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

(11) **EP 2 375 176 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
12.10.2011 Bulletin 2011/41

(21) Application number: **09830334.0**

(22) Date of filing: **26.11.2009**

(51) Int Cl.:
F24F 6/10 *(2006.01)*

(86) International application number:
PCT/JP2009/069926

(87) International publication number:
WO 2010/064567 (10.06.2010 Gazette 2010/23)

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

(30) Priority: **03.12.2008 JP 2008308954**
17.12.2008 JP 2008321055

(71) Applicant: **Daikin Industries, Ltd.**
Osaka 530-8323 (JP)

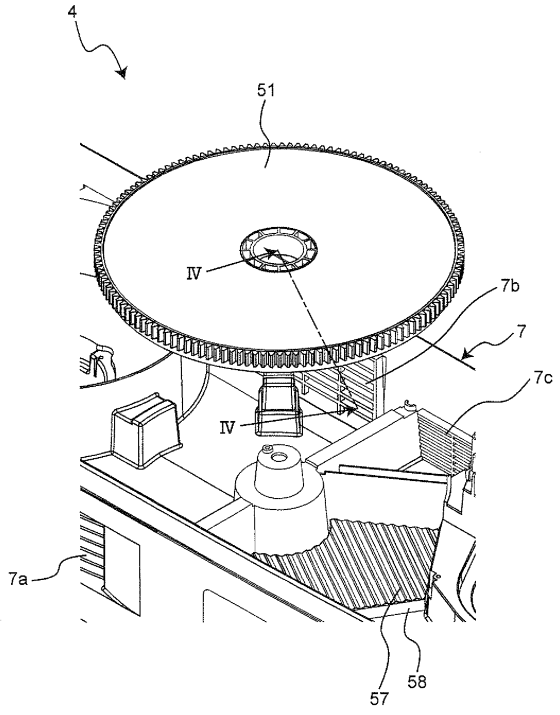
(72) Inventors:
- **MURATA, Katsunori**
Kusatsu-shi
Shiga 525-0044 (JP)
- **MATSUMOTO, Sachiko**
Kusatsu-shi
Shiga 525-0044 (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastraße 4
81925 München (DE)

(54) HUMIDIFYING UNIT

(57) A humidifying unit (4) is provided with a humidifying rotor (51) through which a humidifying path passes. In the humidifying path, a heating device is provided upstream of the humidifying rotor (51) and a radiation plate (57) is provided downstream of the humidifying rotor (51). The configuration allows the temperature of the humidifying rotor (51) to be increased by radiant heat of the radiation plate (57) without an increase in the output of the heating device, and this increases the amount of moisture released from the humidifying rotor (51).

Fig.3



EP 2 375 176 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a humidifying unit for humidifying air that is supplied into a room, for instance.

BACKGROUND ART

[0002] A conventional humidifying unit has a humidifying rotor, a moisture adsorption path extending through the humidifying rotor, a humidifying path extending through the humidifying rotor, and a heater for heating air upstream of the humidifying rotor in the humidifying path, in which unit the humidifying rotor adsorbs moisture from air in the moisture adsorption path while humidifying the heated air in the humidifying path (see JP 3430993 B2 (Patent Literature 1), for instance).

[0003] That is, a region of the humidifying rotor that faces the moisture adsorption path adsorbs moisture from the air flowing through the moisture adsorption path. On the other hand, a temperature of a region of the humidifying rotor that faces the humidifying path is increased by passage therethrough of the air heated by the heater. Then the moisture is released from the region of the humidifying rotor that faces the humidifying path and the air passing through the region is thereby humidified.

[0004] Though the air in the humidifying path passes through the humidifying rotor after being heated by the heater, in the conventional humidifying unit, the heated air decreases in temperature before reaching the humidifying rotor. Thus, a quantity of the moisture released from the humidifying rotor decreases accordingly. Under this condition, increase in temperature of the heater, e.g., to a maximum allowable temperature for components might cause increase in the quantity of the moisture released from the humidifying rotor, whereas the increase in the temperature might deteriorate an efficiency of the release of the moisture from the humidifying rotor.

[0005] The air heated by the heater is prone to flow through a center part of the region of the humidifying rotor that faces the humidifying path and thus a temperature thereof is prone to increase, whereas a circumferential edge part (i.e., a part along a circumferential edge) of the region resists flow therethrough of the air heated by the heater and thus resists increase in a temperature thereof. As a result, less moisture is released from the circumferential edge part of the region of the humidifying rotor that faces the humidifying path.

[0006] As described above, the conventional humidifying unit has a problem in that it is impossible to efficiently release moisture from the humidifying rotor thereof.

CITATION LIST

PATENT LITERATURE

[0007] PTL1: JP 3430993 B2

SUMMARY OF INVENTION

Technical Problem

[0008] An object of the invention is to provide a humidifying unit by which an efficiency of release of moisture from a humidifying rotor can be increased.

Solution to Problem

[0009] There is provided, according to the present invention, a humidifying unit comprising:

a humidifying rotor;
a humidifying path extending through the humidifying rotor;
a heating unit provided upstream of the humidifying rotor in the humidifying path; and
a radiation plate provided downstream of the humidifying rotor in the humidifying path.

[0010] According to the humidifying unit having an above configuration, air upstream of the humidifying rotor in the humidifying path is heated by the heating element and thereafter passes through the humidifying rotor. Then the radiation plate is heated by the air from the humidifying rotor because the radiation plate is provided downstream of the humidifying rotor in the humidifying path.

[0011] Therefore, a temperature of the humidifying rotor is increased by radiant heat from the radiation plate, without increase in a temperature of the air heated by the heating element, and a quantity of moisture released from the humidifying rotor is thereby increased, so that the moisture can be released from the humidifying rotor with a high efficiency.

[0012] In one embodiment, the humidifying unit further comprises a baffle plate provided downstream of the humidifying rotor in the humidifying path.

[0013] According to the humidifying unit of the embodiment, the baffle plate residing downstream of the humidifying rotor in the humidifying path resists flow of air. Thus the radiation plate can sufficiently be heated by the air.

[0014] As a result, a surface of the humidifying rotor that faces the radiation plate can sufficiently be heated by the radiant heat from the radiation plate, so that a quantity of moisture released from the humidifying rotor can sufficiently be increased.

[0015] In one embodiment, the baffle plate faces a part other than a circumferential edge part (i.e., a part along a circumferential edge) of a region of the humidifying rotor that faces the humidifying path.

[0016] According to the humidifying unit of the embodiment, the baffle plate faces a part other than the circumferential edge parts of the region of the humidifying rotor that faces the humidifying path and thus resists air flowing through a part that faces the part other than the circumferential edge part in the humidifying path downstream of the humidifying rotor, so that the heated air can be delivered as uniformly as possible to a part facing the circumferential edge part (part resisting flow of the air) and a part facing the non-circumferential edge part (part prone to allow flow of the air). Thus the radiant heat from the radiation plate can be projected as uniformly as possible onto the humidifying rotor.

[0017] In one embodiment, the baffle plate has a through hole facing both the humidifying rotor and the radiation plate.

[0018] According to the humidifying unit of the embodiment, the baffle plate has a through hole (or through holes) facing the humidifying rotor and the radiation plate, and thus the radiant heat from the radiation plate can be applied through the through hole(s) of the baffle plate onto the humidifying rotor.

[0019] In one embodiment, the humidifying unit further comprises a heat insulator placed on an opposite side of the radiation plate from the humidifying rotor.

[0020] According to the humidifying unit of the embodiment, because the heat insulator is placed on an opposite side of the radiation plate from the humidifying rotor, that is, opposite from the humidifying rotor relative to the radiation plate, the heat from the radiation plate can be prevented from escaping toward a side opposite from the humidifying rotor.

[0021] In one embodiment, the humidifying rotor is in shape of a disc.

[0022] According to the humidifying unit of the embodiment, the humidifying rotor is in shape of a disc and thus the humidifying unit can be reduced in size.

[0023] In one embodiment, air heated by the heating unit passes through a generally fan-shaped region of the humidifying rotor.

[0024] According to the humidifying unit of the embodiment, the radiant heat from the radiation plate prevents the uneven heating in the humidifying rotor that is prone to occur when the air heated by the heating unit passes through the generally fan-shaped region of the humidifying rotor.

[0025] In one embodiment, a surface of the radiation plate that faces the humidifying rotor is an uneven surface.

[0026] According to the humidifying unit of the embodiment, the surface of the radiation plate facing the humidifying rotor is an uneven surface, and thus the radiant heat can be applied onto a wide area on the humidifying rotor.

[0027] In one embodiment, the humidifying unit further comprises a first distribution element that is provided between the heating unit and the humidifying rotor and that distributes air heated by the heating element among parts of the humidifying rotor facing the humidifying path so as to increase uniformity of the distribution.

[0028] According to the humidifying unit of the embodiment, the first distribution element is provided between the heating unit and the humidifying rotor. The first distribution element distributes the air, heated by the heating unit, among the parts of the humidifying rotor facing the humidifying path so as to increase uniformity of the distribution.

[0029] As a result, the air heated by the heating unit passes through an increased portion of the region of the humidifying rotor that faces the humidifying path.

[0030] This increases moisture released from the region of the humidifying rotor that faces the humidifying path and improves moisture releasing performance of the humidifying rotor.

[0031] In one embodiment, the first distribution element faces a part other than a circumferential edge part of a region of the humidifying rotor that faces the humidifying path.

[0032] According to the humidifying unit of the embodiment, the first distribution element faces a part, other than the circumferential edge part, of the region of the humidifying rotor that faces the humidifying path, thereby prevents air flow from the heating unit from concentrating on the parts other than the circumferential edge part, and reduces unevenness in the heating of the region of the humidifying rotor that faces the humidifying path.

[0033] In one embodiment, the first distribution element comprises a guide element for guiding the air to a circumferential edge part of the region of the humidifying rotor that faces the humidifying path.

[0034] According to the humidifying unit of the embodiment, the first distribution element has the guide element for guiding the air to the circumferential edge part of the region of the humidifying rotor that faces the humidifying path, and thus makes the circumferential edge part prone to increase in temperature, so that an efficiency of humidification by the circumferential edge part of the region of the humidifying rotor that faces the humidifying path can be increased.

[0035] In one embodiment, the humidifying unit further comprises a moisture adsorption path extending through the humidifying rotor, and a second distribution element that is provided upstream of the humidifying rotor in the moisture adsorption path and that distributes air, directed toward the humidifying rotor, among parts of the humidifying rotor facing the moisture adsorption path so as to increase uniformity of the distribution.

[0036] According to the humidifying unit of the embodiment, the second distribution element is provided upstream of the humidifying rotor in the moisture adsorption path. The second distribution element distributes the air, directed toward the humidifying rotor, among the parts of the humidifying rotor facing the moisture adsorption path so as to increase the uniformity of the distribution.

[0037] As a result, the air heated by the heating unit passes through an increased portion of the region of the

humidifying rotor that faces the humidifying path.

[0038] This increases moisture adsorbed by the region of the humidifying rotor that faces the moisture adsorption path and improves moisture adsorbing performance of the humidifying rotor.

[0039] In one embodiment, the second distribution element faces a part other than a circumferential edge part in a region of the humidifying rotor that faces the moisture adsorption path.

[0040] According to the humidifying unit of the embodiment, the second distribution element faces a part, other than the circumferential edge part, of the region of the humidifying rotor that faces the moisture adsorption path, thereby prevents air flow from concentrating on the part other than the circumferential edge part, and reduces unevenness in the moisture adsorption in the region of the humidifying rotor that faces the moisture adsorption path.

[0041] In one embodiment, the second distribution element comprises a guide element for guiding the air to the circumferential edge part of the region of the humidifying rotor that faces the moisture adsorption path.

[0042] According to the humidifying unit of the embodiment, the second distribution element has the guide element for guiding the air to the circumferential edge part of the region of the humidifying rotor that faces the moisture adsorption path, and thus makes the circumferential edge part prone to adsorb the moisture, so that efficiency of the moisture adsorption by the circumferential edge part of the region of the humidifying rotor that faces the moisture adsorption path can be increased.

[0043] In one embodiment, the first distribution element or the second distribution element comprises a plate which is provided with a through hole.

[0044] According to the humidifying unit of the embodiment, the first distribution element or the second distribution element includes the plate having a through hole (or through holes), and the air is thus prevented from being excessively or too little supplied only to a part of the humidifying rotor that faces the plate.

[0045] In one embodiment, the first distribution element or the second distribution element comprises wire-mesh or a punching plate.

[0046] According to the humidifying unit of the embodiment, the first distribution element or the second distribution element includes a wire-mesh or a punching plate and thus can easily be formed, so that a manufacturing cost therefor can be reduced.

[0047] In one embodiment, the humidifying rotor is generally in shape of a disc.

[0048] According to the humidifying unit of the embodiment, the humidifying rotor is in shape of a disc in general and thus the humidifying unit can be reduced in size.

[0049] There is also provided, according to the present invention, a humidifying unit comprising:

a humidifying rotor;

a humidifying path extending through the humidifying rotor;

a heating unit provided upstream of the humidifying rotor in the humidifying path; and

a first distribution element that is provided between the heating unit and the humidifying rotor and that distributes air heated by the heating element among parts of the humidifying rotor facing the humidifying path so as to increase uniformity of the distribution.

[0050] According to the humidifying unit of the embodiment, the first distribution element is provided between the heating unit and the humidifying rotor. The first distribution element distributes the air, heated by the heating unit, among the parts of the humidifying rotor facing the humidifying path so as to increase uniformity of the distribution.

[0051] As a result, the air heated by the heating unit passes through an increased portion of the region of the humidifying rotor that faces the humidifying path.

[0052] This increases moisture released from the region of the humidifying rotor that faces the humidifying path and improves the moisture releasing performance of the humidifying rotor.

[0053] In one embodiment, the first distribution element faces a part other than a circumferential edge part in a region of the humidifying rotor that faces the humidifying path.

[0054] According to the humidifying unit of the embodiment, the first distribution element faces a part, other than the circumferential edge part, of the region of the humidifying rotor that faces the humidifying path, thereby prevents air flow from the heating unit from concentrating on the parts other than the circumferential edge part, and reduces unevenness in the heating of the region of the humidifying rotor that faces the humidifying path.

[0055] In one embodiment, the first distribution element comprises a guide element for guiding the air to a circumferential edge part of the region of the humidifying rotor that faces the humidifying path.

[0056] According to the humidifying unit of the embodiment, the first distribution element has the guide element for guiding the air to the circumferential edge part of the region of the humidifying rotor that faces the humidifying path, and thus makes the circumferential edge part prone to increase in temperature, so that an efficiency of humidification by the circumferential edge part of the region of the humidifying rotor that faces the humidifying path can be increased.

[0057] In one embodiment, the humidifying unit further comprises a moisture adsorption path extending through the humidifying rotor, and a second distribution element that is provided upstream of the humidifying rotor in the moisture adsorption path and that distributes air, directed toward the humidifying rotor, among parts of the humidifying rotor facing the moisture adsorption path so as to increase uniformity of the distribution.

[0058] According to the humidifying unit of the embodiment, the second distribution element is provided up-

stream of the humidifying rotor in the moisture adsorption path. The second distribution element distributes the air, directed toward the humidifying rotor, among the parts of the humidifying rotor facing the moisture adsorption path so as to increase the uniformity of the distribution.

[0059] As a result, the air heated by the heating unit passes through an increased portion of the region of the humidifying rotor that faces the humidifying path.

[0060] This increases moisture adsorbed by the region of the humidifying rotor that faces the moisture adsorption path and improves moisture adsorbing performance of the humidifying rotor.

[0061] In one embodiment, the second distribution element faces a part other than a circumferential edge part in a region of the humidifying rotor that faces the moisture adsorption path.

[0062] According to the humidifying unit of the embodiment, the second distribution element faces a part, other than the circumferential edge part, of the region of the humidifying rotor that faces the moisture adsorption path, thereby prevents air flow from concentrating on the part other than the circumferential edge part, and reduces unevenness in the moisture adsorption in the region of the humidifying rotor that faces the moisture adsorption path.

[0063] In one embodiment, the second distribution element comprises a guide element for guiding the air to the circumferential edge part of the region of the humidifying rotor that faces the moisture adsorption path.

[0064] According to the humidifying unit of the embodiment, the second distribution element has the guide element for guiding the air to the circumferential edge part of the region of the humidifying rotor that faces the moisture adsorption path, and thus makes the circumferential edge part prone to adsorb the moisture, so that efficiency of the moisture adsorption by the circumferential edge part of the region of the humidifying rotor that faces the moisture adsorption path can be increased.

[0065] In one embodiment, the first distribution element or the second distribution element comprises a plate which is provided with a through hole.

[0066] According to the humidifying unit of the embodiment, the first distribution element or the second distribution element includes the plate having a through hole (or through holes), and the air is thus prevented from being excessively or too little supplied only to a part of the humidifying rotor that faces the plate.

[0067] In one embodiment, the first distribution element or the second distribution element comprises wire-mesh or a punching plate.

[0068] According to the humidifying unit of the embodiment, the first distribution element or the second distribution element includes a wire-mesh or a punching plate and thus can easily be formed, so that a manufacturing cost therefor can be reduced.

[0069] In one embodiment, the humidifying rotor is generally in shape of a disc.

[0070] According to the humidifying unit of the embodiment, the humidifying rotor is in shape of a disc in general and thus the humidifying unit can be reduced in size.

Advantageous Effects of Invention

[0071] According to the humidifying unit of the invention, the radiation plate provided downstream of the humidifying rotor in the humidifying path causes an increase in the temperature of the humidifying rotor by the radiant heat from the radiation plate, without increase in the temperature of the air heated by the heating element, and an increase in the quantity of moisture released from the humidifying rotor, so that the efficiency of releasing moisture from the humidifying rotor can be increased.

[0072] According to the humidifying unit of the invention, first distribution means distributes the air, heated by heating means, among the parts of the humidifying rotor facing the humidifying path so as to increase the uniformity of the distribution, and thus a portion through which the air heated by the heating means passes is increased in the region of the humidifying rotor that faces the humidifying path, so that an increase in moisture released and improvement in the moisture releasing performance of the humidifying rotor are attained.

BRIEF DESCRIPTION OF DRAWINGS

[0073]

Fig. 1 shows a schematic configuration of an air conditioner in accordance with a first embodiment of the invention;

Fig. 2 is an exploded perspective view of a humidifying unit in accordance with the first embodiment of the invention;

Fig. 3 is an enlarged view of a principal part of Fig. 2;

Fig. 4 is a schematic sectional view of the humidifying unit in accordance with the first embodiment;

Fig. 5 is an exploded perspective view of a principal part of a humidifying unit in accordance with a second embodiment of the invention;

Fig. 6 is a schematic sectional view of the humidifying unit in accordance with the second embodiment;

Fig. 7 is a schematic perspective view of a baffle plate for the humidifying unit in accordance with the second embodiment;

Fig. 8 is a schematic perspective view of another baffle plate for the humidifying unit in accordance with the second embodiment;

Fig. 9 shows a schematic configuration of an air conditioner in accordance with a third embodiment of the invention;

Fig. 10 is an exploded perspective view of a humidifying unit in accordance with the third embodiment of the invention;

Fig. 11 is a schematic perspective view of a humidifying rotor and a heating device in accordance with the third embodiment of the invention;

Fig. 12 is a schematic perspective view of a humidifying side air distribution element in accordance with the third embodiment of the invention;
Fig. 13 is a schematic top plan view of the humidifying rotor and the heating device;
Fig. 14 is a graph showing flow rates of air that passes through parts of the humidifying rotor;
Fig. 15 is a schematic top plan view of a humidifying rotor and a heating device of a humidifying unit of a comparative example;
Fig. 16 is a graph showing flow rates of air that passes through parts of the humidifying rotor of the comparative example;
Fig. 17 is a schematic perspective view of a modification of a humidifying side air distribution element in accordance with the third embodiment of the invention;
Fig. 18 is a schematic horizontal section of a humidifying unit in accordance with a fourth embodiment of the invention;
Fig. 19 is a schematic perspective view of a humidifying side air distribution element in accordance with the fourth embodiment of the invention;
Fig. 20 is a schematic representation of a humidifying unit in accordance with an embodiment of the invention;
Fig. 21 is a schematic representation of a humidifying unit in accordance with an embodiment of the invention;
Fig. 22 is a schematic representation of a humidifying unit in accordance with an embodiment of the invention;
Fig. 23 is a schematic representation of a humidifying unit in accordance with an embodiment of the invention;
Fig. 24 is a schematic representation of a humidifying unit in accordance with an embodiment of the invention; and
Fig. 25 is a schematic representation of a humidifying unit in accordance with an embodiment of the invention.

DESCRIPTION OF EMBODIMENTS

[0074] Hereinbelow, humidifying units of the invention will be described in detail with reference to embodiments shown in the drawings.

First Embodiment

[0075] Fig. 1 shows a schematic configuration of an air conditioner 1 in which a humidifying unit 4 in accordance with a first embodiment of the invention is installed.

[0076] The air conditioner 1 is a multiple-type air conditioner in which one outdoor unit 3 and two (first and second) indoor units 2a, 2b are connected in parallel by refrigerant pipes 13a, 13b, 14a, 14b. The air conditioner 1 is capable of performing operations such as ordinary operation including cooling operation and heating operation, humidifying operation, air supplying operation, and air discharging operation. Provided between the humidifying unit 4 and each of the first and second indoor units 2a, 2b are intake and discharge hoses 6a, 6b through which communication between an inner space in the humidifying unit 4 and each of inner spaces in the first and second indoor units 2a, 2b is attained. The intake and discharge hoses 6a, 6b are each composed of an outdoor duct 8a, 8b provided outdoors and an indoor duct 9a, 9b provided indoors.

[0077] The first and second indoor units 2a, 2b will initially be described. Both the first and second indoor units 2a, 2b are wall-hanging type indoor units that are mounted on a wall or the like. The first indoor unit 2a is placed in a first room 1a, and the second indoor unit 2b is placed in a second room 1b. Housed in the first indoor unit 2a are a first indoor heat exchanger 11a and a first indoor fan 12a facing the first indoor heat exchanger 11a.Housed in the second indoor unit 2b are a second indoor heat exchanger 11b and a second indoor fan 12b facing the second indoor heat exchanger 11b, as in the first indoor unit 2a.

[0078] The first and second indoor heat exchangers 11a, 11b are each composed of a heat transfer pipe folded a plurality of times and a plurality of fins through which the heat transfer pipe is inserted, and perform heat exchange between the heat exchangers and air that is in contact therewith.

[0079] The first and second indoor fans 12a, 12b are each configured in shape of a cylinder, and have at the periphery thereof blades that extend in a direction of the rotation axis thereof. The first and second indoor fans 12a, 12b are each driven to rotate so as to produce air flow in a direction intersecting with the rotation axis. The first and second indoor fans 12a, 12b take air from the first and second rooms 1a, 1b into the first and second indoor units 2a, 2b, respectively, and blow out into the first and second rooms 1a, 1b, respectively, the air having undergone the heat exchange with the first and second indoor heat exchangers 11a, 11b.

[0080] Portions of the indoor ducts 9a, 9b are placed in the first and second indoor units 2a, 2b, respectively. The indoor ducts 9a, 9b have respective openings, which are placed in positions facing a surface of the first and second indoor heat exchangers 11a, 11b, respectively. More particularly, the positions of the openings are downstream of air intakes provided on a top part of each of the first and second indoor units 2a, 2b and upstream of the first and second indoor heat exchangers 11a, 11b, in a state in which the first and second indoor fans 12a, 12b are rotated so that air flow is produced.

[0081] Subsequently, the outdoor unit 3 will be described. The outdoor unit 3 includes an outdoor air conditioning unit 5 in a lower part thereof and the humidifying unit 4 in an upper part thereof. Thus power sources for the outdoor air conditioning unit 5 and the humidifying unit 4 can be unified in the outdoor unit 3.

[0082] The outdoor air conditioning unit 5 has an outdoor unit casing 43. Housed in the outdoor unit casing 43 are a compressor 21, a four way valve 22 connected to a discharge side of the compressor 21, an accumulator 23 connected to an intake side of the compressor 21, an outdoor heat exchanger 24 connected to the four way valve 22, outdoor expansion valves 25a, 25b connected to the outdoor heat exchanger 24, and an outdoor fan 29 facing the outdoor heat exchanger 24.

[0083] The outdoor expansion valves 25a, 25b are connected through filters 26a, 26b and, liquid stop valves 27a, 27b to refrigerant pipes 13a, 13b and through the refrigerant pipes 13a, 13b to an end of the indoor heat exchangers 11a, 11b, respectively.

[0084] The four way valve 22 is connected through gas stop valves 28a, 28b to refrigerant pipes 14a, 14b and, through the refrigerant pipes 14a, 14b to the other end of the indoor heat exchangers 11a, 11b, respectively.

[0085] Subsequently, the humidifying unit 4 will be described. The humidifying unit 4 has a humidifying unit casing 7. Provided in the humidifying unit casing 7 are a humidifying unit main body 6 and an air channel switching device 56.

[0086] Provided on a front face of the humidifying unit casing 7 is an adsorption air blow-off port 7a composed of a plurality of slit-like openings. The adsorption air blow-off port 7a is an opening through which air that has flowed through a moisture adsorption path 101 is discharged out of the humidifying unit casing 7.

[0087] Provided on a back face of the humidifying unit casing 7 are an adsorption air intake 7b and an intake and discharge port 7c.

[0088] The adsorption air intake 7b is an opening through which air passes that is taken into the humidifying unit casing 7 from outdoors for adsorption of moisture by the humidifying rotor 51. More specifically, driving an adsorption blower 55 causes outdoor air to flow through the adsorption air intake 7b into the moisture adsorption path 101. The air having flowed into the moisture adsorption path 101 passes through the humidifying rotor 51 and is thereby dehumidified. That is, moisture in the air is adsorbed to the humidifying rotor 51 facing the moisture adsorption path 101.

[0089] The intake and discharge port 7c is an opening for allowing outdoor air to flow into the humidifying path 102 in an air intake operation and the humidifying operation. When the outdoor air comes into the humidifying path 102, the air passes through a generally fan-shaped region of the humidifying rotor 51, thereafter heated by a heating device 52, then passing through another generally fan-shaped region of the humidifying rotor 51, and flowing toward a humidifying fan device 54. In the air discharging operation, air taken into the humidifying unit casing 7 from the indoor units 2a, 2b is discharged through the intake and discharge port 7c to the outdoors. The heating device 52 is an example of the hating unit.

[0090] The humidifying unit main body 6 has the humidifying rotor 51, the heating device 52, the humidifying fan device 54, and the adsorption blower 55.

[0091] The humidifying rotor 51 is a ceramic rotor having a honeycomb structure and is generally shaped like a disc. The humidifying rotor 51 is rotatably installed so as to be driven to be rotated by a rotor driving motor (not shown). Main components of the humidifying rotor 51 have been produced by burning of adsorbent such as zeolite. The adsorbent such as zeolite has a property of adsorbing moisture in air that is in contact with the adsorbent and releasing the adsorbed moisture by heating of the moisture. Though zeolite is used as the adsorbent in the embodiment, silica gel, alumina or the like can be used as the adsorbent.

[0092] The humidifying rotor 51 shaped generally like a disc allows the humidifying unit 4 to be reduced in size.

[0093] The heating device 52 is positioned above the humidifying rotor 51 so as to face the humidifying rotor 51. The air heated by the heating device 52 passes through the humidifying rotor 51 and thus increases a temperature of the humidifying rotor 51.

[0094] The humidifying fan device 54 is positioned on a lateral side of the humidifying rotor 51 and is a radical fan assembly that produces an air flow passing through a part of the humidifying rotor 51 facing the heating device 52. The humidifying fan device 54 is capable of delivering outdoor air to the indoor units 2a, 2b, as well as taking indoor air into the indoor units 2a, 2b and then discharging the air to the outdoors.

[0095] When delivering the air taken in from the outdoors to the indoor units 2a, 2b, the humidifying fan device 54 sucks the outdoor air though the intake and discharge port 7c into the humidifying path 102, passes the air through the humidifying rotor 51, and thereafter delivers the air through the air channel switching device 56 and the intake and discharge hoses 6a, 6b to the indoor units 2a, 2b, respectively. In this operation, the air flows along directions of arrows A1 in the intake and discharge hoses 6a, 6b.

[0096] When discharging to the outdoors the indoor air taken into the indoor units 2a, 2b, the humidifying fan device 54 discharges the air to the outdoors through the intake and discharge hoses 6a, 6b, the humidifying path 102, and the intake and discharge port 7c. In this operation, the air flows along directions A2 in the intake and discharge hoses 6a, 6b.

[0097] The air channel switching device 56 is connected to the intake and discharge hoses 6a, 6b and is capable of supplying the air from the humidifying path 102 to one of the intake and discharge hoses 6a, 6b. The air channel switching device 56 is also capable of stopping the supply of the air from the humidifying path 102 to the intake and discharge hoses 6a, 6b. That is, the air from the humidifying fan device 54 can be prevented from flowing into either of the intake and discharge hoses 6a, 6b.

[0098] The adsorption blower 55 has an adsorption fan motor 59 and an adsorption fan 61 that is driven to rotate by the adsorption fan motor 59, and produces an air flow passing through a part of the humidifying rotor 51 that

does not face the heating device 52. That is, the adsorption blower 55 produces an air flow directed toward the adsorption air blow-off port 7a in the moisture adsorption path 101.

[0099] Fig. 2 is an exploded perspective view of the humidifying unit 4. In Fig. 2, illustration of a top plate that forms a top part of the humidifying unit casing 7 is omitted.

[0100] In the humidifying unit 4 in the humidifying operation, an air flow along arrows A11 through A13 and an air flow along arrows A21 through A27 are produced. While the air flows are produced, the humidifying rotor 51 rotates in a direction of an arrow L.

[0101] The air flow along the arrow A11 is a flow of air going from the adsorption air intake 7b through the humidifying rotor 51 toward vicinity of a bell mouth 62. Flowing through the humidifying path 101, the air passes through the part not facing the heating device 52 of the humidifying rotor 51, and moisture in the air is then adsorbed to the part.

[0102] The air flow along the arrow A12 is a flow of air going from the vicinity of the bell mouth 62 through a space surrounded by the bell mouth 62 into the adsorption fan 61.

[0103] The air flow along the arrow A13 is a flow of air blown out from the adsorption fan 61 and going toward the adsorption air blow-off port 7a.

[0104] The air flow along the arrows A21, A22 is a flow of air going from the intake and discharge port 7c through the humidifying rotor 51 toward the heating device 52. The air passes through a generally fan-shaped first region of the humidifying rotor 51 (region facing a part of the humidifying path 102 upstream of the heating device 52), and turning of the humidifying rotor 51 in the direction of the arrow L makes the first region face the moisture adsorption path 101.

[0105] The air flow along the arrows A23 through A25 is a flow of air heated by the heating device 52 and going through the humidifying rotor 51 toward the air channel switching device 56. The air passes through a generally fan-shaped second region of the humidifying rotor 51 (region facing a part of the humidifying path 102 downstream of the heating device 52) and heats the region. Turning of the humidifying rotor 51 in the direction of the arrow L makes the second region face the part of the humidifying path 102 upstream of the heating device 52.

[0106] The air flow along the arrows A26, A27 is a flow of air that leaves the air channel switching device 56, that passes through the humidifying fan device 54 and that is returned to the air channel switching device 56.

[0107] Fig. 3 is an enlarged view of a portion of Fig. 2. Fig. 4 is a schematic sectional view of the humidifying unit 4 taken along a vertical plane including a line IV-IV of Fig. 3. In Fig. 4, a portion in a small circle is shown in a large circle with enlargement.

[0108] A radiation plate 57 shown in Figs. 3 and 4 is provided under the region facing the part of the humidifying path 102 downstream of the heating device 52, i.e., under the generally fan-shaped second region. A heat insulator 58 composed of polyethylene foam, for instance, is provided between the radiation plate 57 and a bottom part of the humidifying unit casing 7.

[0109] The radiation plate 57 is formed with use of a plate made of metal, such as aluminum plate, Galvalume steel plate, and iron plate. A surface of the radiation plate 57 facing the humidifying rotor 51 is an uneven surface. As shown in the large circle in Fig. 4, more specifically, a sectional shape of the radiation plate 57 includes a plurality of generally trapezoidal shaped protrusions and a plurality of generally triangular shaped depressions therebetween.

[0110] As described above, the radiation plate 57 facing the generally fan-shaped second region of the humidifying rotor 51 is provided downstream of the second region, so that the radiation plate 57 is heated by the air heated by the heating device 52 and having passed through the humidifying rotor 51.

[0111] Without increase in output of the heating device 52, therefore, a temperature of the second region in the humidifying rotor 51 is increased by radiant heat from the radiation plate 57, and a quantity of moisture released from the second region of the humidifying rotor 51 is thereby increased, so that the moisture can be released from the second region of the humidifying rotor 51 with a high efficiency.

[0112] The heat insulator 58 provided between the radiation plate 57 and the bottom part of the humidifying unit casing 7 prevents heat in the radiation plate 57 from escaping to the bottom part of the humidifying unit casing 7.

[0113] On condition that the radiation plate 57 is not provided downstream of the generally fan-shaped second region of the humidifying rotor 51, the heating is made uneven in the generally fan-shaped second region of the humidifying rotor 51. The unevenness in the heating can be decreased by the provision of the radiation plate 57 as in the embodiment.

[0114] The uneven surface of the radiation plate 57 facing the humidifying rotor 51 makes the radiant heat from the radiation plate 57 spread over a wide area, as shown by arrows in Fig. 4. As a result, an inner circumferential edge part (i.e., a part along an inner circumferential edge) and an outer circumferential edge part (i.e., a part along an outer circumferential edge) of the generally fan-shaped second region of the humidifying rotor 51, which parts are difficult to heat with the air from the heating device 52, are allowed to be heated by the radiant heat from the radiation plate 57.

Second Embodiment

[0115] Fig. 5 is an enlarged view of a principal part of an exploded perspective view of a humidifying unit 104 in accordance with a second embodiment of the invention. Fig. 6 is a schematic sectional view of the humidifying unit 104 taken along a vertical plane including a line VI-VI of Fig. 5. Components in Figs. 5 and 6 that are the

same as those of the first embodiment shown in Figs. 1 through 4 are denoted by the same reference numerals as those of the components in Figs. 1 through 4, and description thereof is omitted.

[0116] As shown in Figs. 5 and 6, the humidifying unit 104 is different from the humidifying unit 4 of the first embodiment only in that the humidifying unit 104 has a baffle plate 159 placed between the generally fan-shaped second region (region facing the part downstream of the heating device 52) of the humidifying rotor 51 and the radiation plate 57.

[0117] The baffle plate 159 is formed of a punching plate and has a function of radiation like the radiation plate 57. The baffle plate 159 faces the generally fan-shaped second region of the humidifying rotor 51 at parts other than the inner circumferential edge part and the outer circumferential edge part in the generally fan-shaped second region thereof. The baffle plate 159, as shown in Fig. 7, has a plurality of through holes 160 that face the humidifying rotor 51 and the radiation plate 57 (see Figs. 5 and 6).

[0118] With use of the humidifying unit 104 having the above configuration, the baffle plate 159 placed between the generally fan-shaped second region of the humidifying rotor 51 and the radiation plate 57 resists flow to downstream side of the air having passed through the second region.

[0119] As a result, the radiation plate 57 is sufficiently heated by the air having passed through the generally fan-shaped second region of the humidifying rotor 51, so that performance of radiation from the radiation plate 57 can be improved.

[0120] The baffle plate 159 faces the generally fan-shaped second region of the humidifying rotor 51 other than the inner circumferential edge part and the outer circumferential edge part thereof, and thus increases an effect of resisting the flow to the downstream side of the air having passed through the second region.

[0121] The baffle plate 159 has the through holes 160 facing the humidifying rotor 51 and the radiation plate 57, and thus the radiant heat from the radiation plate 57 can be applied through the through holes 160 of the baffle plate 159 onto the generally fan-shaped second region of the humidifying rotor 51.

[0122] The baffle plate 159 has the function of radiation, and thus radiant heat from the baffle plate 159 can be applied onto the generally fan-shaped second region of the humidifying rotor 51 as shown by arrows in Fig. 6.

[0123] The baffle plate 159 is placed between the generally fan-shaped second region of the humidifying rotor 51 and the radiation plate 57 in the second embodiment, whereas there may be placed a baffle plate 259 shown in Fig. 8. A part of the baffle plate 259 that faces the humidifying rotor 51 and the radiation plate 57 is formed of wire-mesh 260.

[0124] The baffle plate 259 may be placed so as to face a part of the generally fan-shaped second region of the humidifying rotor 51 other than the inner circumferential edge part and the outer circumferential edge part thereof.

[0125] The humidifying units 4, 104 of the first and second embodiments are installed in the multiple-type air conditioner 1, whereas a humidifying unit in accordance with an embodiment of the invention may be installed in a single-type air conditioner. That is, the humidifying units of the invention can be installed in various types of air conditioners and are capable of humidifying inside of rooms, for instance, only by themselves.

[0126] The humidifying units of the invention may be installed in air conditioners having wall-hanging type indoor units, as in the first and second embodiments, or may be installed in air conditioners having indoor units of types other than wall-hanging type. Among the indoor units of types other than wall-hanging type are those of floor type, ceiling-embedded cassette type, and ceiling suspended type, for instance.

[0127] Shape of baffle plates in the humidifying units of the invention are not limited to those shown in Figs. 7 and 8 but may be any of shapes that resist flow of air humidified by being passed through the humidifying rotor.

Third Embodiment

[0128] Fig. 9 shows a schematic configuration of an air conditioner 1 in which a humidifying unit 1004 in accordance with a third embodiment of the invention is installed.

[0129] The air conditioner 1 is a multiple-type air conditioner in which one outdoor unit 1003 and two (first and second) indoor units 1002a, 1002b are connected in parallel by refrigerant pipes 1013a, 1013b, 1014a, 1014b. The air conditioner 1 is capable of performing operations such as ordinary operation including cooling operation and heating operation, humidifying operation, air supplying operation, and air discharging operation. Provided between the humidifying unit 1004 and each of the first and second indoor units 1002a, 1002b are intake and discharge hoses 1006a, 1006b through which communication between an inner space in the humidifying unit 1004 and each of inner spaces in the first and second indoor units 1002a, 1002b is attained. The intake and discharge hoses 1006a, 1006b are each composed of an outdoor duct 1008a, 1008b provided outdoors and an indoor duct 1009a, 1009b provided indoors.

[0130] The first and second indoor units 1002a, 1002b will initially be described. Both the first and second indoor units 1002a, 1002b are wall-hanging type indoor units that are mounted on a wall or the like. The first indoor unit 1002a is placed in a first room 1001a, and the second indoor unit 1002b is placed in a second room 1001b. Housed in the first indoor unit 1002a are a first indoor heat exchanger 1011a and a first indoor fan 1012a facing the first indoor heat exchanger 1011a. Housed in the second indoor unit 1002b are a second indoor heat exchanger 1011b and a second indoor fan 1012b facing the second indoor heat exchanger 1011b, as in the first indoor

unit 1002a.

[0131] The first and second indoor heat exchangers 1011a, 1011b are each composed of a heat transfer pipe folded a plurality of times and a plurality of fins through which the heat transfer pipe is inserted, and perform heat exchange between the heat exchangers and air that is in contact therewith.

[0132] The first and second indoor fans 1012a, 1012b are configured in shape of a cylinder, and have at the periphery thereof blades that extend in a direction of the rotation axis thereof. The first and second indoor fans 1012a, 1012b are each driven to rotate so as to produce air flow in a direction intersecting with the rotation axis. The first and second indoor fans 1012a, 1012b take air from the first and second rooms 1001a, 1001b into the first and second indoor units 1002a, 1002b, respectively, and blow out into the first and second rooms 1001a, 1001b, respectively, the air having undergone the heat exchange with the first and second indoor heat exchangers 1011a, 1011b.

[0133] Portions of the indoor ducts 1009a, 1009b are placed in the first and second indoor units 1002a, 1002b, respectively. The indoor ducts 1009a, 1009b have respective openings, which are placed in positions facing a surface of the first and second indoor heat exchangers 1011a, 1011b, respectively. More specifically, the positions of the openings are downstream of air intakes provided on a top part of each of the first and second indoor units 1002a, 1002b and upstream of the first and second indoor heat exchangers 1011a, 1011b, in a state in which the first and second indoor fans 1012a, 1012b are rotated so that air flow is produced.

[0134] Subsequently, the outdoor unit 1003 will be described. The outdoor unit 1003 includes an outdoor air conditioning unit 1005 in a lower part thereof and the humidifying unit 1004 in an upper part thereof. Thus power sources for the outdoor air conditioning unit 1005 and the humidifying unit 1004 can be unified in the outdoor unit 1003.

[0135] The outdoor air conditioning unit 1005 has an outdoor unit casing 1043. Housed in the outdoor unit casing 1043 are a compressor 1021, a four way valve 1022 connected to a discharge side of the compressor 1021, an accumulator 1023 connected to an intake side of the compressor 1021, an outdoor heat exchanger 1024 connected to the four way valve 1022, outdoor expansion valves 1025a, 1025b connected to the outdoor heat exchanger 1024, and an outdoor fan 1029 facing the outdoor heat exchanger 1024.

[0136] The outdoor expansion valves 1025a, 1025b are connected through filters 1026a, 1026b and liquid stop valves 1027a, 1027b to refrigerant pipes 1013a, 1013b and, through the refrigerant pipes 1013a, 1013b to an end of the indoor heat exchangers 1011a, 1011b, respectively.

[0137] The four way valve 1022 is connected through gas stop valves 1028a, 1028b to refrigerant pipes 1014a, 1014b and, through the refrigerant pipes 1014a, 1014b to the other end of the indoor heat exchangers 1011a, 1011b, respectively.

[0138] Subsequently, the humidifying unit 1004 will be described. The humidifying unit 1004 has a humidifying unit casing 1007. Provided in the humidifying unit casing 1007 are a humidifying unit main body 1006 and an air channel switching device 1056.

[0139] Provided on a front face of the humidifying unit casing 1007 are an adsorption air blow-off port 1007a and an adsorption air intake 1007d that are each composed of a plurality of slit-like openings. The adsorption air blow-off port 1007a is an opening through which air that has flowed through a moisture adsorption path 1101 is discharged out of the humidifying unit casing 1007.

[0140] Provided on a back face of the humidifying unit casing 1007 are an adsorption air intake 1007b and an intake and discharge port 1007c.

[0141] The adsorption air intakes 1007b, 1007d are openings through which air passes that is taken into the humidifying unit casing 1007 from outdoors for adsorption of moisture by the humidifying rotor 1051. More specifically, driving an adsorption blower 1055 causes outdoor air to flow through the adsorption air intakes 1007b, 1007d into the moisture adsorption path 1101. The air having flowed into the moisture adsorption path 1101 passes through the humidifying rotor 1051 and is thereby dehumidified. That is, moisture in the air is adsorbed to the humidifying rotor 1051 facing the moisture adsorption path 1101.

[0142] The intake and discharge port 1007c is an opening for allowing the outdoor air to flow into the humidifying path 1102 in an air intake operation and the humidifying operation. When the outdoor air comes into the humidifying path 1102, the air passes through a generally fan-shaped region of the humidifying rotor 1051, thereafter heated by a heating device 1052, then passing through another generally fan-shaped region of the humidifying rotor 1051, and flowing toward a humidifying fan device 1054. In the air discharging operation, air taken into the humidifying unit casing 1007 from the indoor units 1002a, 1002b is discharged through the intake and discharge port 1007c to the outdoors.

[0143] The humidifying unit main body 1006 has the humidifying rotor 1051, the heating device 1052, the humidifying fan device 1054, and the adsorption blower 1055.

[0144] The humidifying rotor 1051 is a ceramic rotor having a honeycomb structure and is generally shaped like a disc. The humidifying rotor 1051 is rotatably installed so as to be driven to be rotated by a rotor driving motor (not shown). Main components of the humidifying rotor 1051 have been produced by burning or calcining of adsorbent such as zeolite. The adsorbent such as zeolite has a property of adsorbing moisture in air that is in contact with the adsorbent and releasing the adsorbed moisture by heating of the moisture. Though zeolite is used as the adsorbent in the embodiment, silica gel, alumina or the like can be used as the adsorbent.

[0145] The humidifying rotor 1051 shaped generally like a disc allows the humidifying unit 1004 to be reduced in size.

[0146] The heating device 1052 is positioned above the humidifying rotor 1051 so as to face the humidifying rotor 1051. The air heated by the heating device 1052 passes through the humidifying rotor 1051 and thus increases a temperature of the humidifying rotor 1051.

[0147] The humidifying fan device 1054 is positioned on a lateral side of the humidifying rotor 1051 and is a radical fan assembly that produces an air flow passing through a part facing the heating device 1052 of the humidifying rotor 1051. The humidifying fan device 1054 is capable of delivering outdoor air to the indoor units 1002a, 1002b, as well as taking indoor air into the indoor units 1002a, 1002b and then discharging the air to the outdoors.

[0148] When delivering to the indoor units 1002a, 1002b the air taken in from the outdoors, the humidifying fan device 1054 sucks outdoor air though the intake and discharge port 1007c into the humidifying path 102, passes the air through the humidifying rotor 1051, and thereafter delivers the air through the air channel switching device 1056 and the intake and discharge hoses 1006a, 1006b to the indoor units 1002a, 1002b. In this operation, the air flows along directions of arrows A1 in the intake and discharge hoses 1006a, 1006b.

[0149] When discharging to the outdoors the indoor air taken into the indoor units 1002a, 1002b, the humidifying fan device 1054 discharges the air to the outdoors through the intake and discharge hoses 1006a, 1006b, the humidifying path 1102, and the intake and discharge port 1007c. In this operation, the air flows along directions A2 in the intake and discharge hoses 1006a, 1006b.

[0150] The air channel switching device 1056 is connected to the intake and discharge hoses 1006a, 1006b and is capable of supplying air from the humidifying path 1102 to one of the intake and discharge hoses 1006a, 1006b. The air channel switching device 1056 is also capable of stopping the supply of the air from the humidifying path 1102 to the intake and discharge hoses 1006a, 1006b. That is, the air from the humidifying fan device 1054 can be blocked from flowing into either of the intake and discharge hoses 1006a, 1006b.

[0151] The adsorption blower 1055 has an adsorption fan motor 1059 and an adsorption fan 1061 that is driven to rotate by the adsorption fan motor 1059, and produces an air flow passing through a part of the humidifying rotor 1051 that does not face the heating device 1052. That is, the adsorption blower 1055 produces an air flow directed toward the adsorption air blow-off port 1007a in the moisture adsorption path 1101.

[0152] Fig. 10 is an exploded perspective view of the humidifying unit 1004. In Fig. 10, illustration of a top plate that forms a top part of the humidifying unit casing 1007 is omitted.

[0153] In the humidifying unit 1004 in the humidifying operation, an air flow along arrows A11 through A13 and an air flow along arrows A21 through A27 are produced. While the air flow is produced, the humidifying rotor 1051 rotates in a direction of an arrow L.

[0154] The air flow along the arrow A11 is a flow of air going from the adsorption air intake 1007b through the humidifying rotor 1051 toward vicinity of a bell mouth 1062. Flowing through the humidifying path 1101, the air passes through the part not facing the heating device 1052 of the humidifying rotor 1051, and moisture in the air is then adsorbed to the part.

[0155] The air flow along the arrow A12 is a flow of air going from the vicinity of the bell mouth 1062 through a space surrounded by the bell mouth 1062 into the adsorption fan 1061.

[0156] The air flow along the arrow A13 is a flow of air blown out from the adsorption fan 1061 and going toward the adsorption air blow-off port 1007a.

[0157] The air flow along the arrows A21, A22 is a flow of air going from the intake and discharge port 1007c through the humidifying rotor 1051 toward the heating device 1052. The air passes through a generally fan-shaped first region of the humidifying rotor 1051 (region facing a part of the humidifying path 1102 upstream of the heating device 1052), and turning of the humidifying rotor 1051 in the direction of the arrow L makes the first region face the moisture adsorption path 1101.

[0158] The air flow along the arrows A23 through A25 is a flow of air heated by the heating device 1052 and going through the humidifying rotor 1051 toward the air channel switching device 1056. The air passes through a generally fan-shaped second region of the humidifying rotor 1051 (region facing a part of the humidifying path 1102 downstream of the heating device 1052) and thereby heats the second region. Turning of the humidifying rotor 1051 in the direction of the arrow L makes the second region face a part of the humidifying path 1102 upstream of the heating device 1052.

[0159] The air flow along the arrows A26, A27 is a flow of air that leaves the air channel switching device 1056, that passes through the humidifying fan device 1054, and that is returned to the air channel switching device 1056.

[0160] Fig. 11 is a schematic representation of the humidifying rotor 1051 and the heating device 1052, as seen looking diagonally from above.

[0161] The heating device 1052 has a heater casing 1103, a heating element 1104 provided on an upstream side in the heater casing 1103, and a humidifying side air distribution element 1105 provided on a downstream side in the heater casing 1103. The humidifying side air distribution element 1105 is an example of the "first distribution element".

[0162] The heater casing 1103 is placed so as to cover generally a half of a top surface of the humidifying rotor 1051 and forms a part of the humidifying path 1102.

[0163] The humidifying side air distribution element 1105 is placed downstream of the heating element 1104. Thus air heated by the heating element 1104 flows via the humidifying side air distribution element 1105 toward

the humidifying rotor 1051.

[0164] Fig. 12 is a schematic representation of the humidifying side air distribution element 1105, as seen looking diagonally from above.

[0165] The humidifying side air distribution element 1105 has a punching plate 1106 that is shaped generally like a fan in plan view, an inner circumferential wall 1107 that is provided so as to stand at an inner circumferential edge of the punching plate 1106, and an outer circumferential wall 1108 that is provided so as to stand at an outer circumferential edge of the punching plate 1106. The humidifying side air distribution element 1105 is placed so as to face a region other than the inner circumferential edge part and the outer circumferential edge part of the humidifying rotor 1051 (see Fig. 13).

[0166] The punching plate 1106 is positioned so as to be generally parallel to the top surface of the humidifying rotor 1051. The punching plate 1106 has a plurality of through holes 1113 that face the top surface of the humidifying rotor 1051. Air having passed through the plurality of through holes 1113 is allowed to flow toward the top surface of the humidifying rotor 1051.

[0167] An inner circumferential flange 1109 overhangs radially inward from an upper end of the inner circumferential wall 1107. An inner circumferential guide element 1111 is provided on an end on an upstream side (a side facing the heating element 1104) of the inner circumferential wall 1107. The inner circumferential guide element 1111 is an example of the "guide element".

[0168] An outer circumferential flange 1110 overhangs radially outward from an upper end of the outer circumferential wall 1108. An outer circumferential guide element 1112 is provided on an end on an upstream side (a side facing the heating element 1104) of the outer circumferential wall 1108. The outer circumferential guide element 1112 is an example of the "guide element".

[0169] The inner circumferential guide element 1111 and the outer circumferential guide element 1112 guide air from the heating element 1104 toward the inner circumferential edge part and the outer circumferential edge part of the humidifying rotor 1051. Distances between the inner circumferential guide element 1111 and the outer circumferential guide element 1112 decrease with decrease in distance to the heating element 1104.

[0170] With use of the humidifying unit having the above configuration, the air heated by the heating element 1104 flows via the humidifying side air distribution element 1105 in the heater casing 1103 toward the humidifying rotor 1051. The humidifying side air distribution element 1105 distributes the air from the heating element 1104 among the inner circumferential edge part, a center part and the outer circumferential edge part of the humidifying rotor 1051, as shown by arrows in Fig. 13. Herein, the center part of the humidifying rotor 1051 refers to a part between the inner circumferential edge part of the humidifying rotor 1051 and the outer circumferential edge part of the humidifying rotor 1051.

[0171] As a result, the air heated by the heating element 1104 passes not only through the center part of the humidifying rotor 1051 but also through the inner circumferential edge part and the outer circumferential edge part of the humidifying rotor 1051, so that a heated area of the humidifying rotor 1051 increases accordingly.

[0172] This increases moisture released from the humidifying rotor 1051 and improves moisture releasing performance of the humidifying rotor 1051.

[0173] The humidifying side air distribution element 1105, which faces the center part of the humidifying rotor 1051, prevents the air flow from the heating element 1104 from concentrating on the center part of the humidifying rotor 1051 and reduces unevenness in the heating of the humidifying rotor 1051.

[0174] The inner circumferential guide element 1111 and the outer circumferential guide element 1112, which guide the air from the heating element 1104 toward the inner circumferential edge part and the outer circumferential edge part of the humidifying rotor 1051, make the inner circumferential edge part and the outer circumferential edge part prone to increase in temperature, and thus increase an efficiency of humidification by the inner circumferential edge part and the outer circumferential edge part of the humidifying rotor 1051.

[0175] Fig. 14 shows a result of measurement of flow rates of air passing through the humidifying rotor 1051, which measurement was performed along a chain line in Fig. 13. In Fig. 14, a position A corresponds to the inner circumferential edge of the humidifying rotor 1051 and a position A' corresponds to the outer circumferential edge of the humidifying rotor 1051.

[0176] As apparent from Fig. 14, the provision of the humidifying side air distribution element 1105 results in moderate air flow through the inner circumferential edge part and the outer circumferential edge part of the humidifying rotor 1051 and prevents the air flow from being concentrated on the center part of the humidifying rotor 1051.

[0177] Fig. 15 is a schematic representation of a principal part of a humidifying unit that is a comparative example, as seen looking from above. The humidifying device of the comparative example corresponds to the humidifying unit of the embodiment from which the humidifying side air distribution element 1105 has been removed.

[0178] Fig. 16 shows a result of measurement of flow rates of air that passing through the humidifying rotor 1051, which measurement was performed along a chain line in Fig. 15. In Fig. 16, a position B corresponds to the inner circumferential edge of the humidifying rotor 1051 and a position B' corresponds to the outer circumferential edge of the humidifying rotor 1051.

[0179] As apparent from Fig. 16, the absence of the humidifying side air distribution element 1105 results in little air flow through the inner circumferential edge part and the outer circumferential edge part of the humidifying rotor 1051 and results in air flow concentrated on the center part of the humidifying rotor 1051.

[0180] The above proves that the humidifying side air distribution element 1105 is capable of improving uniformity in quantity of air passing through the parts of the humidifying rotor 1051 downstream of the heating element 1104.

[0181] In the third embodiment, a humidifying side air distribution element 1115 of Fig. 17 may be used in place of the humidifying side air distribution element 1105 of Fig. 12. Components in Fig. 17 that are the same as those shown in Fig. 12 are provided with the same reference numerals as those of the components in Fig. 12, and description thereof is omitted.

[0182] In the third embodiment, a plate provided with one or more through holes may be used in place of the humidifying side air distribution element 1105 of Fig. 12. Provided that such a plate is placed so as to be generally parallel to the top surface of the humidifying rotor 1051 in this configuration, for instance, air is prevented from being excessively or too little supplied only to a part of the humidifying rotor 1051 that faces the plate.

[0183] The humidifying side air distribution element 1115 is different from the humidifying side air distribution element 1105 of Fig. 12 only in that the element 1115 has wire-mesh 1114, and the element 1115 is capable of achieving the same effects as the humidifying side air distribution element 1105 of Fig. 12.

Fourth Embodiment

[0184] Fig. 18 is a schematic sectional view, taken along a horizontal plane, of a principal part of a humidifying unit 1204 in accordance with a fourth embodiment of the invention. Components in Fig. 18 that are the same as those shown in Figs. 9 and 10 are provided with the same reference numerals as those of the components in Figs. 9 and 10, and description thereof is omitted.

[0185] The humidifying unit 1204 is different from the humidifying unit 1004 of the third embodiment only in that the humidifying unit 1204 has a moisture adsorption side air distribution element 1205 provided upstream of the humidifying rotor 1051 in the moisture adsorption path 1101. That is, the humidifying unit 1204 corresponds to the humidifying unit 1004 of the third embodiment to which the moisture adsorption side air distribution element 1205 is added. The moisture adsorption side air distribution element 1205 is an example of the "second distribution element".

[0186] Fig. 19 is a schematic representation of the moisture adsorption side air distribution element 1205, as seen looking diagonally from above.

[0187] The moisture adsorption side air distribution element 1205 has a punching plate 1206 that is rectangular in plan view and first and second side parts 1207, 1208 extending in a direction generally perpendicular to the punching plate 1206. The moisture adsorption side air distribution element 1205 is placed so as to face a region of the humidifying rotor 1051 other than the inner circumferential edge part and the outer circumferential edge part (see Fig. 18).

[0188] The punching plate 1206 is positioned so as to be generally parallel to a bottom surface of the humidifying rotor 1051. The punching plate 1206 is provided with a plurality of through holes 1213 that face the bottom surface of the humidifying rotor 1051. Air having passed through the plurality of through holes 1213 is allowed to flow toward the bottom surface of the humidifying rotor 1051.

[0189] The first side part 1207 is connected to an edge of the punching plate 1206 on a side of the heating device 1052. A first guide element 1211 extends toward the adsorption air intake 1007b from one end of the first side part 1207, and a third guide element 1214 extends toward the adsorption air intake 1007d from the other end of the first side part 1207 (see Fig. 18). The first and third guide elements 1211, 1214 are an example of the "guide element".

[0190] The second side part 1208 is connected to an edge of the punching plate 1206 opposite from, i.e., farther from the heating device 1052. A second guide element 1212 extends toward the adsorption air intake 1007b from one end of the second side part 1208, and a fourth guide element 1215 extends toward the adsorption air intake 1007d from the other end of the second side part 1208 (see Fig. 18). The second and fourth guide elements 1212, 1215 are an example of the "guide element".

[0191] The first and second guide elements 1211, 1212 guide air from the adsorption air intake 1007b toward the inner circumferential edge part and the outer circumferential edge part of the humidifying rotor 1051, respectively. The third and fourth guide elements 1214, 1215 guide air from the adsorption air intake 1007d toward the inner circumferential edge part and the outer circumferential edge part of the humidifying rotor 1051, respectively. Distances between the first guide element 1211 and the second guide element 1212 and distances between the third guide element 1214 and the fourth guide element 1215 decrease with decrease in distance to the adsorption air intakes 1007b, 1007d (that is, as the guide elements approach to the corresponding adsorption air intakes), respectively.

[0192] With use of the humidifying unit 1204 having the above configuration, air taken through the adsorption air intakes 1007b, 1007d into the humidifying unit casing 1007 flows through the moisture adsorption path 1101 via the moisture adsorption side air distribution element 1205 toward the humidifying rotor 1051. On this occasion, the moisture adsorption side air distribution element 1205 distributes the air from the adsorption air intakes 1007b, 1007d among the parts of the humidifying rotor 1051 facing the moisture adsorption path 1101 so that quantities of air passing through the parts of the humidifying rotor 1051 are made generally uniform. That is, the moisture adsorption side air distribution element 1205 distributes the air from the adsorption air intakes 1007b, 1007d among the inner circumferential edge part, the

center part and the outer circumferential edge part of the humidifying rotor 1051. Herein, the center part of the humidifying rotor 1051 refers to a part between the inner circumferential edge part of the humidifying rotor 1051 and the outer circumferential edge part of the humidifying rotor 1051.

[0193] As a result, the air from the adsorption air intakes 1007b, 1007d passes not only through the center part of the humidifying rotor 1051 but also through the inner circumferential edge part and the outer circumferential edge part of the humidifying rotor 1051, so that the humidifying rotor 1051 adsorbs moisture in an increased area..

[0194] This increases the moisture adsorbed by the humidifying rotor 1051, meaning that moisture adsorbing performance of the humidifying rotor 1051 is increased.

[0195] The moisture adsorption side air distribution element 1205, facing the center part of the humidifying rotor 1051, prevents the air flow from the adsorption air intakes 1007b, 1007d from being concentrated on the center part of the humidifying rotor 1051 and reduces unevenness in the adsorption in the humidifying rotor 1051.

[0196] The first and second guide elements 1211, 1212 guide air from the adsorption air intake 1007b toward the inner circumferential edge part and the outer circumferential edge part of the humidifying rotor 1051, and the third and fourth guide elements 1214, 1215 guide air from the adsorption air intake 1007d toward the inner circumferential edge part and the outer circumferential edge part of the humidifying rotor 1051, so that the moisture is made prone to be adsorbed to the inner circumferential edge part and the outer circumferential edge part, and so that an efficiency of the moisture adsorption by the inner circumferential edge part and the outer circumferential edge part of the humidifying rotor 1051 can be increased.

[0197] In the fourth embodiment, the punching plate 1206 of the moisture adsorption side air distribution element 1205 may be replaced by wire-mesh.

[0198] In the fourth embodiment, a plate provided with one through hole or a plurality of through holes may be used in place of the moisture adsorption side air distribution element 1205 of Fig. 19. Provided that the plate is placed so as to be generally parallel to the bottom surface of the humidifying rotor 1051 in this configuration, for instance, air is prevented from being excessively or too little supplied only to a part of the humidifying rotor 1051 that faces the plate.

[0199] It is needless to say that the humidifying unit 1204 of the fourth embodiment may be installed in an air conditioner as in the third embodiment.

[0200] The humidifying units 1004, 1204 of the third and fourth embodiments are installed in the multiple-type air conditioner 1, whereas a humidifying unit in accordance with an embodiment of the invention may be installed in a single-type air conditioner. That is, the humidifying units of the invention can be installed in various types of air conditioners, and are capable of humidifying inside of rooms, for instance, only by themselves.

[0201] The humidifying units of the invention may be installed in air conditioners having a wall-hanging type indoor unit, as in the third and fourth embodiments, or may be installed in air conditioners having an indoor unit of type other than wall-hanging type. Among the indoor units of the types other than wall-hanging type are those of floor type, ceiling-embedded cassette type, and ceiling suspended type, for instance.

[0202] The invention can be applied not only to humidifying units of non-water-feeding type such as the humidifying units 1004, 1204 of the third and fourth embodiments but also to humidifying units of water feeding type. The humidifying unit of water feeding type has a water feeding tank detachable from and attachable to the humidifying unit casing, and is arranged such that water stored in the water feeding tank is adsorbed to the humidifying rotor 1051.

[0203] Shapes of the first and second distribution elements of the invention are not limited to those of the third and fourth embodiments but may be various. That is, the first and second distribution elements of the invention may have any shapes as long as the shapes increase a quantity of air flowing toward the circumferential edge parts of the humidifying rotor while decreasing a quantity of air flowing toward regions other than the circumferential edge parts of the humidifying rotor so as to decrease a difference in quantity between air passing through the circumferential edge parts of the humidifying rotor and air passing through the regions other than the circumferential edge parts of the humidifying rotor.

[0204] An appropriate combination of the first/second embodiment and the third/fourth embodiment may be made as one embodiment of the invention.

[0205] For instance, as shown in Fig. 20, the humidifying unit 4 of the first embodiment may be provided with the humidifying side air distribution element 1105 described in connection with the third embodiment. Placement of the humidifying side air distribution element 1105 may be the same as that in the third embodiment.

[0206] Also, as shown in Fig. 21, the humidifying unit 4 of the first embodiment may be provided with the humidifying side air distribution element 1115 in the third embodiment. Placement of the humidifying side air distribution element 1115 may be the same as that of the humidifying side air distribution element 1105 in the third embodiment.

[0207] Also, as shown in Fig. 22, the humidifying unit 104 of the second embodiment may be provided with the humidifying side air distribution element 1105 in the third embodiment. Placement of the humidifying side air distribution element 1105 may be the same as that in the third embodiment.

[0208] Also, as shown in Fig. 23, the modification of the humidifying unit 104 of the second embodiment (i.e., the example described referring to Fig. 8) may be provided with the humidifying side air distribution element

1105 in the third embodiment. Placement of the humidifying side air distribution element 1105 may be the same as that in the third embodiment.

[0209] Also, as shown in Fig. 24, the humidifying unit 104 of the second embodiment may be provided with the humidifying side air distribution element 1115 in the third embodiment. Placement of the humidifying side air distribution element 1115 may be the same as that of the humidifying side air distribution element 1105 in the third embodiment.

[0210] Also, as shown in Fig. 25, the modification of the humidifying unit 104 of the second embodiment (i.e., the example described referring to Fig. 8) may be provided with the humidifying side air distribution element 1115 in the third embodiment. Placement of the humidifying side air distribution element 1115 may be the same as that of the humidifying side air distribution element 1105 in the third embodiment.

[0211] Components in Figs. 20, 21, and 22 through 25 that are the same as those shown in Figs. 3, 5, and 8 are provided with the same reference numerals as those of the components in Figs. 3, 5, and 8.

REFERENCE SIGNS LIST

[0212]

4, 104 humidifying unit
51 humidifying rotor
52 heating device
57 radiation plate
58 heat insulator
101 moisture adsorption path
102 humidifying path
159, 259 baffle plate
160 through hole
1004, 1204 humidifying unit
1051 humidifying rotor
1101 moisture adsorption path
1102 humidifying path
1104 heating element
1105, 1115 humidifying side air distribution element
1106, 1206 punching plate
1111 inner circumferential guide element
1112 outer circumferential guide element
1113, 1213 through hole
1114 wire-mesh
1205 moisture adsorption side air distribution element
1211 first guide element
1212 second guide element
1214 third guide element
1215 fourth guide element

Claims

1. A humidifying unit comprising:

a humidifying rotor (51, 1051) ;
a humidifying path (102, 1102) extending through the humidifying rotor (51, 1051);
a heating unit (52, 1104) provided upstream of the humidifying rotor (51, 1051) in the humidifying path (102, 1102); and
a radiation plate (57) provided downstream of the humidifying rotor (51, 1051) in the humidifying path (102, 1102).

2. The humidifying unit as claimed in Claim 1, further comprising:

a baffle plate (159, 259) provided downstream of the humidifying rotor (51, 1051) in the humidifying path (102, 1102).

3. The humidifying unit as claimed in Claim 2, wherein the baffle plate (159, 259) faces a part other than a circumferential edge part of a region of the humidifying rotor (51, 1051) that faces the humidifying path (102, 1102).

4. The humidifying unit as claimed in Claim 2 or 3, wherein
the baffle plate (159) has a through hole (160) facing both the humidifying rotor (51, 1051) and the radiation plate (57).

5. The humidifying unit as claimed in any one of Claims 1 through 3, further comprising:

a heat insulator (58) placed on an opposite side of the radiation plate (57) from the humidifying rotor (51, 1051).

6. The humidifying unit as claimed in any one of Claims 1 through 3, wherein
the humidifying rotor (51, 1051) is in shape of a disc.

7. The humidifying unit as claimed in Claim 6, wherein air heated by the heating unit (52, 1104) passes through a generally fan-shaped region of the humidifying rotor (51, 1051).

8. The humidifying unit as claimed in any one of Claims 1 through 3, wherein
a surface of the radiation plate (57) that faces the humidifying rotor (51, 1051) is an uneven surface.

9. The humidifying unit as claimed in Claim 1, further comprising:

a first distribution element (1105, 1115) that is provided between the heating unit (1104) and the humidifying rotor (1051) and that distributes air heated by the heating element (1104) among parts of the humidifying rotor (1051) facing the

humidifying path (1102) so as to increase uniformity of the distribution.

10. The humidifying unit as claimed in Claim 9, wherein the first distribution element (1105, 1115) faces a part other than a circumferential edge part of a region of the humidifying rotor (1051) that faces the humidifying path (1102).

11. The humidifying unit as claimed in Claim 9 or 10, wherein
the first distribution element (1105, 1115) comprises a guide element (1111, 1112) for guiding the air to a circumferential edge part of the region of the humidifying rotor (1051) that faces the humidifying path (1102).

12. The humidifying unit as claimed in Claim 9 or 10, further comprising:

a moisture adsorption path (1101) extending through the humidifying rotor (1051); and
a second distribution element (1205) that is provided upstream of the humidifying rotor (1051) in the moisture adsorption path (1101) and that distributes air, directed toward the humidifying rotor (1051), among parts of the humidifying rotor (1051) facing the moisture adsorption path (1101) so as to increase uniformity of the distribution.

13. The humidifying unit as claimed in Claim 12, wherein the second distribution element (1205) faces a part other than a circumferential edge part of a region of the humidifying rotor (1051) that faces the moisture adsorption path (1101).

14. The humidifying unit as claimed in Claim 12, wherein the second distribution element (1205) comprises a guide element (1211, 1212, 1214, 1215) for guiding the air to the circumferential edge part of the region of the humidifying rotor (1051) that faces the moisture adsorption path (1101).

15. The humidifying unit as claimed in Claim 9 or 10, wherein
the first distribution element (1105) or the second distribution element (1205) comprises a plate (1106, 1206) which is provided with a through hole (1113, 1213).

16. The humidifying unit as claimed in Claim 9 or 10, wherein
the first distribution element (1105, 1115) or the second distribution element (1205) comprises wiremesh (1114) or a punching plate (1106, 1206).

17. The humidifying unit as claimed in Claim 9 or 10, wherein
the humidifying rotor (1051) is generally in shape of a disc.

18. A humidifying unit comprising:

a humidifying rotor (1051);
a humidifying path (1102) extending through the humidifying rotor (1051);
a heating unit (1104) provided upstream of the humidifying rotor (1051) in the humidifying path (1102); and
a first distribution element (1105, 1115) that is provided between the heating unit (1104) and the humidifying rotor (1051) and that distributes air heated by the heating element (1104) among parts of the humidifying rotor (1051) facing the humidifying path (1102) so as to increase uniformity of distribution therein.

19. The humidifying unit as claimed in Claim 18, wherein the first distribution element (1105, 1115) faces a part other than a circumferential edge part of a region of the humidifying rotor (1051) that faces the humidifying path (1102).

20. The humidifying unit as claimed in Claim 18 or 19, wherein
the first distribution element (1105, 1115) comprises a guide element (1111, 1112) for guiding the air to a circumferential edge part of the region of the humidifying rotor (1051) that faces the humidifying path (1102).

21. The humidifying unit as claimed in Claim 18 or 19, further comprising:

a moisture adsorption path (1101) extending through the humidifying rotor (1051); and
a second distribution element (1205) that is provided upstream of the humidifying rotor (1051) in the moisture adsorption path (1101) and that distributes air, directed toward the humidifying rotor (1051), among parts of the humidifying rotor (1051) facing the moisture adsorption path (1101) so as to increase uniformity of the distribution.

22. The humidifying unit as claimed in Claim 21, wherein the second distribution element (1205) faces a part other than a circumferential edge part of a region of the humidifying rotor (1051) that faces the moisture adsorption path (1101).

23. The humidifying unit as claimed in Claim 21, wherein the second distribution element (1205) comprises a guide element (1211, 1212, 1214, 1215) for guiding the air to the circumferential edge part of the region

of the humidifying rotor (1051) that faces the moisture adsorption path (1101).

24. The humidifying unit as claimed in Claim 18 or 19, wherein
the first distribution element (1105) or the second distribution element (1205) comprises a plate (1106, 1206) which is provided with a through hole (1113, 1213).

25. The humidifying unit as claimed in Claim 18 or 19, wherein
the first distribution element (1105, 1115) or the second distribution element (1205) comprises wire-mesh (1114) or a punching plate (1106, 1206).

26. The humidifying unit as claimed in Claim 18 or 19, wherein
the humidifying rotor (1051) is generally in shape of a disc.

Fig. 1

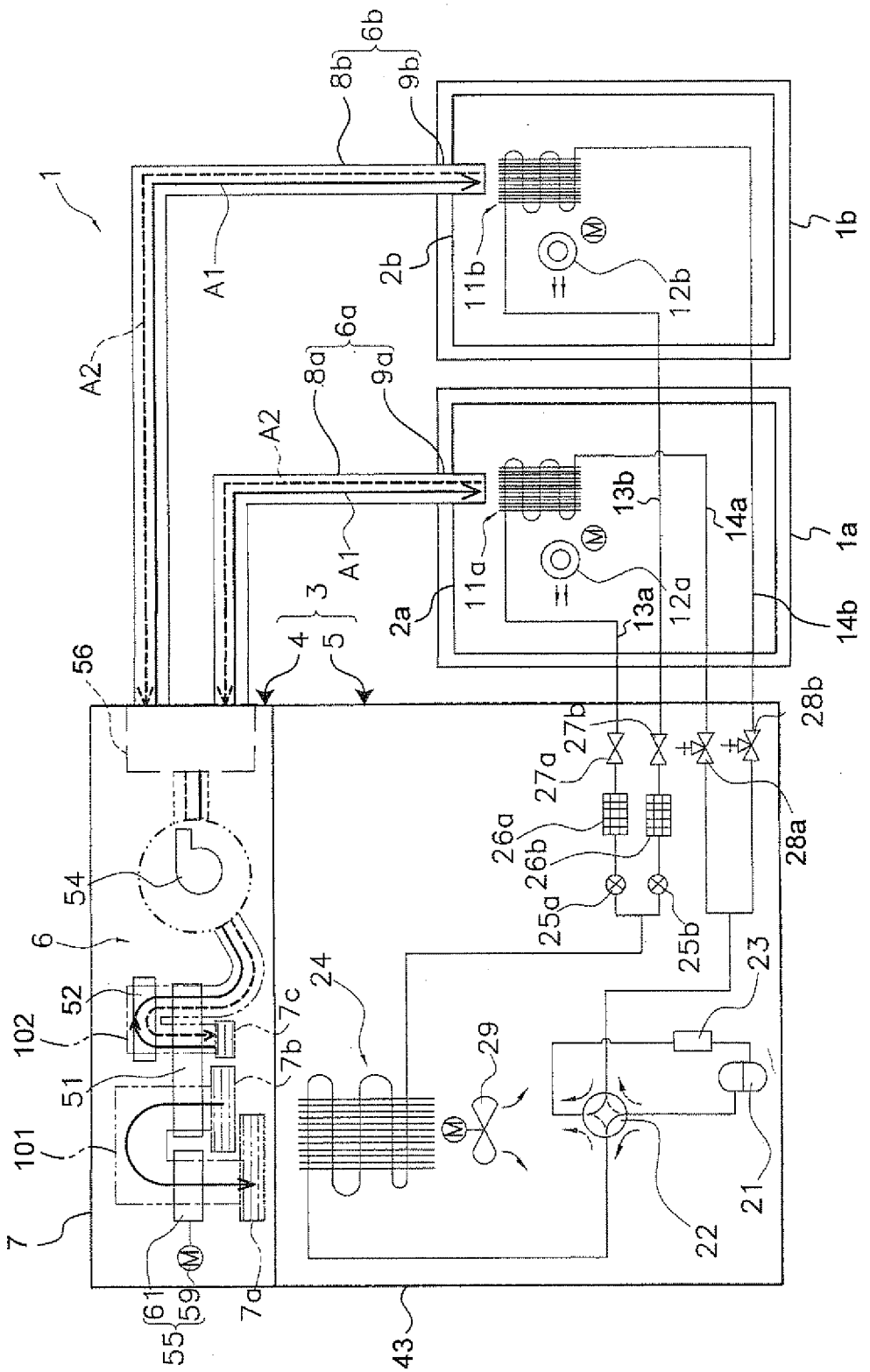

1
A1
A2
2a
2b
3
4
5
6
6a
6b
7
7a
7b
7c
8a
8b
9a
9b
11a
11b
12a
12b
13a
13b
14a
14b
21
22
23
24
25a
25b
26a
26b
27a
27b
28a
28b
29
43
51
52
54
55
56
59
61
101
102
1a
1b

Fig.2

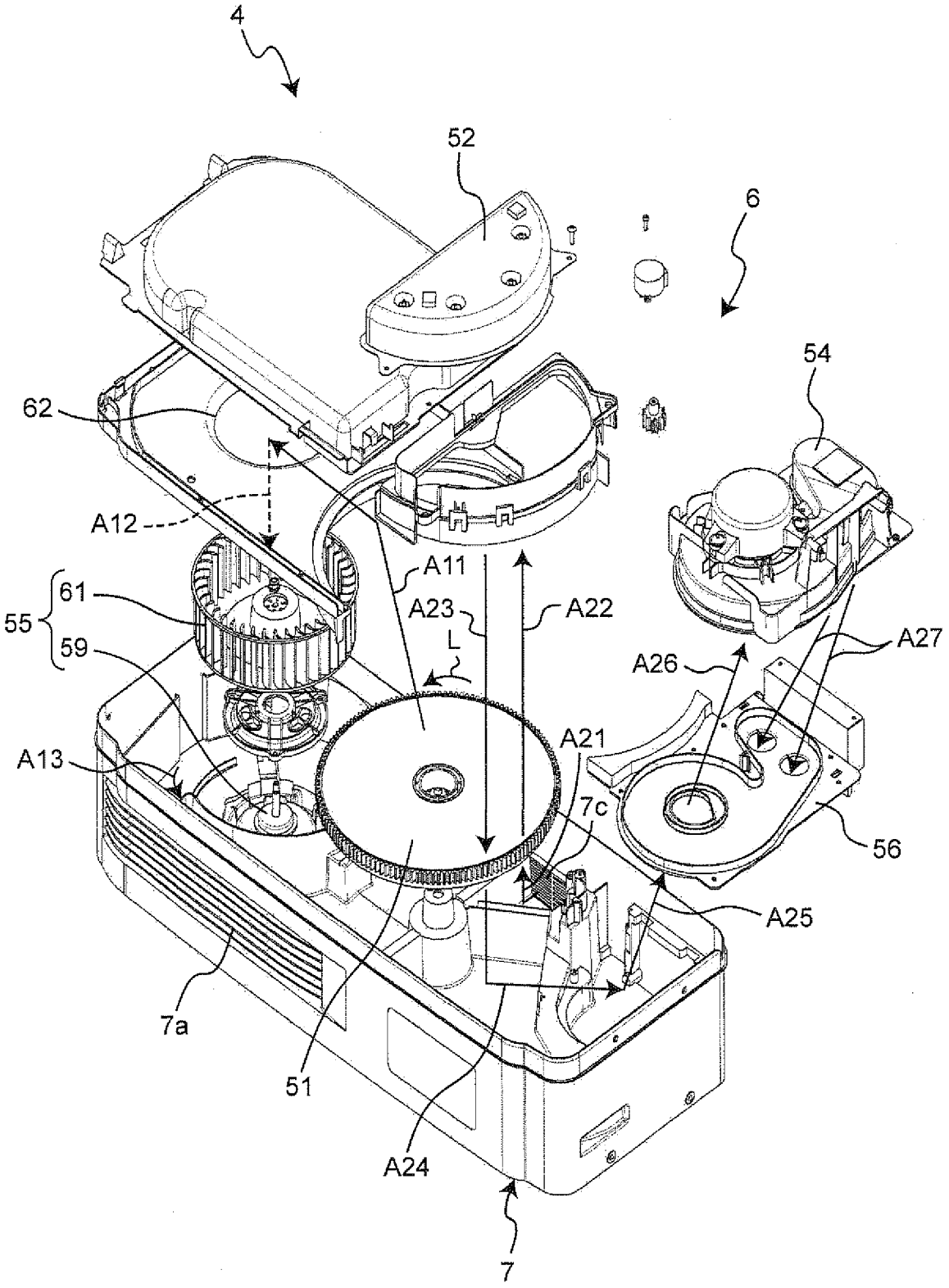

4
52
6
54
62
A12
A11
A23
A22
L
55
61
59
A27
A26
A13
A21
7c
56
A25
7a
51
A24
7

Fig.3

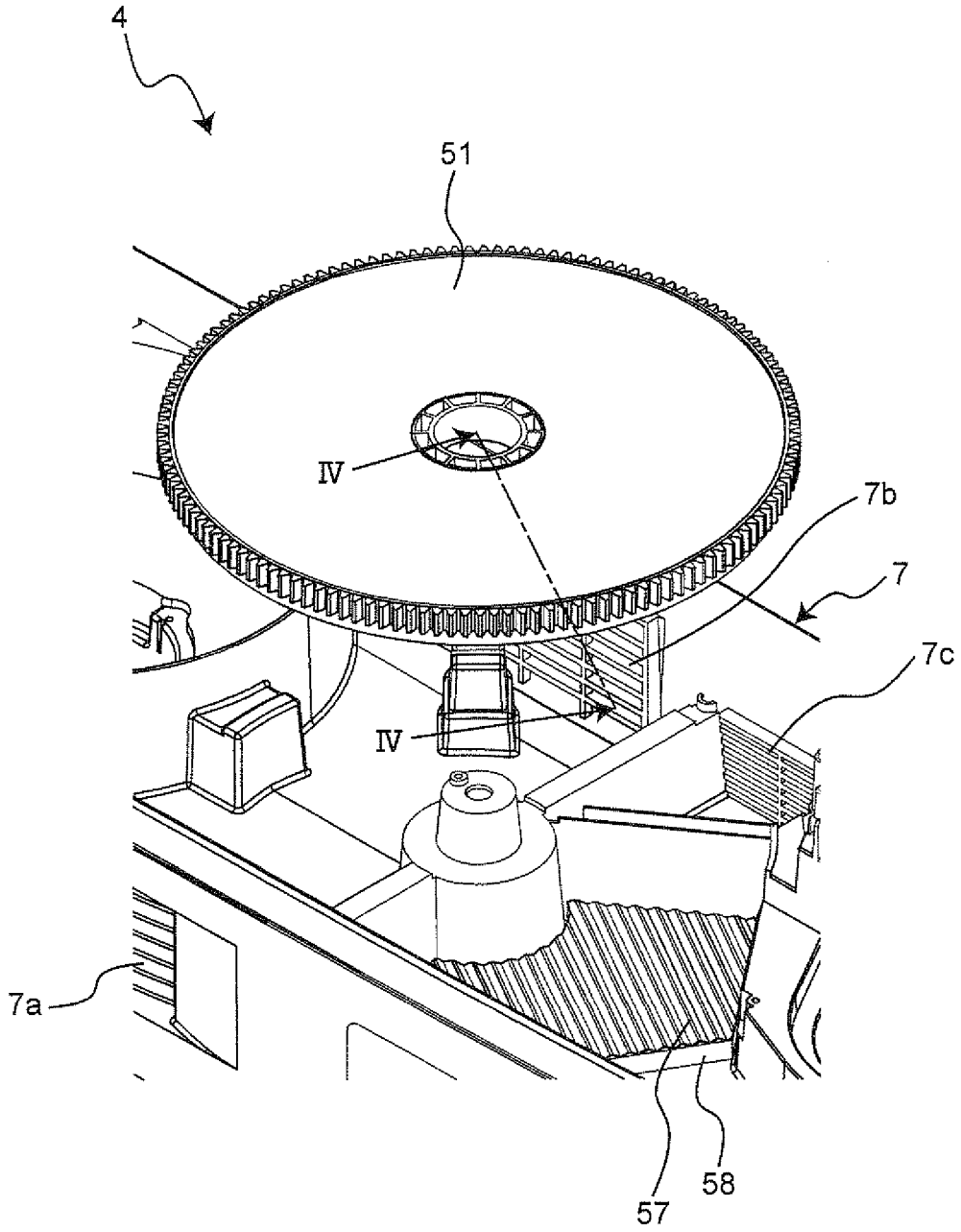


Fig.4

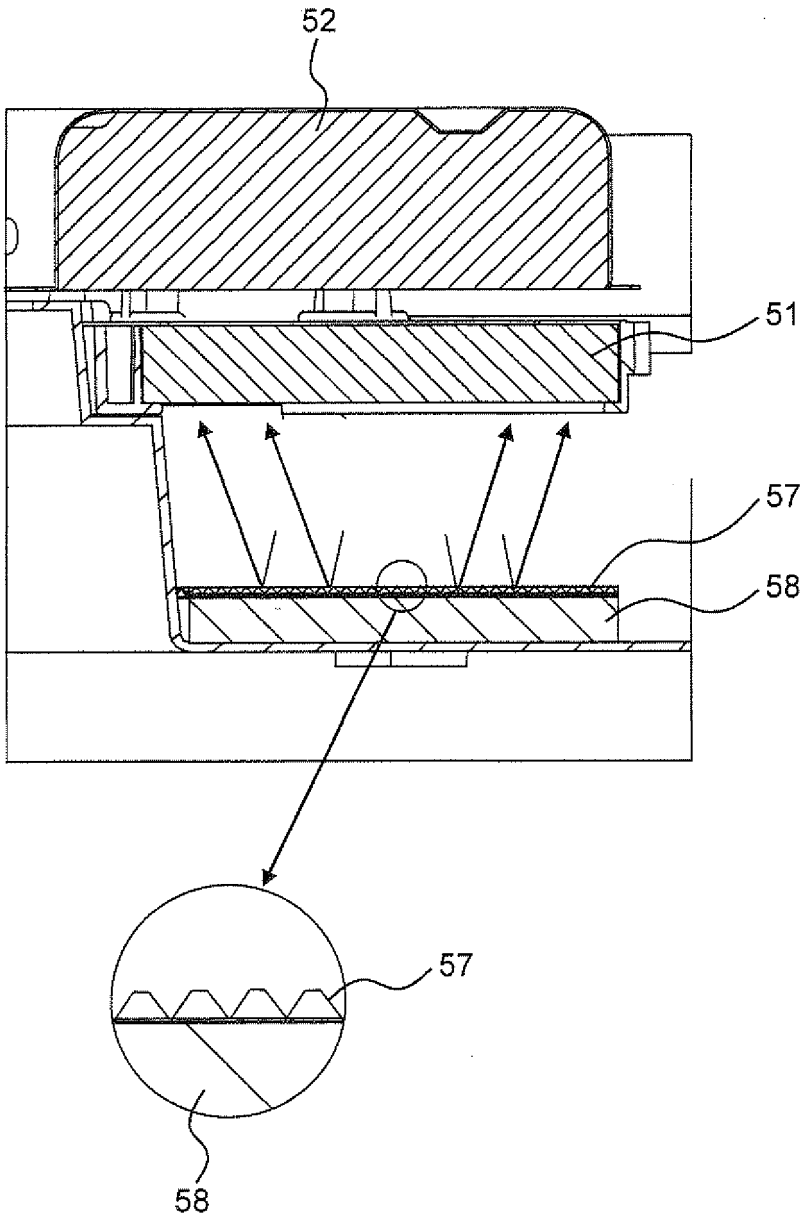


Fig.5

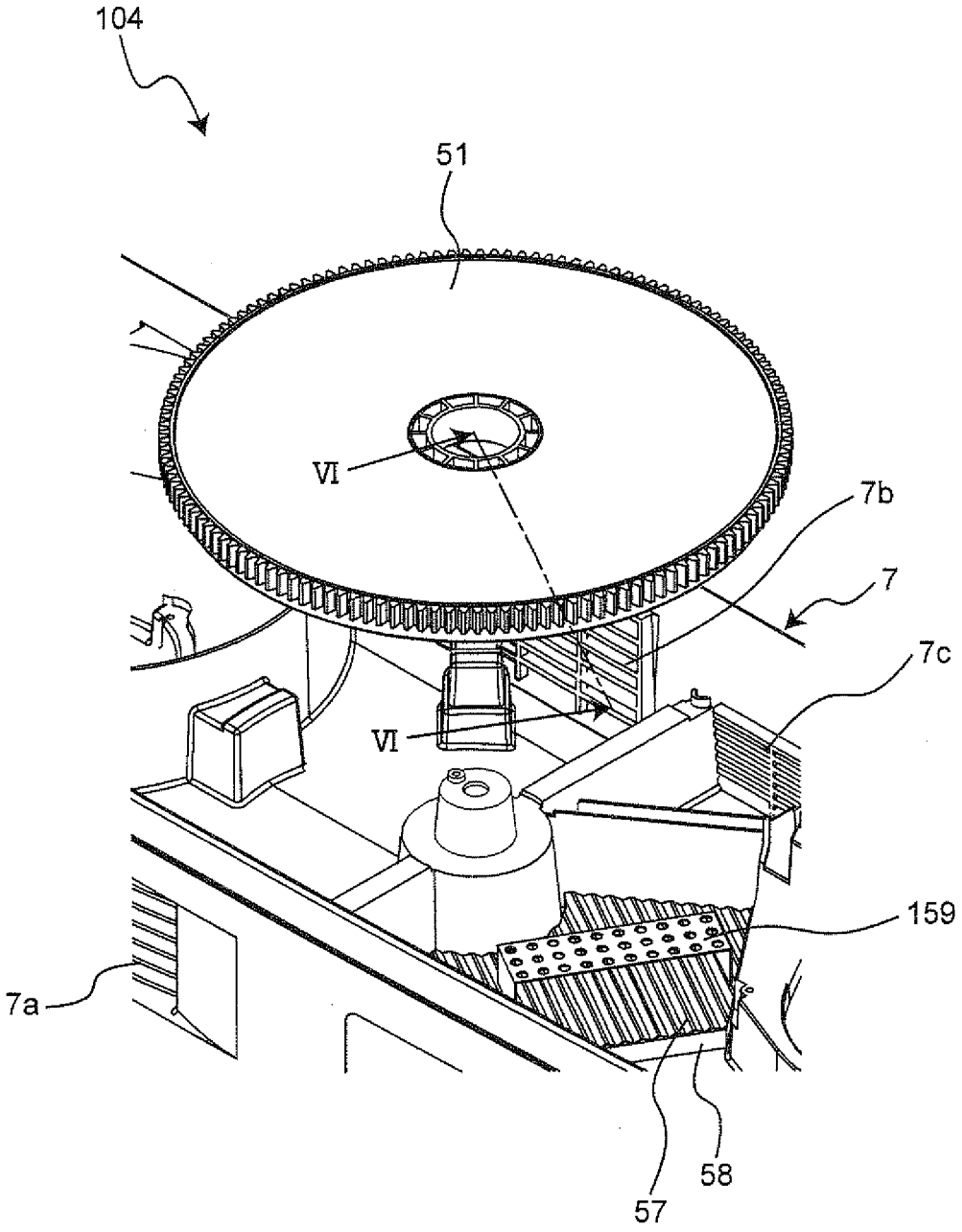


Fig.6

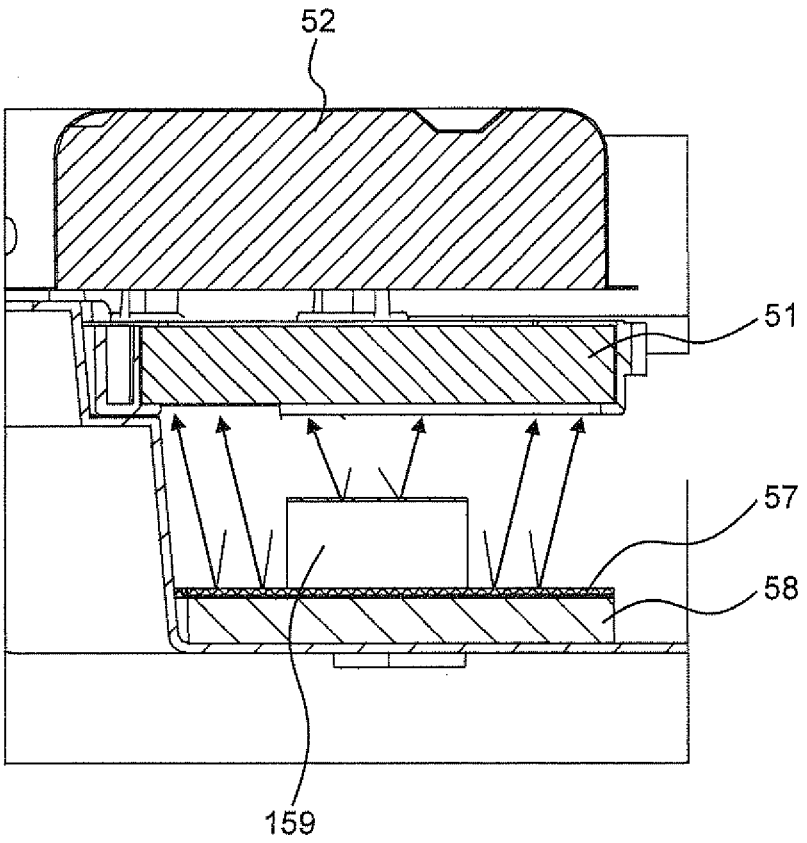


Fig.7

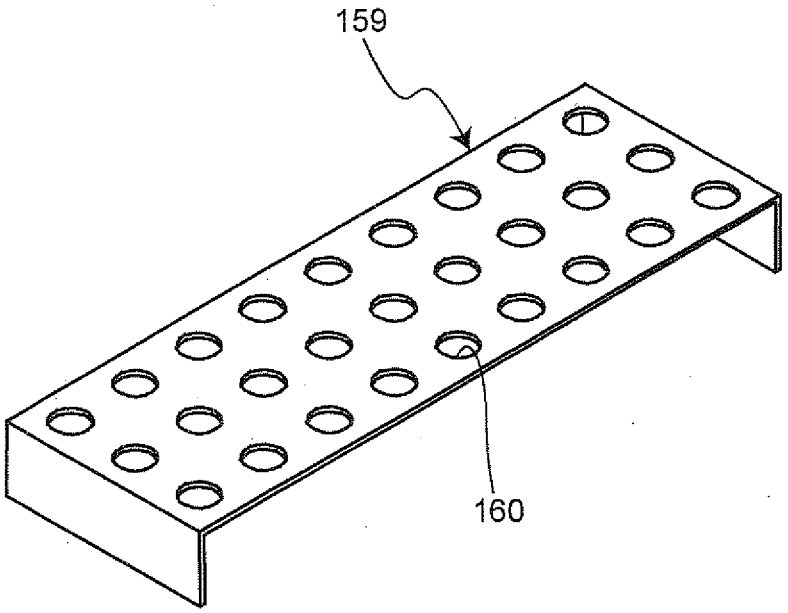


Fig.8

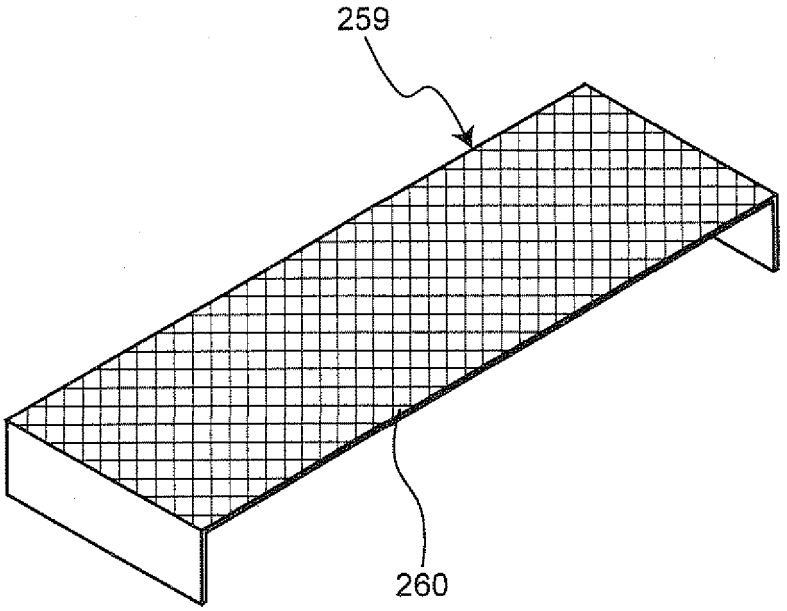


Fig.9

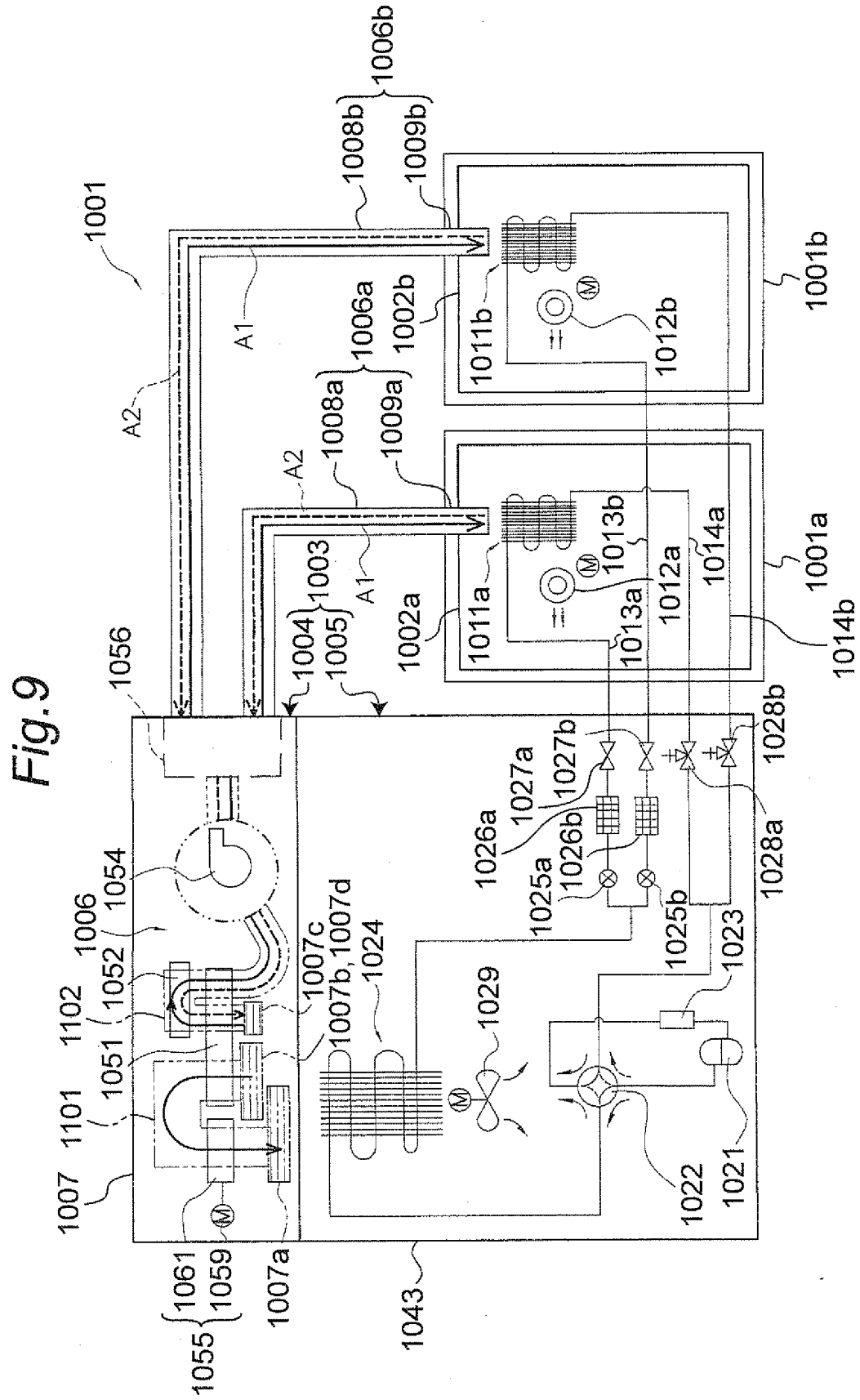

1001
1006b
1008b
1009b
1001b
1011b
1012b
1002b
1006a
1008a
1009a
A1
A2
1001a
1003
1004
1005
1002a
1011a
1013b
1012a
1014a
1013a
1014b
1056
1028b
1027b
1027a
1026a
1028a
1026b
1025a
1025b
1023
1054
1006
1052
1102
1051
1101
1007
1007c
1007b,1007d
1024
1029
1022
1021
1061
1059
1055
1007a
1043

Fig.10

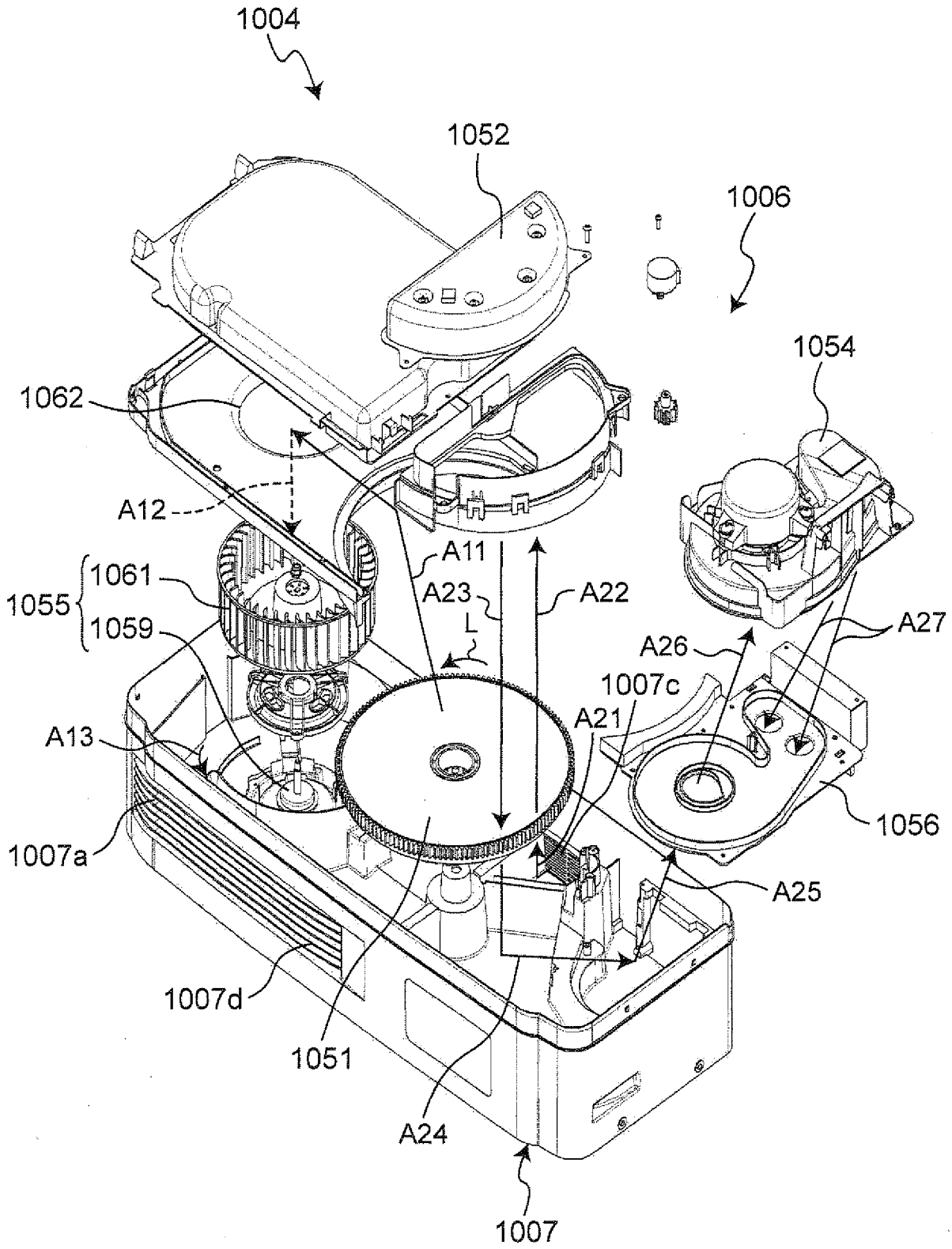

1004
1052
1006
1054
1062
A12
A11
A23
A22
1061
1055
1059
L
A27
A26
1007c
A21
A13
1056
1007a
A25
1007d
1051
A24
1007

Fig.11

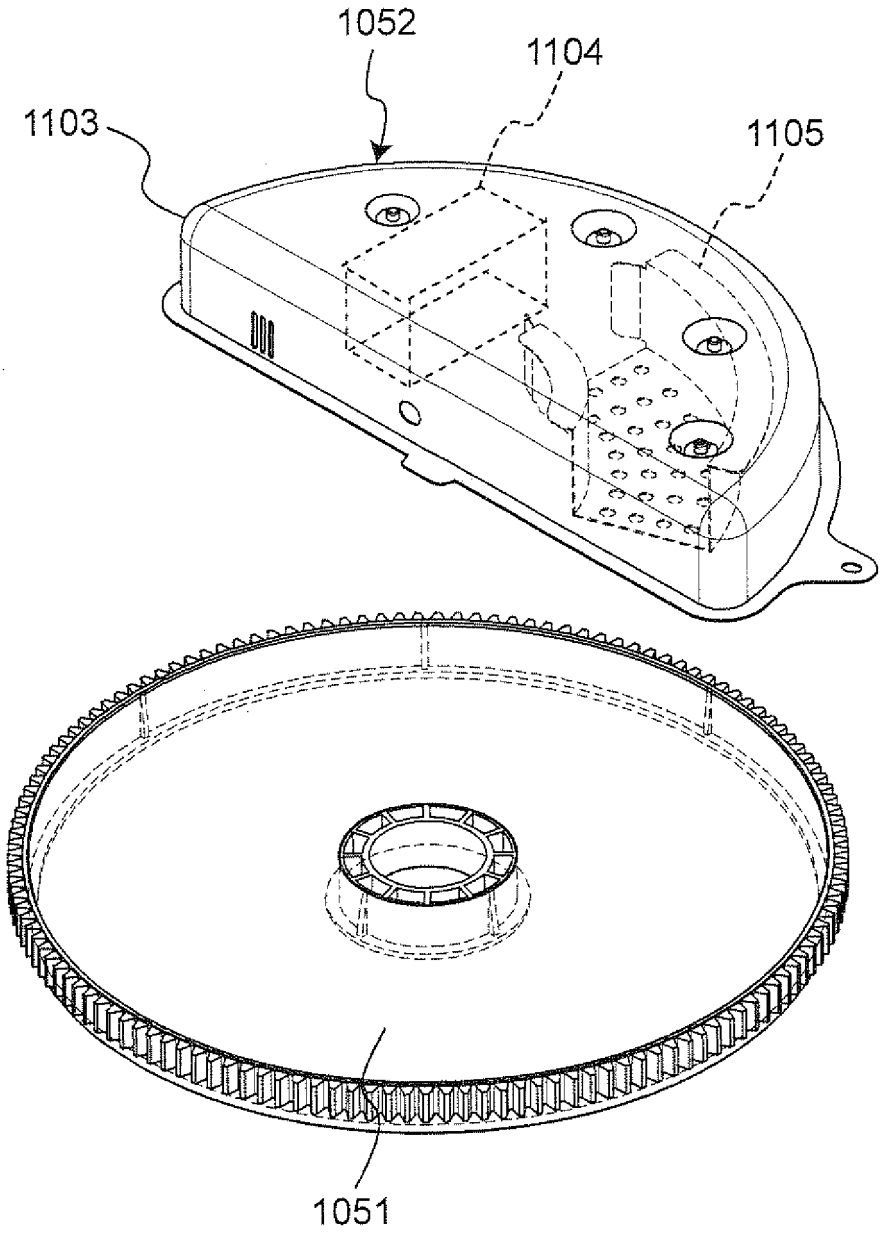


Fig.12

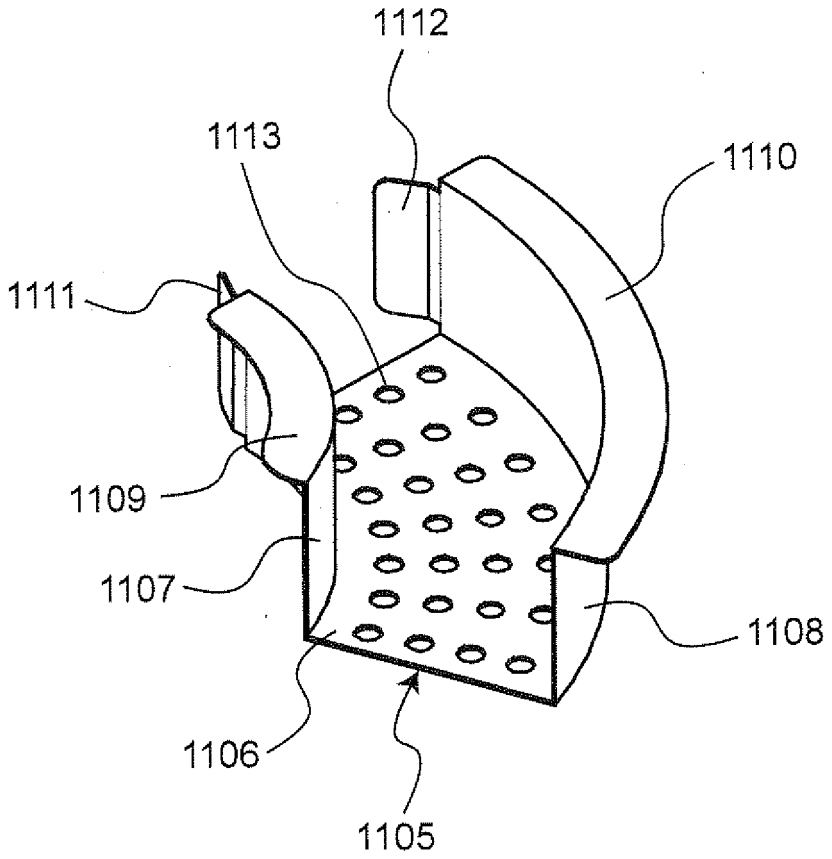


Fig.13

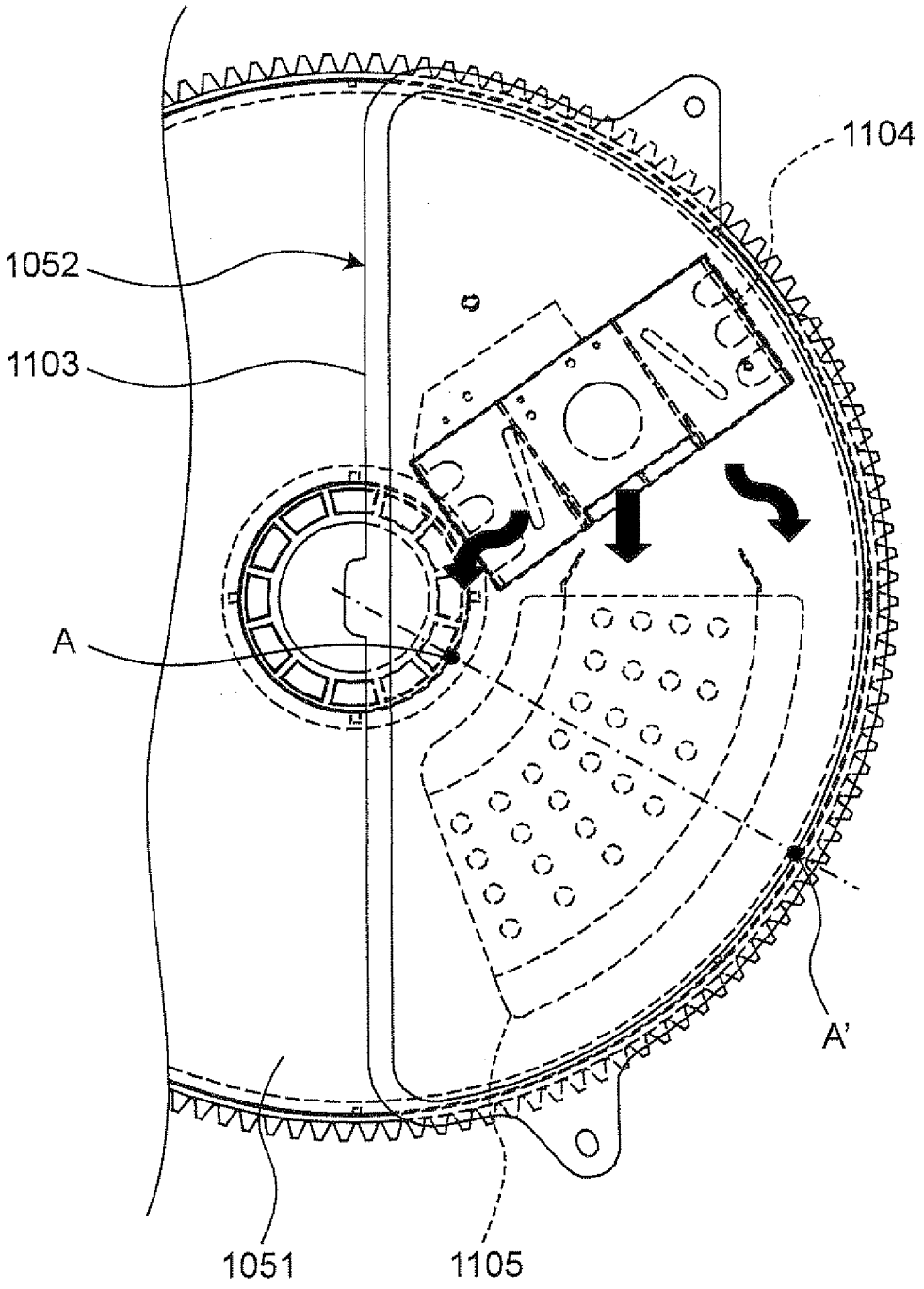


Fig.14

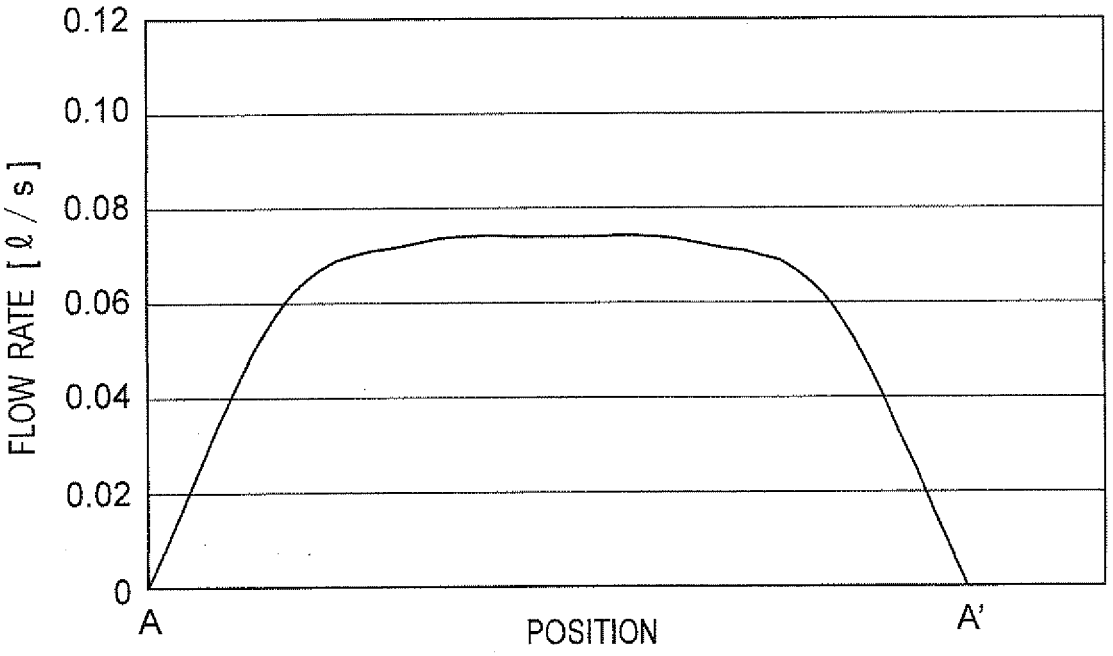


Fig.15

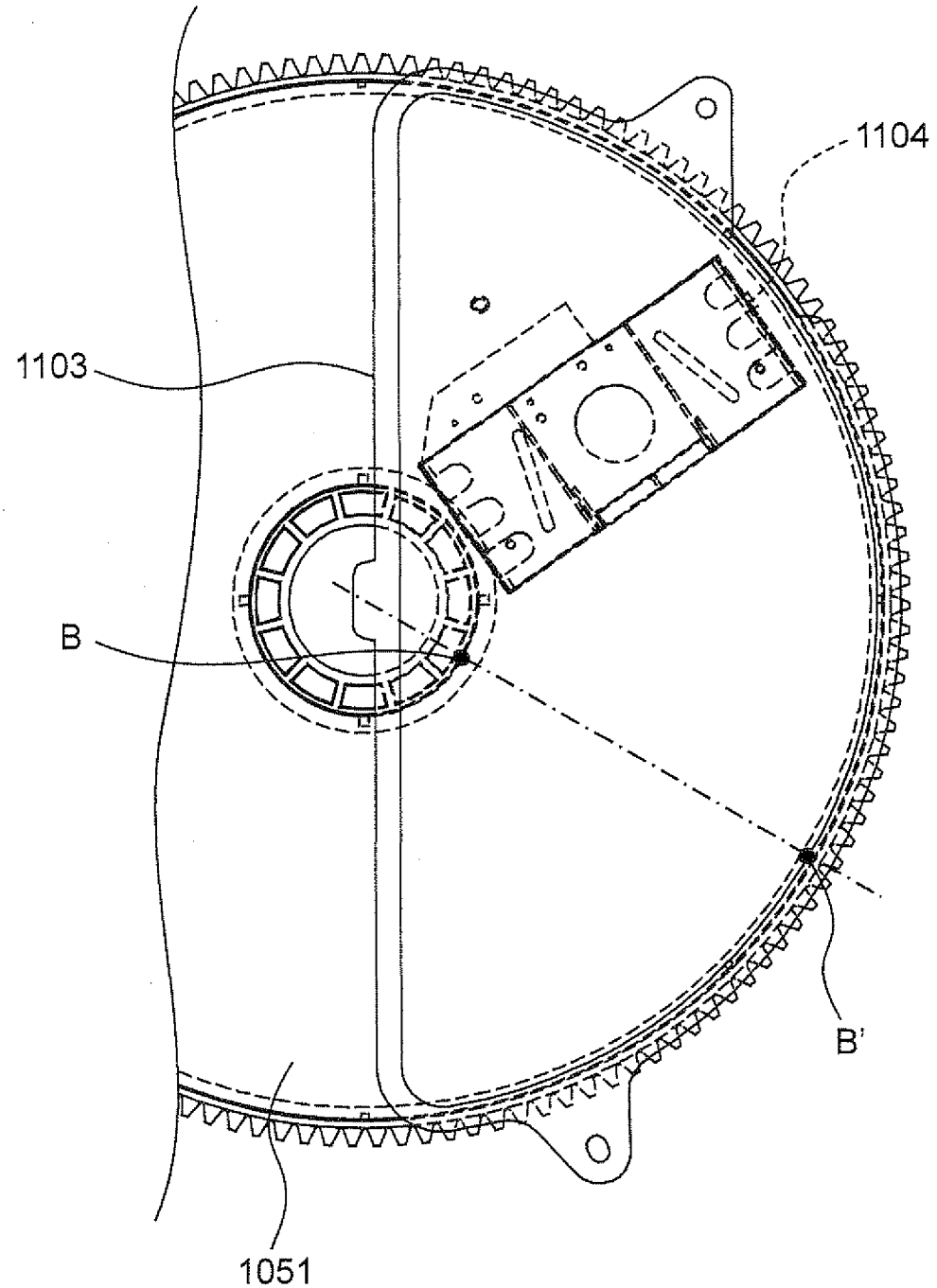


Fig.16

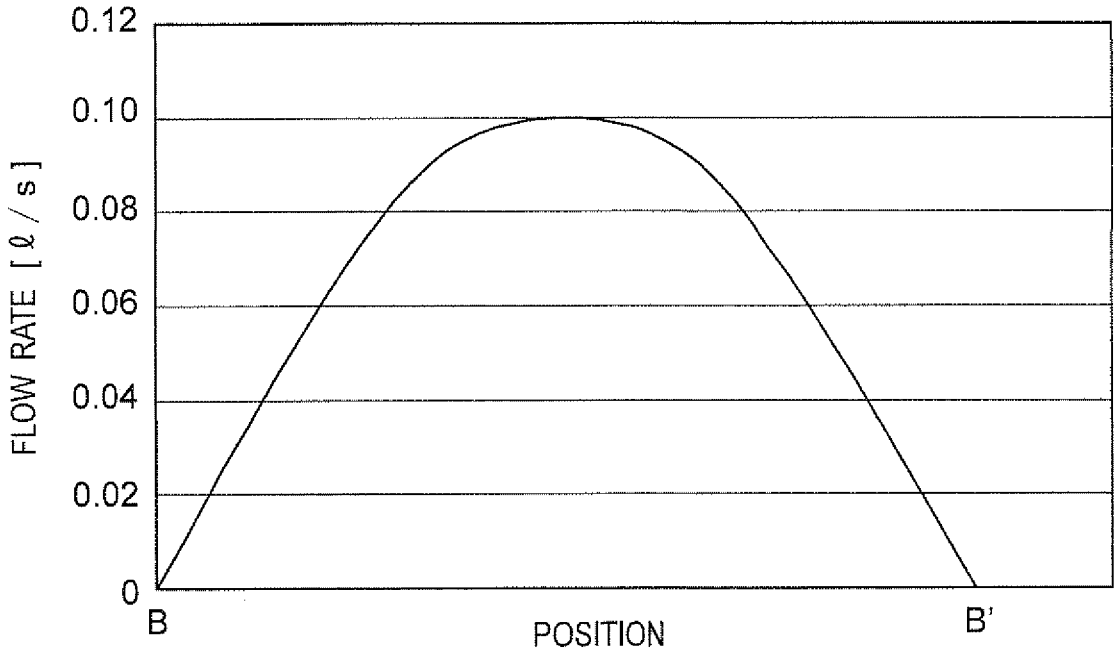


Fig.17

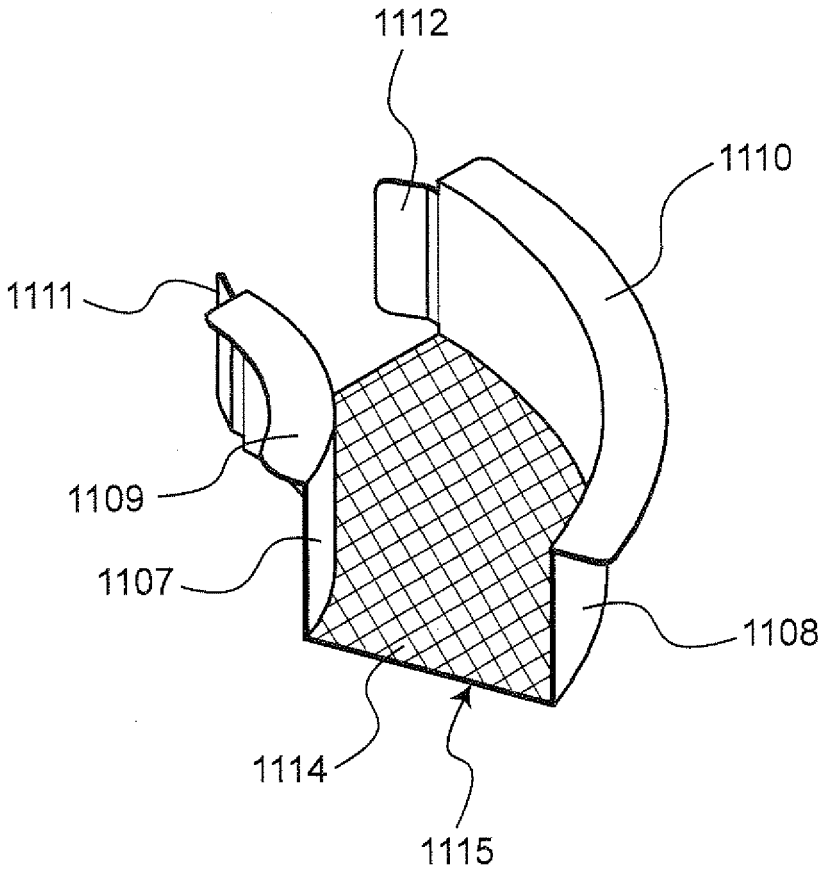


Fig.18

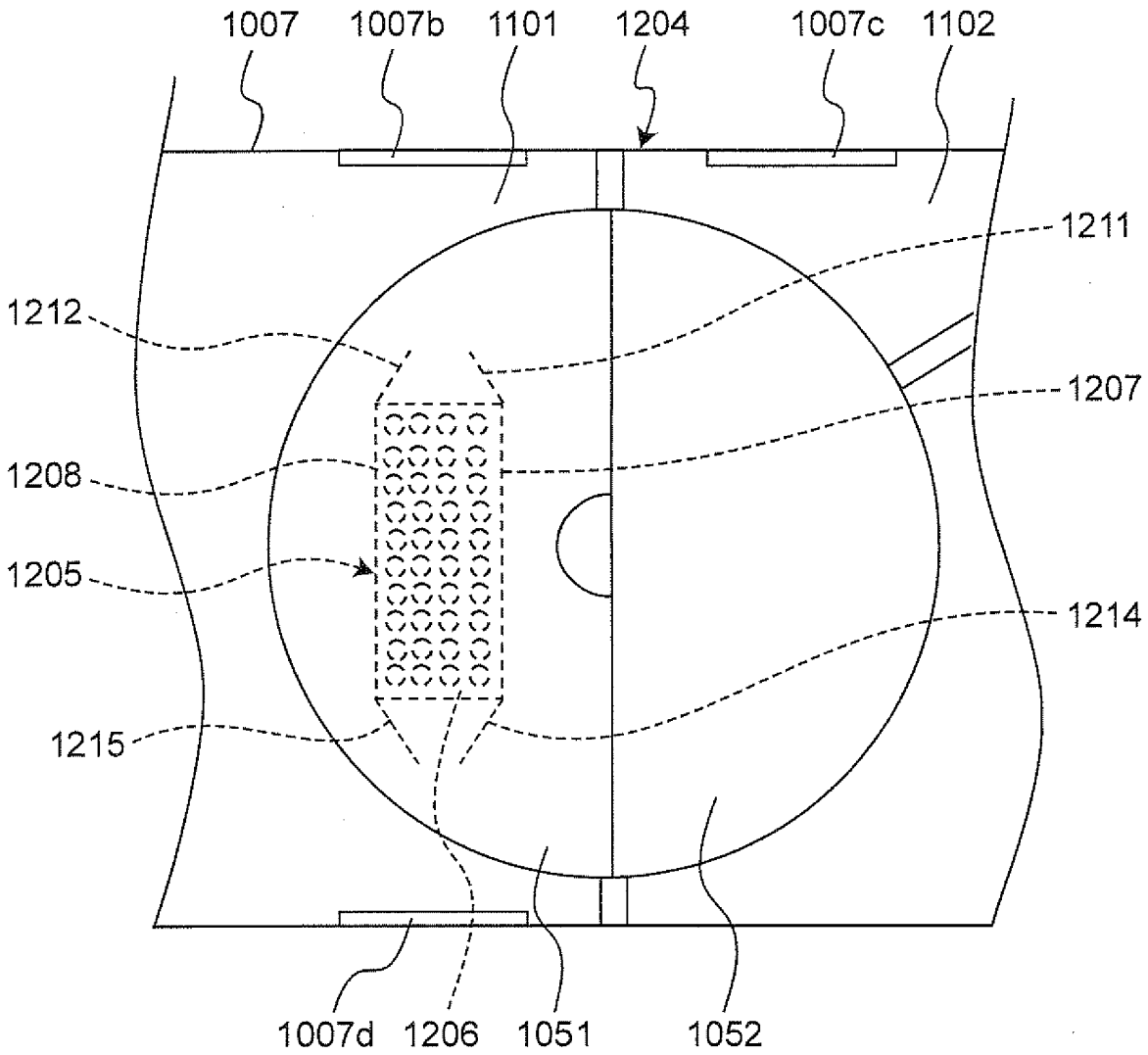

1007
1007b
1101
1204
1007c
1102
1211
1212
1207
1208
1205
1214
1215
1007d
1206
1051
1052

Fig.19

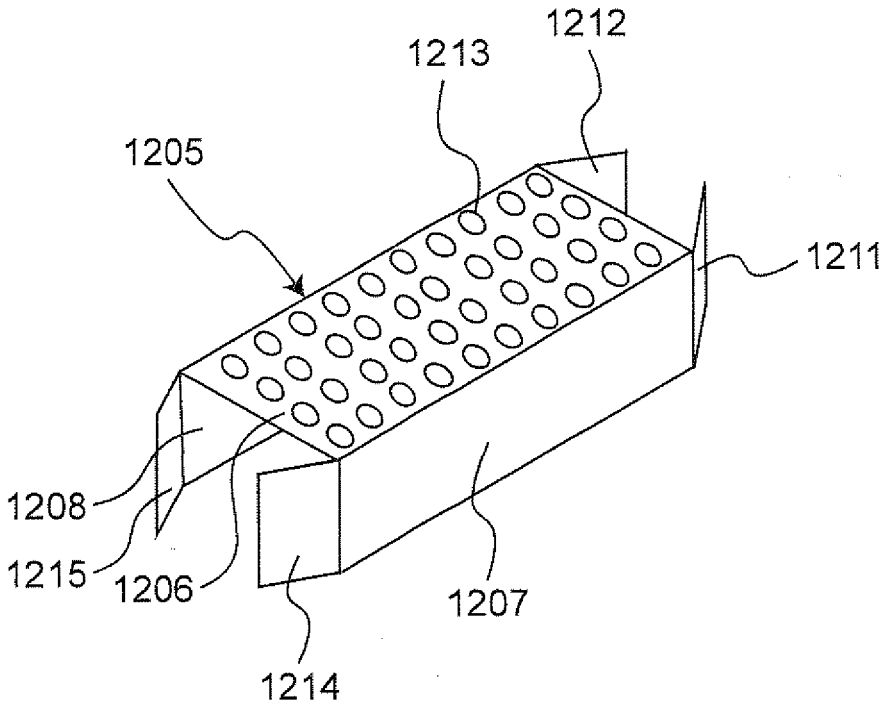


Fig.20

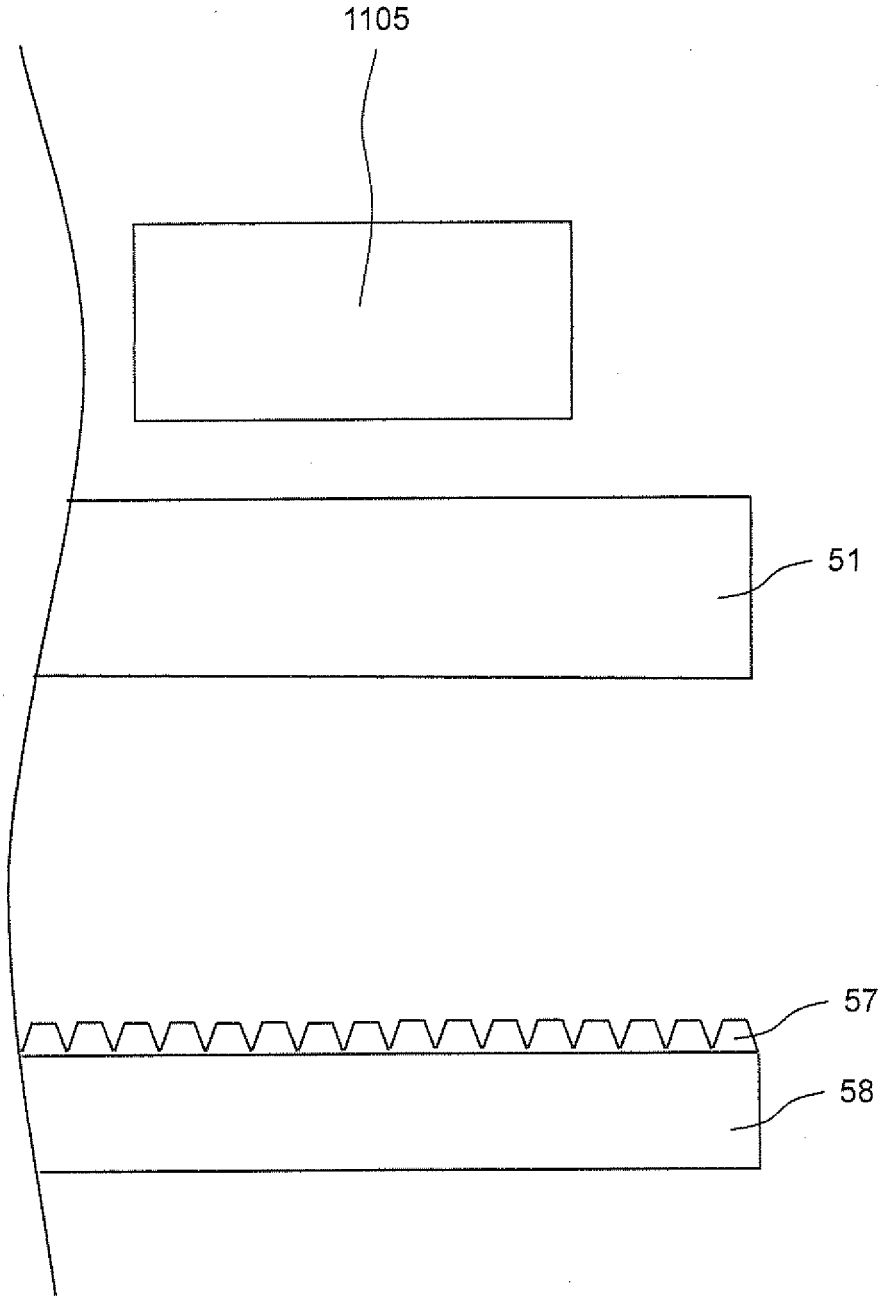


Fig.21

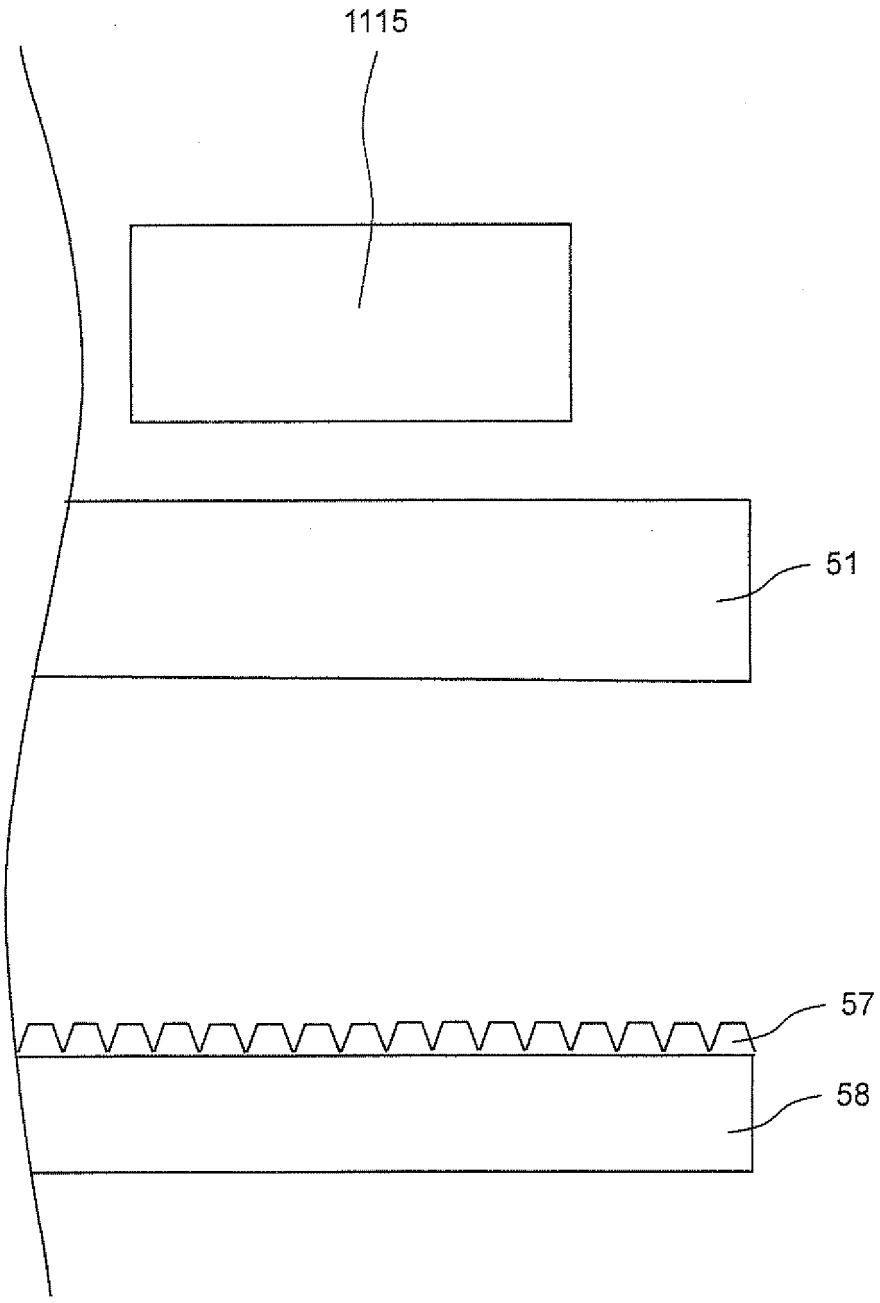


Fig.22

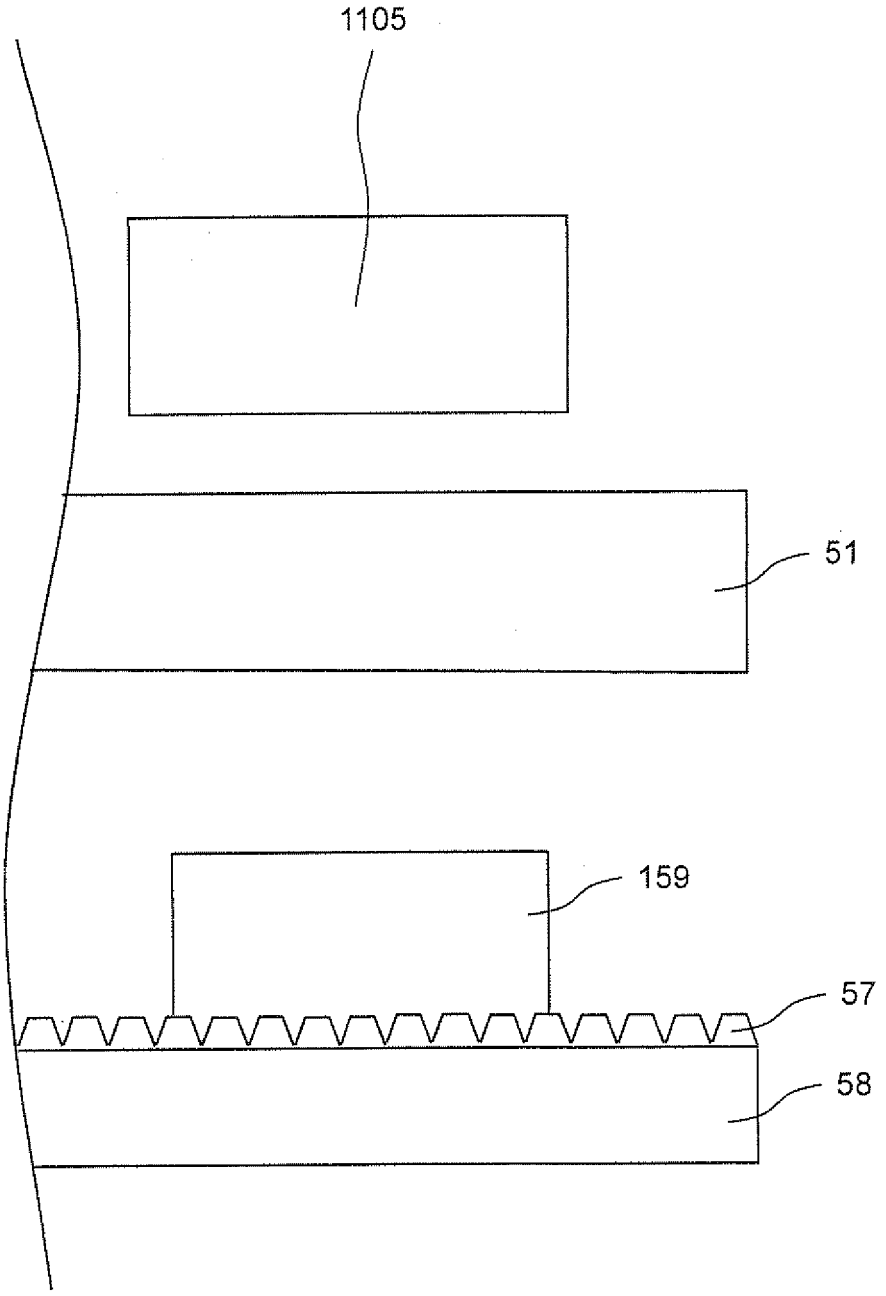


Fig.23

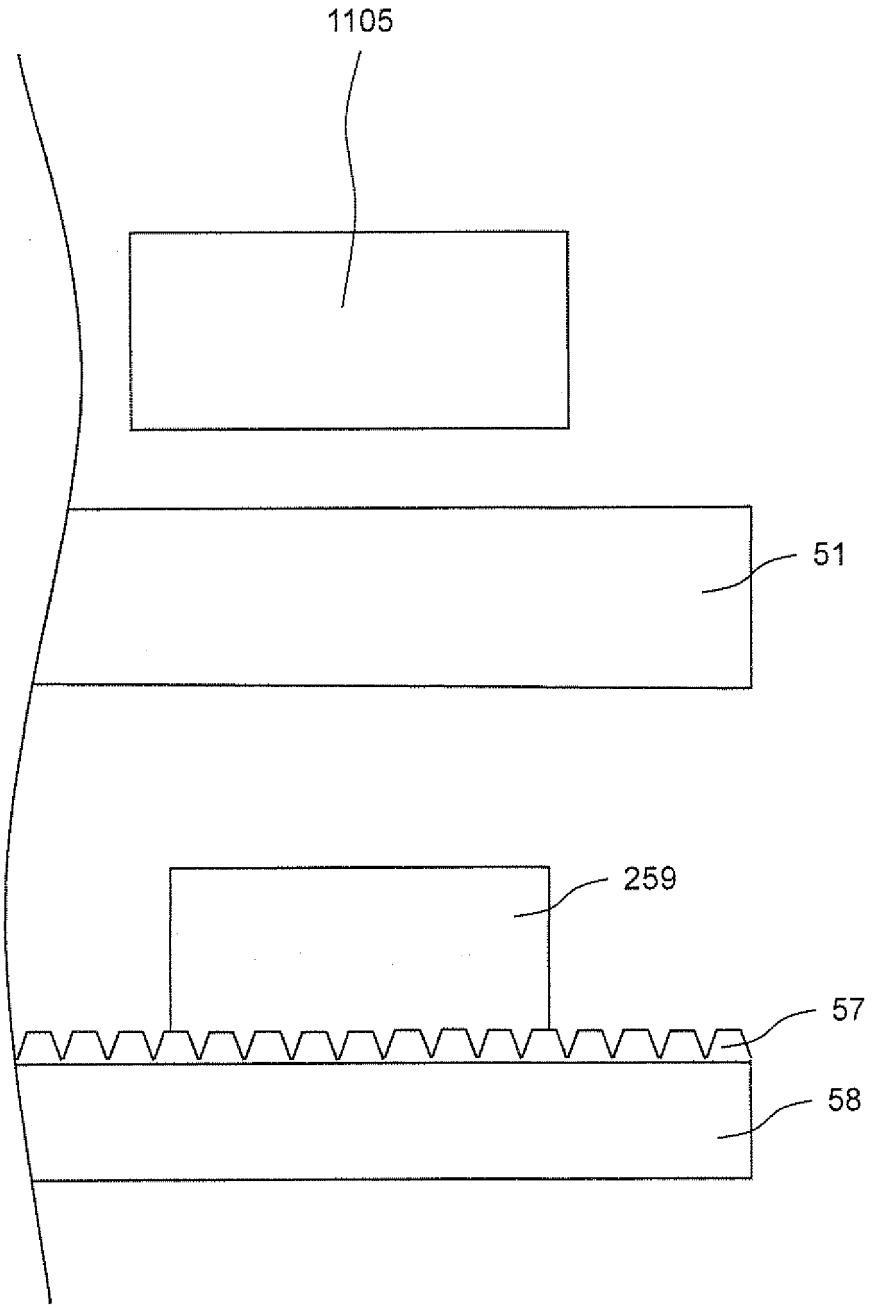


Fig.24

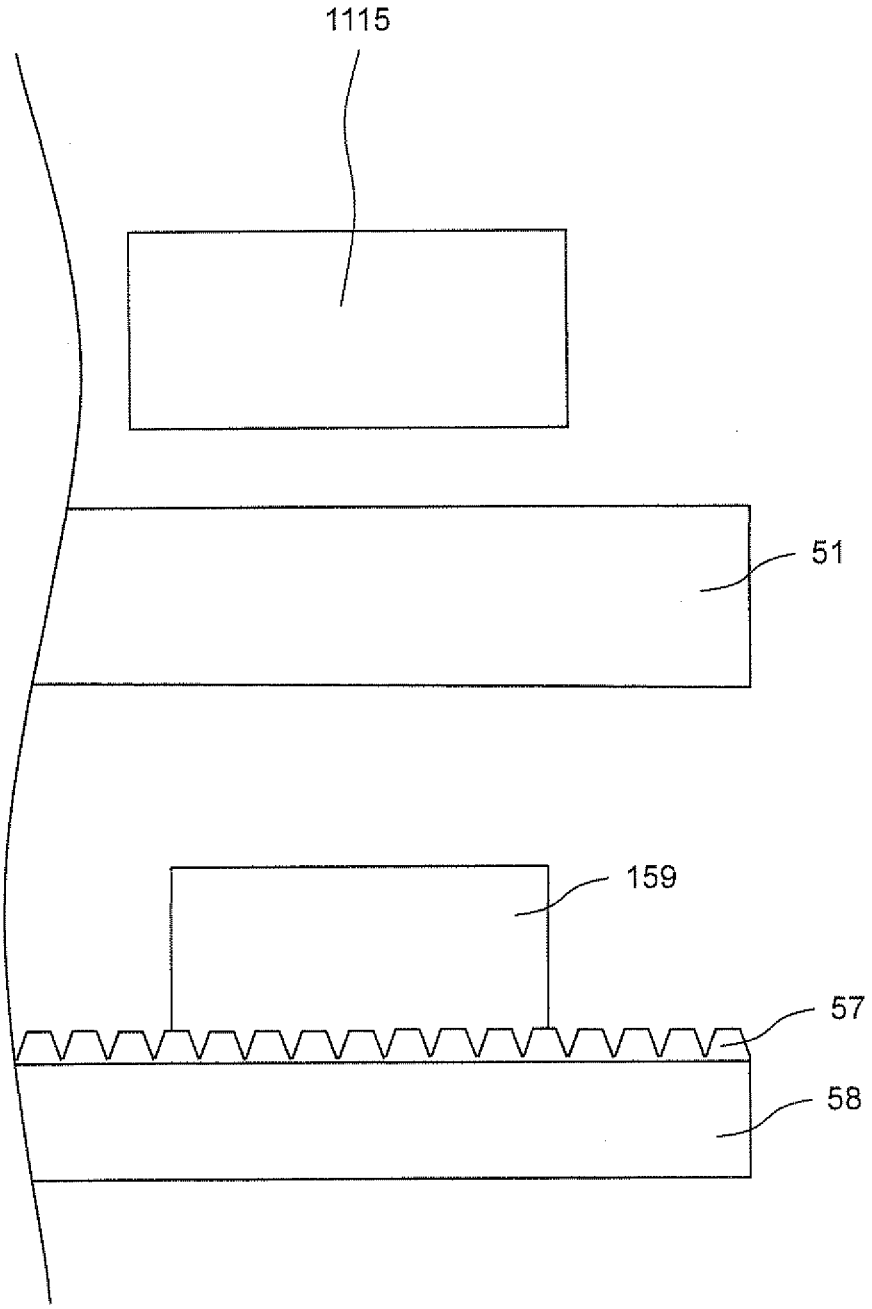
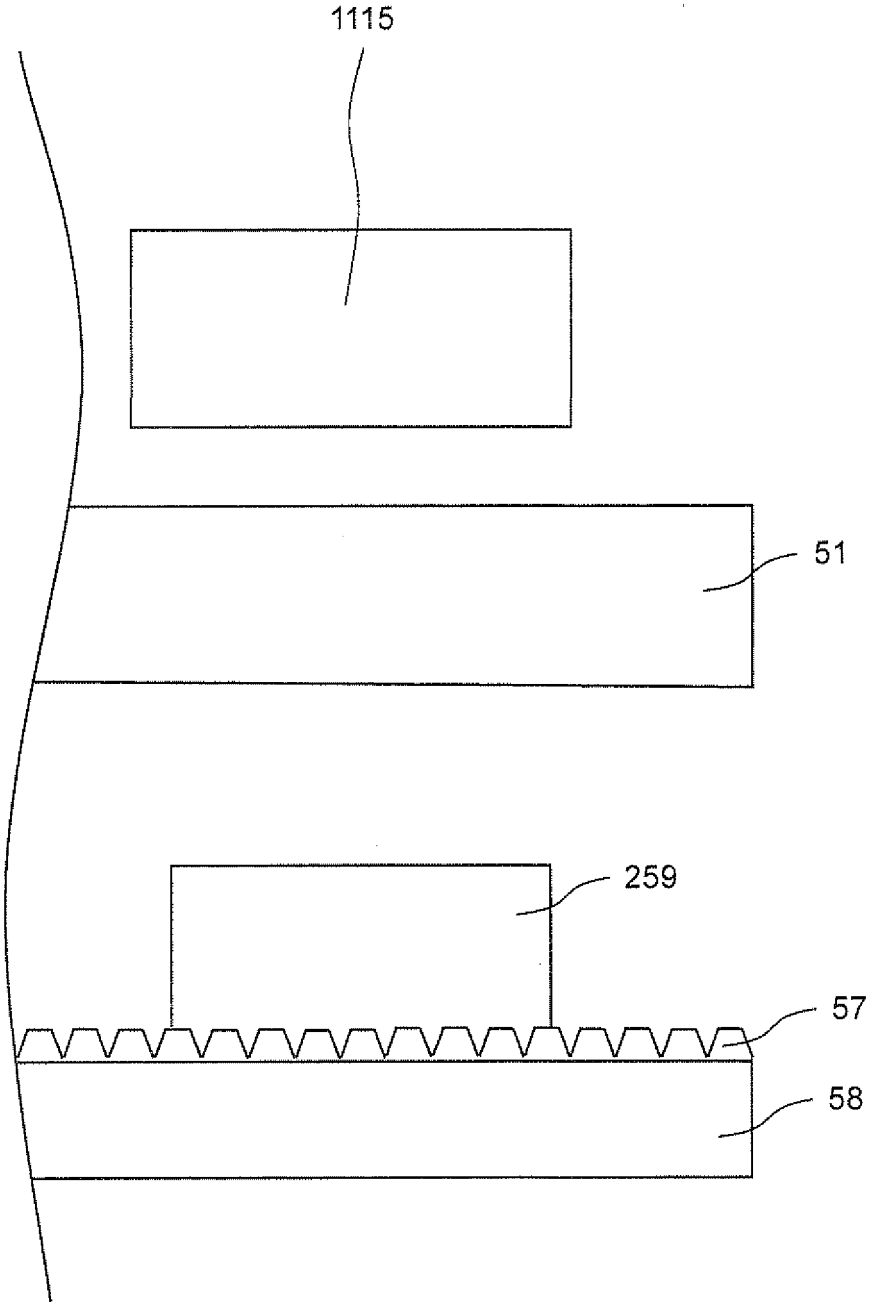


Fig.25



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/069926

A. CLASSIFICATION OF SUBJECT MATTER
F24F6/10(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)
F24F6/10, F24F3/14, B01D53/26

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 1996-2010
Kokai Jitsuyo Shinan Koho 1971-2010 Toroku Jitsuyo Shinan Koho 1994-2010

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	JP 3430993 B2 (Daikin Industries, Ltd.), 23 May 2003 (23.05.2003), entire text; all drawings & JP 2003-227636 A & EP 1118818 A1 & WO 2001/007841 A1 & DE 60030676 D & DE 60030676 T & AT 339658 T & CN 1322288 A & ES 2270857 T	1-26
Y	JP 2005-205276 A (Matsushita Electric Industrial Co., Ltd.), 04 August 2005 (04.08.2005), paragraphs [0075] to [0081]; fig. 5 to 7 (Family: none)	1-17

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 January, 2010 (26.01.10)	02 February, 2010 (02.02.10)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/069926

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2007-127339 A (Matsushita Electric Industrial Co., Ltd.), 24 May 2007 (24.05.2007), paragraph [0039]; fig. 2 (Family: none)	1-17
Y	JP 11-300144 A (Sharp Corp.), 02 November 1999 (02.11.1999), paragraph [0041]; fig. 2, 3 (Family: none)	4
Y	JP 2004-264009 A (Akira HARUHARA, Terukiyo KITAZAWA), 24 September 2004 (24.09.2004), paragraph [0082] (Family: none)	8
Y	JP 11-300146 A (Sharp Corp.), 02 November 1999 (02.11.1999), paragraph [0058]; fig. 8 (Family: none)	9-26

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

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 3430993 B **[0002] [0007]**