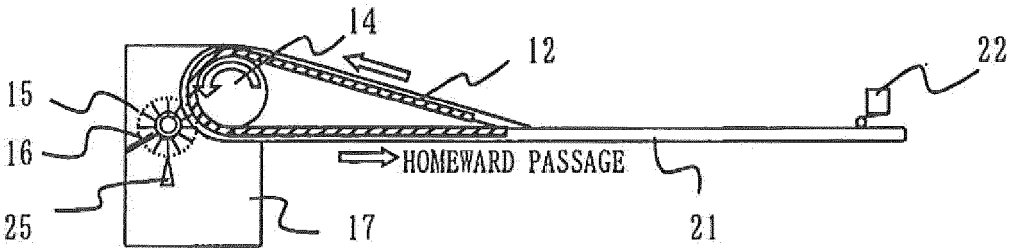


Fig. 14E

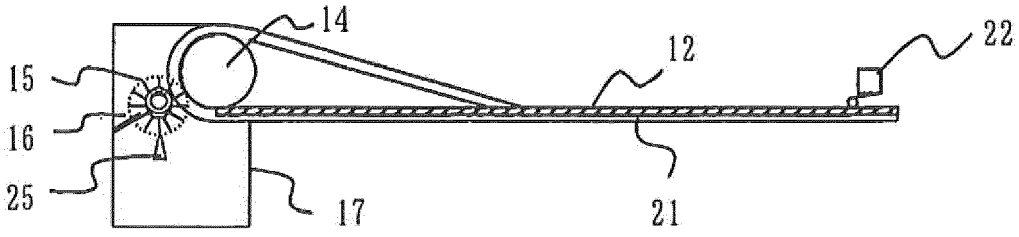


Fig. 15

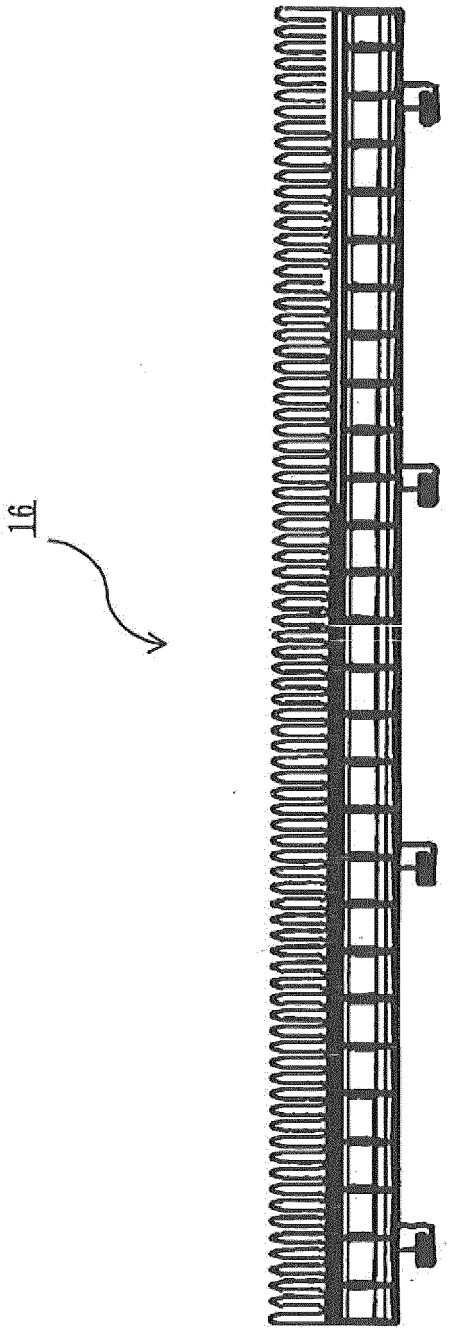
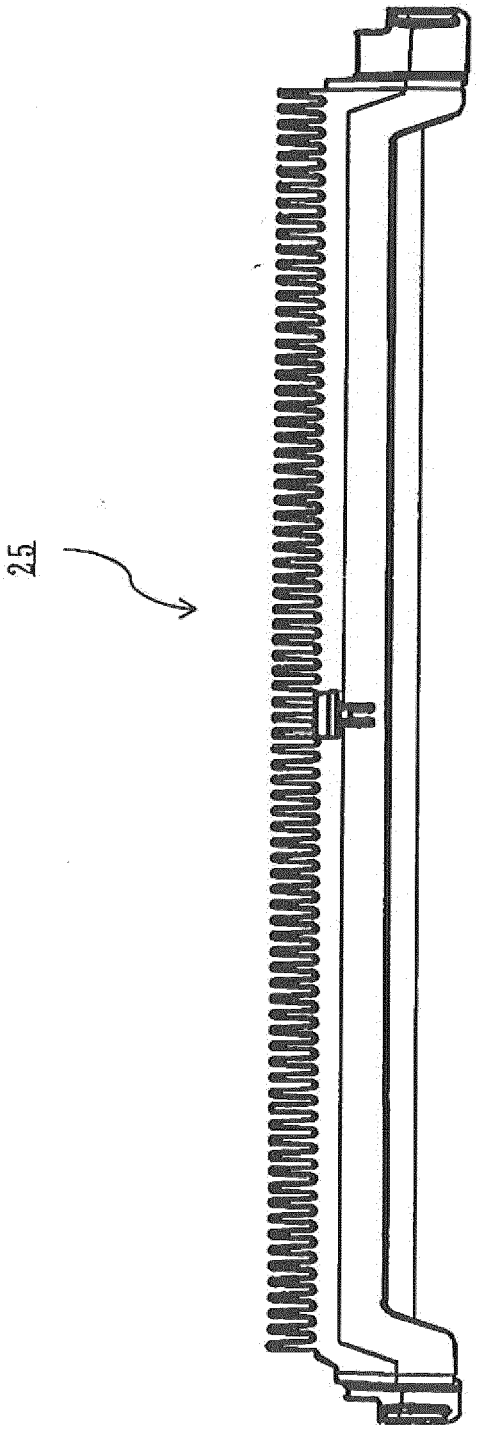


Fig. 16



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 11 19 3859

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 10 009660 A (MITSUBISHI ELECTRIC BILL TECH) 16 January 1998 (1998-01-16) * abstract; claim 1; figure 1 *	1-15	INV. F24F1/00 F24F13/28
A	WO 2008/072588 A (DAIKIN IND LTD [JP]; NAKANISHI JUNICHI [JP]; MIYAGAMI MASATO [JP]; UEY) 19 June 2008 (2008-06-19) * abstract; claim 1; figure 1 *	1-15	
A	JP 2006 071121 A (MATSUSHITA ELECTRIC IND CO LTD) 16 March 2006 (2006-03-16) * abstract; figure 1 *	1-15	
A	WO 2008/038585 A (DAIKIN IND LTD [JP]; MATSUBARA ATSUSHI [JP]) 3 April 2008 (2008-04-03) * abstract; figure 1 *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

F24F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	27 February 2012	Decking, Oliver

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 19 3859

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

27-02-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 10009660 A	16-01-1998	NONE	
WO 2008072588 A	19-06-2008	CN 101548138 A	30-09-2009
		EP 2119979 A1	18-11-2009
		JP 4523578 B2	11-08-2010
		JP 2008145056 A	26-06-2008
		KR 20090082498 A	30-07-2009
		WO 2008072588 A1	19-06-2008
JP 2006071121 A	16-03-2006	NONE	
WO 2008038585 A	03-04-2008	JP 2008082566 A	10-04-2008
		WO 2008038585 A1	03-04-2008

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 10009660 A **[0006]**