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(71) Applicant: **Mitsubishi Heavy Industries, Ltd.**

Minato-ku

Tokyo (JP)

(72) Inventors:

• **TANAKA, Daisuke**
Nagoya, Aichi-ken
453-8515 (JP)

• **KOJIMA, Susumu**
Nagoya, Aichi-ken
453-8515 (JP)

(74) Representative: **Bongiovanni, Simone et al**

STUDIO TORTA

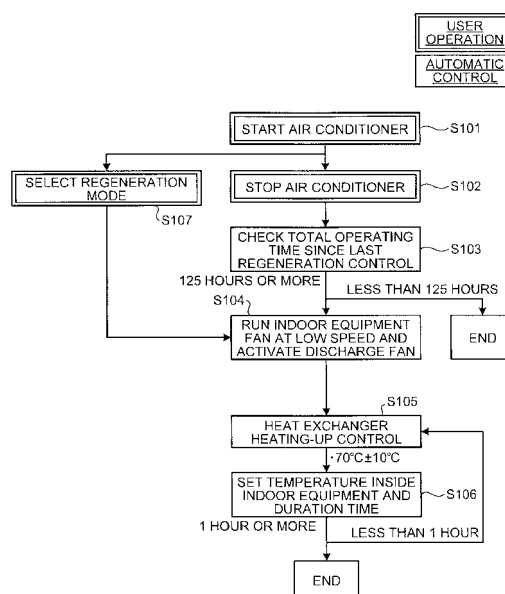
Via Viotti 9

10121 Torino (IT)

(54) **AIR CONDITIONER AND FILTER REGENERATION CONTROL METHOD FOR AIR CONDITIONER**

(57) The present invention has an object to provide an air conditioner in which regeneration of a gas adsorption filter and discharge of gas can be performed without adding a large-scale structure, and a filter regeneration control method for the air conditioner. First, the air conditioner is started (Step S101), and then stopped (Step S102). Subsequently, a total operating time since last filter regeneration control is checked, in most cases, by means of a timer integrated in a computer program that is executed on a computer of a control device. It is then determined whether the total time has exceeded a predetermined time, for example, 125 hours (Step S103). If not exceeded, it is determined that the regeneration control is not necessary, and the control is ended. When the total time has exceeded the predetermined time, a fan of the indoor equipment is rotated at a slow speed, and a discharge fan of a ventilator is run (Step S104). Thereafter, a heating-up control is executed to heat heat exchangers to high temperatures (Step S105).

FIG.8



EP 2 068 090 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to an air conditioner and a filter regeneration control method for an air conditioner, and more particularly, to an air conditioner and a filter regeneration control method for an air conditioner that enable to effectively regenerate a gas adsorption filter while making full use of an existing configuration.

BACKGROUND ART

[0002] Conventionally, an air conditioner on which a gas-removal air filter, for example, a filter that carries thereon activated carbon or zeolite, to remove gas (foul odor, volatile organic compounds (VOC), etc.) is mounted has been available. A common gas-removal air filter is the one using an adsorbent. Because the effectiveness (adsorption power) of such filters is deteriorated with gas adsorption, periodical maintenance such as replacement of filters, wash with water, and dry in the sun, is required.

[0003] A technique for automatic maintenance in a device having a filter has been disclosed to complement the maintenance and to reduce work load of the periodical maintenance. For example, a device that treats foul odor in a bathroom (Patent Document 1) is proposed, although the purpose of use is different. Moreover, for an air purification system in which a similar effect as that of the air filter of an air conditioner is expected, a device (Patent Document 2) that can treat foul odor in a room and regenerate a filter is proposed.

[0004]

Patent Document 1: Japanese Patent Application Laid-open No. H02-128030

Patent Document 2: Japanese Patent Application Laid-open No. H10-290829

DISCLOSURE OF INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0005] However, for the device, a large-scale structure is required to be newly added to control regeneration of a gas adsorption filter with heat, and a discharge process of desorption gas, resulting in a problem that the device becomes large scaled and the cost therefore is high.

[0006] The present invention has been achieved in view of the above problems, and it is an object of the present invention to provide an air conditioner and a filter regeneration control method for an air conditioner that enable regeneration of a gas adsorption filter using existing equipments of the air conditioner.

MEANS FOR SOLVING PROBLEM

[0007] To solve the above problems and achieve the above objects, an air conditioner having a discharge mechanism that discharges atmosphere inside an indoor equipment of the air conditioner to outside of a room in which the indoor equipment is installed, includes: a gas adsorption filter that adsorbs harmful gas components in air taken into the indoor equipment through a first intake; a filter holder that holds the filter between the first intake and a heat exchanger; and a heat source that conducts heat to the filter.

[0008] The discharge mechanism that discharges atmosphere inside the indoor equipment of the air conditioner to outside of a room in which the indoor equipment is installed is used as a ventilation mechanism in many cases. The gas adsorption filter that adsorbs harmful gas components in air that is taken through the first intake generally provided in the indoor equipment in the air conditioner having such a mechanism has such a property that the adsorbed gas components are desorbed when heat is applied. Therefore, when a source of the heat to be applied is available, desorption of the components can be achieved, and the desorbed gas can be discharged from the room by the ventilation mechanism.

[0009] In the air conditioner according to the present invention, the heat source is a heater that is arranged on a surface of the filter holder.

[0010] When a heating wire, a rubber heater, or the like is attached or placed in a tensioned state on the filter holder holding the gas adsorption filter, it is possible to conduct heat directly to the gas adsorption filter, and the filter regeneration can be achieved without adding a large-scale structure, at low cost.

[0011] In the air conditioner according to the present invention, the heat source is a heat exchanger, and includes a control unit that brings the heat exchanger to a high temperature, and that closes a louver and causes a fan to rotate at a low speed.

[0012] Also according to this invention, by adding a twist to the control unit that controls the existing heat exchanger, louver, and fan, the heat can be conducted directly to the gas adsorption filter, and the filter regeneration can be achieved without adding a large-scale structure, at low cost. Although the effect is larger when the temperature of the heat exchanger is higher, an appropriate temperature is selected from the view point of safety and credibility as an air conditioner. The louver contributes to increase hermeticity of the indoor equipment and to discharge the desorbed gas efficiently. Moreover, the fan is rotated at a low speed in the view point of avoiding a malfunction of the air conditioner (refrigerant system).

[0013] The air conditioner according to the present invention, further includes a second intake on a surface of a member constituting the discharge mechanism.

[0014] When the second intake is provided, a strong air flow is generated from the intake to the discharge fan,

and the desorbed gas can be discharged efficiently.

[0015] In the air conditioner according to the present invention, the gas adsorption filter is positioned between the second intake and the discharge mechanism.

[0016] When the gas adsorption filter is positioned between the intake and the discharge mechanism, the gas adsorption filter is placed in the strong air flow, and the desorbed gas can be discharged efficiently.

[0017] In the air conditioner according to the present invention, an opening of the discharge mechanism is arranged inside the indoor equipment at a position at least higher than the filter.

[0018] Although it is not necessary to particularly limit arrangement of the opening (intake of the discharge mechanism) of the discharge mechanism such as the ventilator from the point of view of discharge of atmosphere inside the indoor equipment to outside, the opening is arranged at a position at least higher than the gas adsorption filter so that ascending gas molecules that have been desorbed from the gas adsorption filter are efficiently discharged.

[0019] In the air conditioner according to the present invention, a material of the filter is a material from which at least odorous components are desorbed with the heat of the heat source.

[0020] Humans are relatively sensitive to the odorous components, and thus the odorous components are likely to be a cause of bringing a feel of discomfort or aversion. Accordingly, it is important for the gas absorption filter to remove odorous components also for industrial goods. Therefore, according to this invention, in addition to the above configuration, a material is selected to use the material from which at least odorous components can be desorbed. From that material, the components are desorbed and discharged.

[0021] According to the present invention, a filter regeneration control method for an air conditioner having a discharge mechanism that discharges atmosphere inside an indoor equipment of the air conditioner to outside of a room in which the indoor equipment is installed, the air conditioner in which a gas adsorption filter that adsorbs harmful gas components in air taken into the indoor equipment through a first intake is held by a filter holder between the first intake and a heat exchanger, includes: controlling for a fan of the indoor equipment to rotate at a low speed; controlling for activating the discharge mechanism; and controlling for bringing the heat exchanger to a temperature equal to or higher than a highest temperature that can normally be set.

EFFECT OF THE INVENTION

[0022] According to the air conditioner and the filter regeneration control method for the air conditioner of the present invention, a filter regeneration function of a gas adsorption filter and a desorbed-gas discharge function can be given without changing the configuration or without adding a large-scale structure in the air conditioner

having a discharge mechanism that discharges atmosphere inside the indoor equipment of the air conditioner to the outside of a room in which the indoor equipment is installed.

BRIEF DESCRIPTION OF DRAWINGS

[0023]

[Fig. 1] Fig. 1 is a perspective view of a configuration of an indoor equipment of an air conditioner according to the present invention.

[Fig. 2] Fig. 2 is a cross sectional view of an internal configuration of the indoor equipment.

[Fig. 3] Fig. 3 is a front view of a configuration of a ventilator.

[Fig. 4] Fig. 4 is a perspective view of a duct of the ventilator.

[Fig. 5] Fig. 5 is an explanatory diagram of a filter and a filter holder.

[Fig. 6] Fig. 6 is an explanatory diagram of an example of attachment of a heater.

[Fig. 7] Fig. 7 is an explanatory diagram of another example of attachment of the heater.

[Fig. 8] Fig. 8 is a flowchart of a specific filter regeneration control.

EXPLANATIONS OF LETTERS OR NUMERALS

[0024]

1	indoor equipment
2, 4, 12	heat exchanger
3	prefilter
5	discharge fan
7	second intake
9	opening
10	outlet
11, 32	gas adsorption filter
13	ventilator
15	fan
18	first intake
19	louver
20	duct
21	damper
22	opening
31, 33	filter holder

BEST MODE(S) FOR CARRYING OUT THE INVENTION

[0025] Exemplary embodiments of an air conditioner and a filter regeneration control method for the air conditioner according to the present invention will be explained below in detail with reference to the accompanying drawings. The embodiment is not intended to limit the present invention.

Embodiment

[0026] Fig. 1 is a perspective view of a configuration of an indoor equipment of an air conditioner according to the present invention. Fig. 2 is a cross-section of an internal configuration of the indoor equipment. As shown in Fig. 1 or 2, an indoor equipment 1 of the air conditioner includes a first intake 18 to take air in a room therein, and an indoor heat exchangers 2, 4, and 12 to cool or heat the first intake 18.

[0027] The indoor equipment 1 further includes an outlet 10 to return the air that is heat-exchanged by the heat exchangers 2, 4, and 12 in the room, a fan 15 to take air in through the first intake 18 and to blow out the heat-exchanged air to the room from the outlet 10, a gas adsorption filter 11 that is arranged at a position between the indoor heat exchanger 12 and the first intake 18 and near the indoor heat exchanger 12 on an upper stream side in an air flow path, a ventilator 13 that is arranged on one side of the indoor equipment 1, and a prefilter 3 that is arranged inside the indoor equipment 1 from a front part toward an upper part, and that removes impurities such as dust and dirt from the air that is led to the indoor heat exchangers 12, 2, and 4 through the first intake 18, as main components. Because the first intake 18, the indoor heat exchangers 12, 2, and 4, the outlet 10, the fan 15, and the prefilter 3 are well-known techniques, the explanations thereof are omitted herein.

[0028] Fig. 3 is a front view of a configuration of the ventilator. In the ventilator 13, an opening 9 is formed long in the horizontal direction above the gas adsorption filter 11, and the ventilator 13 includes a duct 20 having a discharge fan 5 at an end. The discharge fan 5 communicates on a downstream side thereof with air outside the room in which the indoor equipment 1 is installed. The ventilator 13 functions as a discharge mechanism that discharges atmosphere inside the indoor equipment 1 of the air conditioner to the outside.

[0029] The gas adsorption filter 11 is held in a case (frame) as a holder, and has a function of absorbing and removing harmful substances such as a foul odor component and VOC included in air taken. It is not necessary to particularly limit the arrangement of the ventilator 13 from the point of view of the discharge of atmosphere inside the indoor equipment 1 to the outside. However, it is preferable that the opening 9 be arranged at a position at least higher than the gas adsorption filter 11 so that

ascending gas molecules that have been desorbed from the gas adsorption filter 11 are efficiently discharged, from the view point of bearing a part of a filter regenerating function.

[0030] In this embodiment of the present invention, the heat exchangers 12, 2, and 4 are used as heat sources that conduct heat to the gas adsorption filter 11. Therefore, as well as being arranged on the inside of the first intake 18 for the function thereof, the gas adsorption filter 11 is preferably arranged as close to the heat exchangers 12, 2 and 4 as possible.

[0031] Prior to bringing the heat exchangers 12, 2 and 4 to high temperatures by means of the heat sources, a louver 19 of the outlet 10 is closed, and the fan 15 is run at a low speed. Although the louver 19 is not necessarily be required to be closed, it is preferable that the louver 19 be closed to prevent the gas component desorbed and concentrated in the indoor equipment 1 from leaking, and to perform the discharge of the gas components efficiently by enhancing the hermeticity inside the indoor equipment 1 to make the pressure inside the indoor equipment negative.

[0032] It is preferable that the fan 15 be run to exchange heat to some extent to prevent failure of the air conditioning system because if very little heat exchange is executed when the heat exchangers 12, 2, and 4 are set to high temperatures, a large quantity of a liquid-phase refrigerant flows into an expansion valve, and thus there is a possibility of causing malfunction such as abnormal noise. Specifically, it is preferable that the output of the fan 15 be the minimum output within an allowable range of a refrigerant system load of the air conditioner.

[0033] After the louver 19 is closed and the fan 15 is rotated, a refrigerant gas at a high temperature is fed to the heat exchangers 12, 2, and 4, and the heat exchangers 12, 2, and 4 are heated to high temperatures, for example, a temperature about $70^{\circ}\text{C} \pm 10^{\circ}\text{C}$, within an allowable range for control of a compressor (not shown) and the expansion valve included in the air conditioner. Upon application of heat to the gas adsorption filter 11, gas components that have been adsorbed are desorbed, thereby regenerating the gas adsorption filter 11. As for the temperature, the effect can be obtained even with a temperature that can normally be set to the indoor equipment 1 with a remote control or the like as a filter regeneration temperature. However, if the temperature is set to the highest temperature allowable as an air conditioning system, more gas molecules are likely to be desorbed from the gas adsorption filter, and therefore it is preferable.

[0034] Fig. 8 is a flowchart of a specific filter regeneration control. First, the air conditioner is started (Step S101), and then stopped (Step S102). Subsequently, a total operating time since last filter regeneration control is checked, in most cases, by means of a timer integrated in a computer program that is executed on a computer of a control device. It is then determined whether the total time has exceeded a predetermined time, for example,

125 hours (Step S103). If not exceeded, it is determined that the regeneration control is not necessary, and the control is ended.

[0035] When the total time has exceeded the predetermined time, the fan of the indoor equipment is rotated at a slow speed, and a discharge fan of the ventilator is run (Step S104). Thereafter, a heating-up control is executed to heat the heat exchangers to high temperatures (Step S105). If possible, a temperature inside the indoor equipment and the duration of the filter regeneration control are measured (Step S106). When the duration has exceeded a predetermined time, for example, 1 hour, it is determined that sufficient filter regeneration has been performed, to end the control. When the filter regeneration is to be executed forcibly irrespective of the total operating time since the last filter regeneration control, a mode for forcibly executing the filter regeneration can be set independently from the flow of the control (Step S107).

[0036] The filter regeneration control can be executable by adding the procedure above mentioned to a computer program for a control computer that is usually included in an air conditioner.

[0037] By performing the control as described above, a filter regeneration function for a gas adsorption filter can be given to an air conditioner having a ventilator, without changing the configuration thereof.

(Modified Example 1)

[0038] Modified example 1 of the present invention is characterized such that a second intake 7 (see Figs. 1, 3, and 4) is arranged at a front part of the duct 20 constituting the ventilator 13 in addition to the configuration according to the above embodiment. Moreover, a damper (rotating opening/shutting door) 21 is arranged in the second intake 7. When the damper 21 is open, air is taken also through the second intake 7, which is formed when the damper 21 is open, and a function as a normal ventilator in which pressure drop is low and that can exhaust air in large volume is obtained. When the damper 21 is closed, to efficiently discharge gas molecules that are desorbed from the gas adsorption filter 11 and concentrated inside the indoor equipment 1, air is taken through an opening 22 that is arranged above the gas adsorption filter 11.

[0039] Although not shown, when the gas adsorption filter 11 is arranged between the second intake 7 and the discharge fan 5, a strong flow of air is generated between the second intake 7 and the discharge fan 5, and as a result, the desorbed gas components can be discharged efficiently. Conversely, the second intake 7 is arranged to generate such an air flow.

[0040] When the second intake 7 and the damper 21 are arranged as described above in an air conditioner having a ventilator, it becomes possible to select a normal ventilation mode with a large air volume, or a mode for discharging concentrated and contaminated desorbed

gas components smoothly to outside. Therefore, it is possible to give a filter regeneration function for a gas adsorption filter and a discharge function, without changing the configuration on a large scale.

(Modified Example 2)

[0041] In this modified example 2, a heater is used as a heat source to conduct heat to the gas adsorption filter 11. Specifically, in a gas adsorption filter 32 and a filter holder (case) shown in Fig. 5, various heaters are placed on a filter holder 31. As a suitable example for this invention, as shown in Fig. 6, an electrically-heated wire (resistance wire) 34 such as a nichrome wire and a canthal wire is run throughout a surface of a filter holder 33. Furthermore, as shown in Fig. 7, another type of heater such as a PTC (positive temperature coefficient) heater, and an elastomer heater can be attached on the filter holder 33.

[0042] As described above, when a heater is arranged on the filter holder 31 or 33 as a heat source to regenerate the gas adsorption filter 11, the gas adsorption filter 11 is directly heated up, and gas components can be desorbed efficiently. In addition, because it is achieved only by equipping the filter holder 31 or 33, which are conventionally arranged, with a heater, a large-scale structure is not required, and the cost therefore can also be low. Furthermore, because this arrangement does not increase airflow resistance of the gas adsorption filter 11, the need for design modification (upsizing of a fan or a motor) associated with this arrangement can be eliminated. The heater can be used together with the heated heat exchangers 12, 2, and 4.

[0043] The gas adsorption filter 11 can take various forms such as a sheet form, a pleats form, a honeycomb form, and a corrugated form. Moreover, as materials of the filter, using a synthetic fiber such as polypropylene, polyester, and a polyamide-containing synthetic fiber, or a natural fiber such as cellulose and rayon as a base, one that carries thereon an adsorbent such as activated carbon and zeolite, one itself having a high adsorption effect such as an activated carbon fiber and polyacrylic acid, or one formed by directly shaping an inorganic porous material of clay mineral such as cordierite and sepiolite into the above forms can be used. It is preferable that the material have a property that at least odorous components are desorbed when heat of a heat source is applied. It is because removal of odorous components is the foremost requirement for the gas adsorption filter 11.

INDUSTRIAL APPLICABILITY

[0044] As described above, the air conditioner and the filter regeneration control method for the air conditioner according to the present invention are useful as an air conditioner including a discharge mechanism that discharges atmosphere inside the indoor equipment of the

air conditioner to outside of a room in which the indoor equipment is installed, and useful for control thereof.

Claims

1. An air conditioner having a discharge mechanism that discharges atmosphere inside an indoor equipment of the air conditioner to outside of a room in which the indoor equipment is installed, the air conditioner comprising:

a gas adsorption filter that adsorbs harmful gas components in air taken into the indoor equipment through a first intake; 10

a filter holder that holds the filter between the first intake and a heat exchanger; and

a heat source that conducts heat to the filter. 15
2. The air conditioner according to claim 1, wherein the heat source is a heater that is arranged on a surface of the filter holder. 20
3. The air conditioner according to claim 1, wherein the heat source is a heat exchanger, and includes a control unit that brings the heat exchanger to a high temperature, and that closes a louver and causes a fan to rotate at a low speed. 25
4. The air conditioner according to any one of claims 1 to 3, further comprising a second intake on a surface of a member constituting the discharge mechanism. 30
5. The air conditioner according to claim 4, wherein the gas adsorption filter is positioned between the second intake and the discharge mechanism. 35
6. The air conditioner according to any one of claims 1 to 3, wherein an opening of the discharge mechanism is arranged inside the indoor equipment at a position at least higher than the filter. 40
7. The air conditioner according to any one of claims 1 to 3, wherein a material of the filter is a material from which at least odorous components are desorbed with the heat of the heat source. 45
8. A filter regeneration control method for an air conditioner having a discharge mechanism that discharges atmosphere inside an indoor equipment of the air conditioner to outside of a room in which the indoor equipment is installed, the air conditioner in which a gas adsorption filter that adsorbs harmful gas components in air taken into the indoor equipment through a first intake is held by a filter holder between the first intake and a heat exchanger, the filter regeneration control method comprising: 50

controlling for a fan of the indoor equipment to rotate at a low speed;
 controlling for activating the discharge mechanism; and
 controlling for bringing the heat exchanger to a temperature equal to or higher than a highest temperature that can normally be set. 55

FIG.1

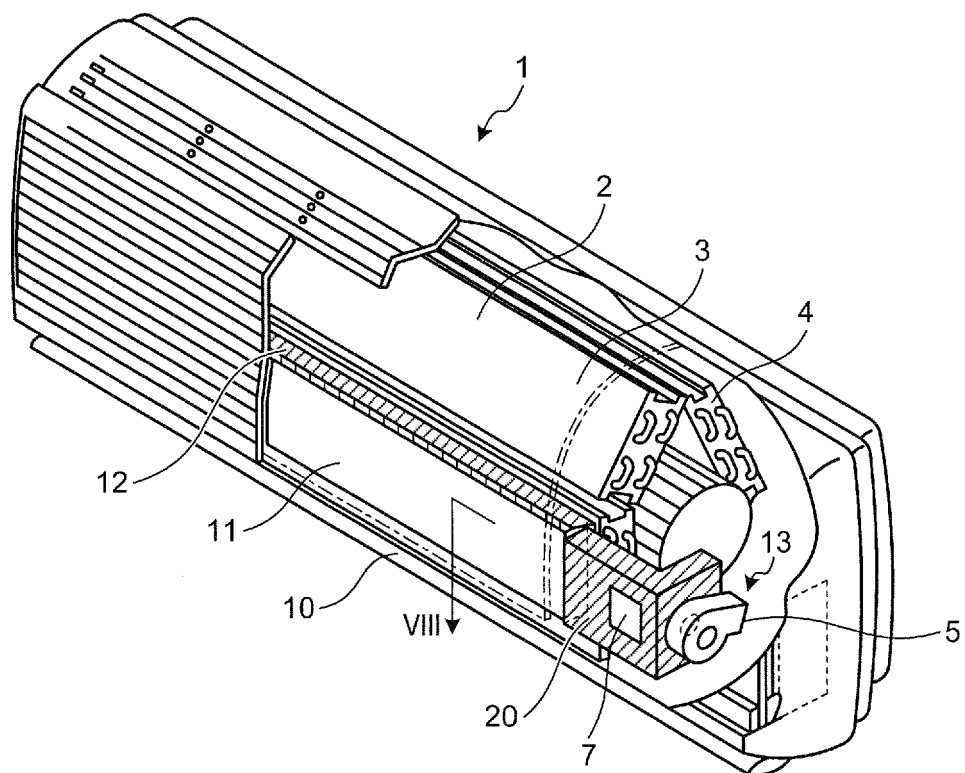


FIG.2

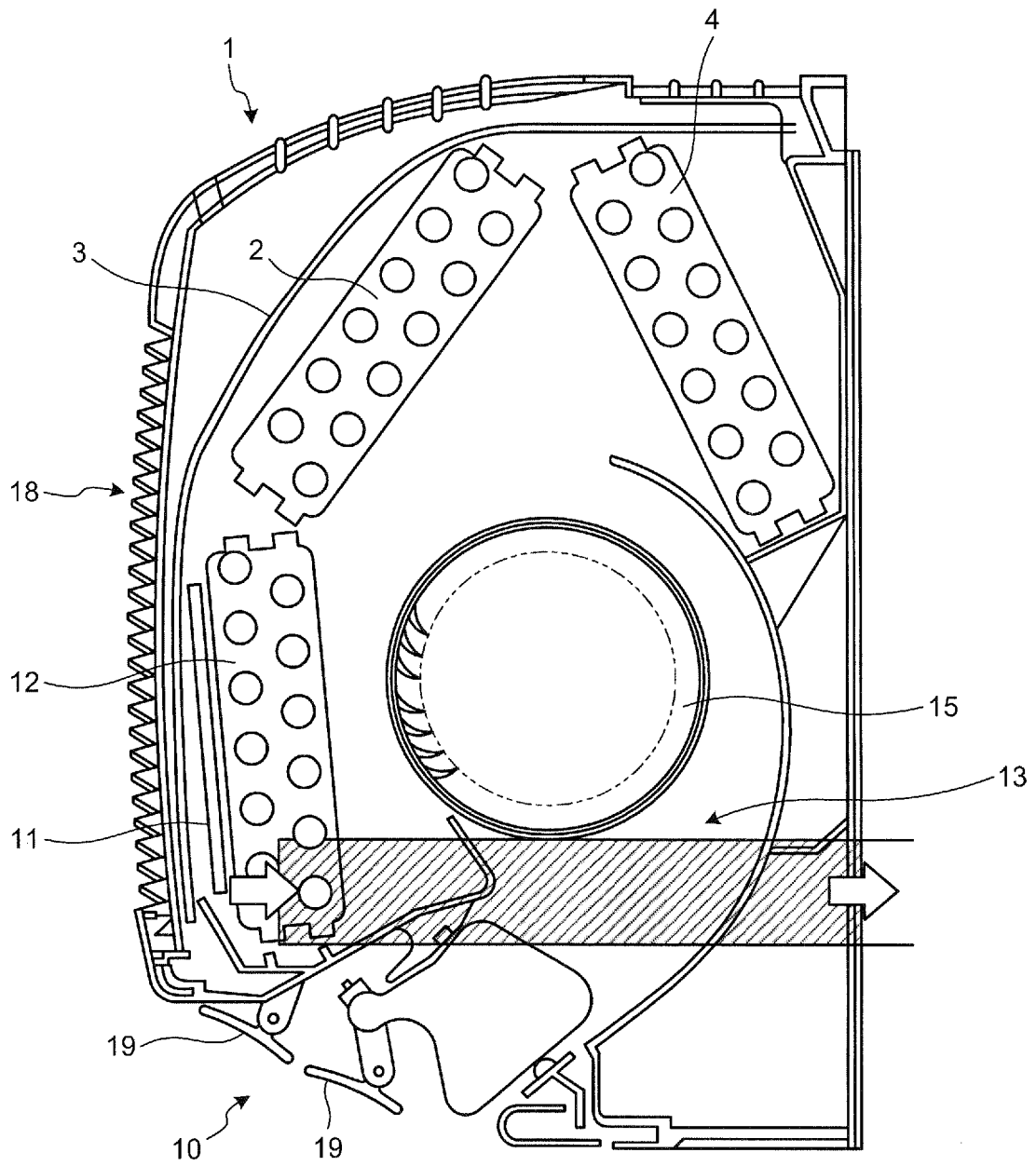


FIG.3

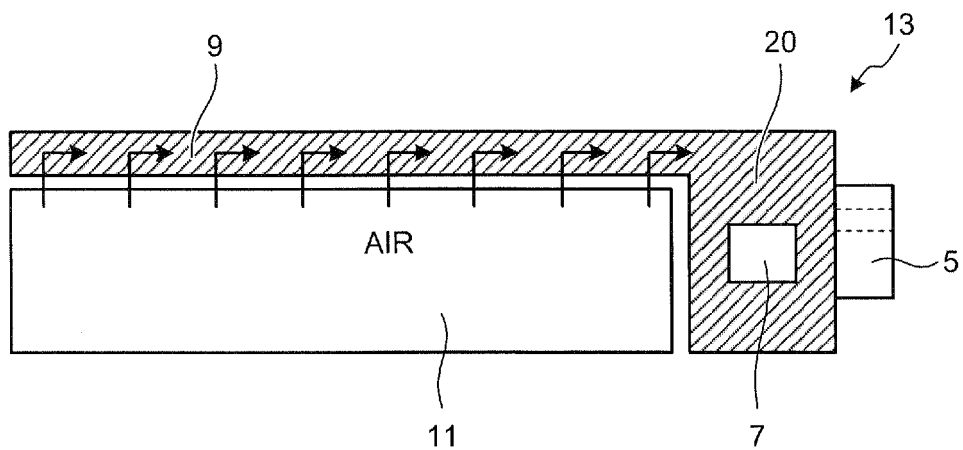


FIG.4

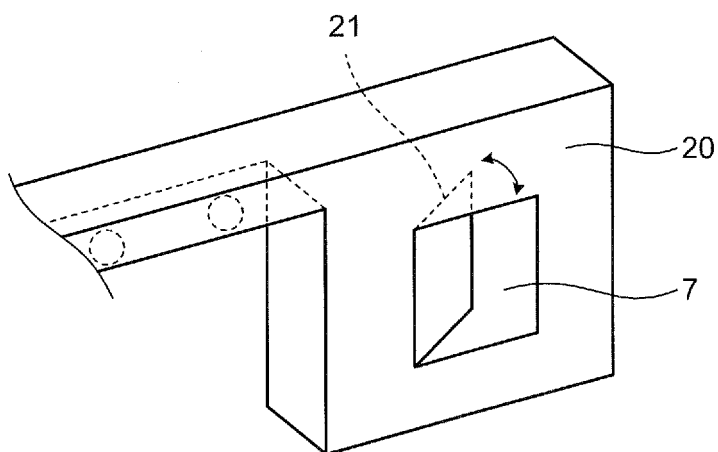


FIG.5

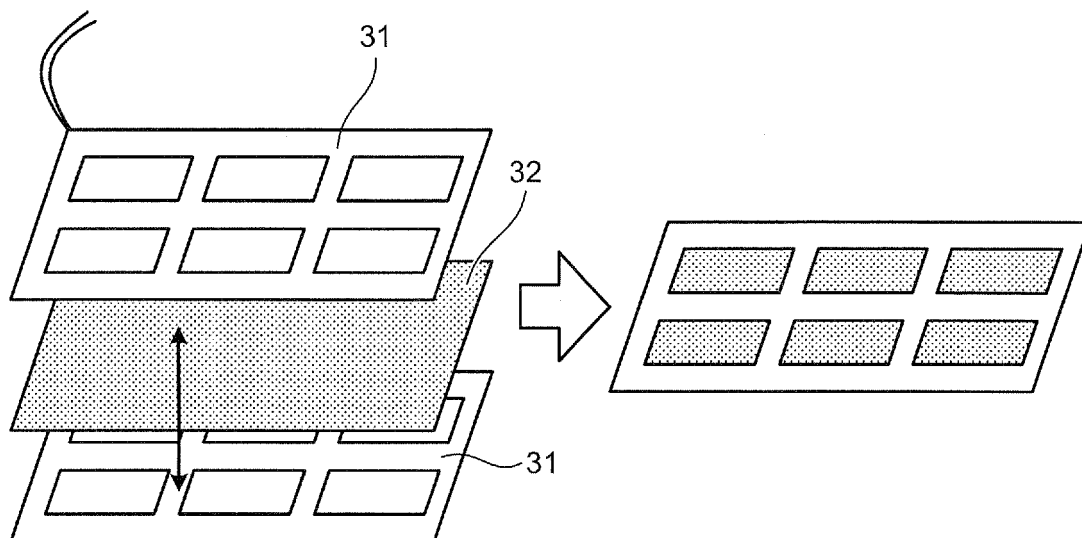


FIG.6

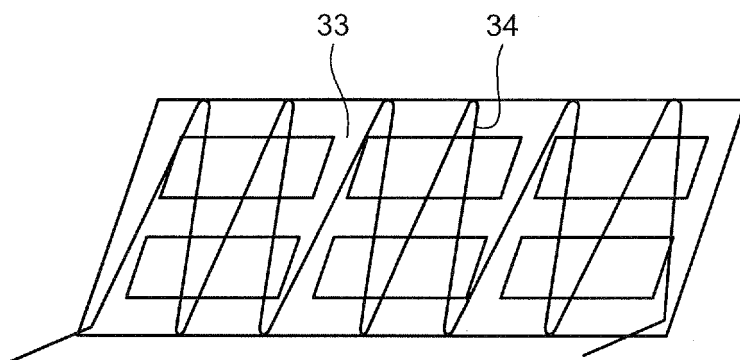


FIG.7

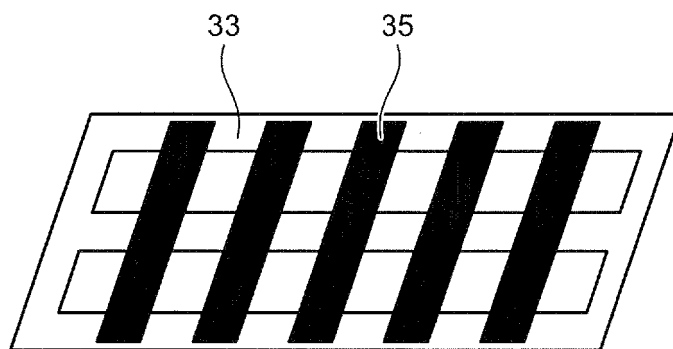
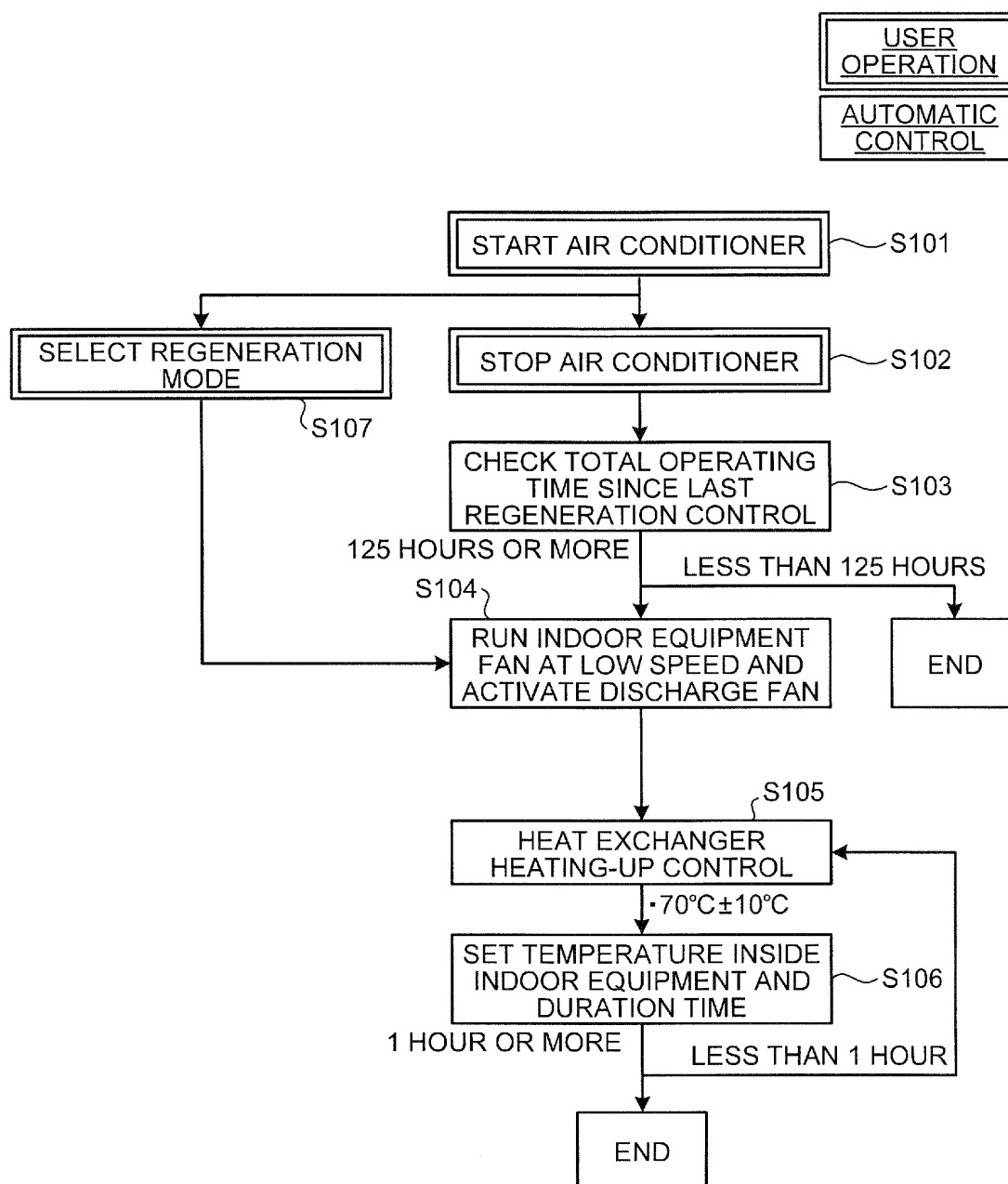


FIG.8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/068538

A. CLASSIFICATION OF SUBJECT MATTER

F24F1/00(2006.01)i, F24F11/02(2006.01)i, F24F11/04(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)

F24F1/00, F24F11/02, F24F11/04

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	1996-2007
Kokai Jitsuyo Shinan Koho	1971-2007	Toroku Jitsuyo Shinan Koho	1994-2007

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2005-265362 A (Matsushita Electric Industrial Co., Ltd.), 29 September, 2005 (29.09.05), Par. Nos. [0015], [0016], [0019] (Family: none)	1, 2, 7 3-6, 8
Y A	JP 7-158877 A (Matsushita Electric Industrial Co., Ltd.), 20 June, 1995 (20.06.95), Par. No. [0028] (Family: none)	1, 2, 7 3-6, 8
Y A	JP 2001-276196 A (Matsushita Electric Industrial Co., Ltd.), 09 October, 2001 (09.10.01), Page 6, left column, lines 15, 16 (Family: none)	1, 2, 7 3-6, 8

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

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Date of the actual completion of the international search
20 December, 2007 (20.12.07)Date of mailing of the international search report
08 January, 2008 (08.01.08)Name and mailing address of the ISA/
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- JP H10290829 B [0004]