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

(11) EP 1 707 892 A1

(12) # EUROPEAN PATENT APPLICATION
published in accordance with Art. 158(3) EPC

(43) Date of publication:
04.10.2006 Bulletin 2006/40

(21) Application number: **04819447.6**

(22) Date of filing: **26.11.2004**

(51) Int Cl.:
F24F 11/02 *(2006.01)*

(86) International application number:
PCT/JP2004/017594

(87) International publication number:
WO 2005/052462 (09.06.2005 Gazette 2005/23)

(84) Designated Contracting States:
IT SE

(30) Priority: **28.11.2003 JP 2003400474**

(71) Applicant: **SHARP KABUSHIKI KAISHA**
Osaka-shi, Osaka 545-8522 (JP)

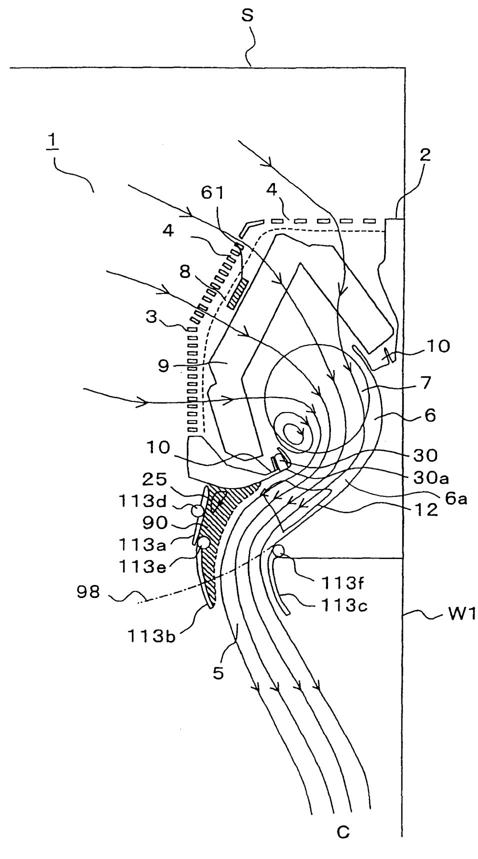
(72) Inventor: **OHTSUKA, Masaki**
Osaka-Shi, Osaka5470026 (JP)

(74) Representative: **Brown, Kenneth Richard et al**
R.G.C. Jenkins & Co.
26 Caxton Street
London SW1H 0RJ (GB)

(54) **AIR CONDITIONER**

(57) An indoor unit (1) of an air conditioner is installed on an upper part of a wall surface (W1), and a suction port (4) and a blowout port (5) are provided in a front part and a lower part, respectively, of the indoor unit (1). The blowout port (5) is fitted with wind deflectors (113a, 113b, and 113c) that can vary the blowout direction between a frontward-horizontal direction and a rearward-downward direction. At the start-up of heating, conditioned air is sent out obliquely downward toward the wall surface (W1). By the Coanda effect, the conditioned air goes down along the wall surface (W1), and then flows over a floor surface (F) to circulate inside the room. When the heating operation has stabilized, the wind deflectors (113b and 113c) are so driven to narrow the air stream path so that the conditioned air is sent out at a lower wind volume.

FIG.1



EP 1 707 892 A1

Description

Technical Field

[0001] The present invention relates to an air conditioner that takes air into a cabinet thereof, then conditions the taken air, and then sends out the conditioned air into a room.

Background Art

[0002] A conventional air conditioner is disclosed, for example, in the Japanese patent application filed as No. 2002-266437. FIG. 28 shows the behavior of air streams in a room as observed when this air conditioner performs heating operation. An indoor unit 1 of the air conditioner is installed on an upper part of a side wall W1. In a lower part of the indoor unit 1, an blowout port (unillustrated) is provided.

[0003] In a start-up state, that is, a state in which heating operation has just been started and thus the room temperature rises quickly, it is necessary to circulate the air inside the room quickly. For this purpose, air is sent out via the blowout port (unillustrated) vigorously, for example at a "high" wind speed (about 5 to 6 m/sec), and substantially straight down, as indicated by arrow B. The air flows inside the room R as indicated by arrows, and returns to a suction port 4 provided in an upper or front part of the indoor unit 1.

[0004] When it is detected that the difference between the temperature of the air taken in via the suction port 4 and the user-specified temperature is small, the volume of wind sent out is gradually lowered until conditioned air is sent out, for example, at a "low" wind speed (about 3 to 4 m/sec). FIG. 29 shows the behavior of air streams inside the room as observed in a stable state, that is, a state in which the room temperature has stabilized within a predetermined range around the user-specified temperature. Conditioned air is sent out via the blowout port at a "low" wind speed and substantially straight down as indicated by arrow B'. The air flows inside the room R, and returns to the suction port 4. When the temperature inside the room R becomes lower than the user-specified temperature, the wind speed is increased again. In this way, the room temperature is kept around the user-specified temperature.

[0005] On the other hand, Patent Publication 1 discloses an air conditioner in which the orientation of a wind direction plate can be varied so that conditioned air can be sent out via an blowout port substantially straight down.
Patent Publication 1: JP-B-3 311 932.

Disclosure of the Invention

Problems to be Solved by the Invention

[0006] FIGS. 30 and 31 show the temperature distribution inside the room as observed when heating operation is performed at a "high" wind speed in a start-up state (FIG. 28) and at a "low" wind speed in a stable state (FIG. 29), respectively. The user-specified temperature, that is, the desired room temperature, is 28 °C, and the room R is six-*tatami*-mat large (2 400 mm high by 3 600 mm wide by 2 400 mm deep). Measurements are taken at a total of 48 spots, that is, six by eight spots at 600 mm intervals in the height and width directions, respectively, on a middle cross section of the room R indicated by dash-and-dot lines D in FIGS. 28 and 29.

[0007] At a "high" wind speed, as shown in FIG. 28, the warm air that the indoor unit 1 sends out straight down to frontward down has a low specific gravity and thus receives a strong buoyant force. Thus, before reaching the floor surface, the direction of the warm air is bent sharply frontward. Hence, the warm air pours directly into the living space. If the warm air continuously pours onto the head of the user, he feels discomfort.

[0008] At a "low" wind speed, as shown in FIG. 29, the conditioned air that the indoor unit 1 sends out straight down not only has a low speed but also a low specific gravity and thus receives a strong buoyant force. Thus, the conditioned air goes up as indicated by arrow B'. Hence, as shown in FIG. 31, only an upper part of the room R is heated, while a part thereof close to the floor surface is not. The user feels cold in a lower part of his body, while warm air directly hits his head. The user thus feels great discomfort.

[0009] FIGS. 28 and 29 also show that part of the conditioned air sent out from the indoor unit 1 goes up as indicated by arrow B" and is immediately taken in by the indoor unit 1 without circulating inside the room R, causing a so-called short circuit. Thus, as shown in FIGS. 30 and 31, the air around the indoor unit 1 is overheated, and the temperature close to the suction port 4 becomes 3 °C or more higher than the user-specified temperature of 28 °C, producing a so-called pool E of warm air. This diminishes air conditioning efficiency.

[0010] If a pool E of warm air is produced by a short circuit while heating operation is being performed at a "high" wind speed (FIG. 28), since the temperature of the air taken in via the suction port 4 is high, it is detected that the user-specified temperature has been reached. Thus, before the entire room R is sufficiently heated, the wind speed is switched to "low". Now, since the pool E of warm air keeps the temperature around the indoor unit 1 high, the wind speed is no longer switched to "high". Thus, the user feels cold in a lower part of his body, while warm air directly hits their head. The user thus continuously feels discomfort.

[0011] An object of the present invention is to provide an air conditioner and an air conditioning method that offer enhanced comfort and enhanced air conditioning efficiency.

Means for Solving the Problem

[0012] To achieve the above object, according to the present invention, an air conditioner that is installed on a wall surface inside a room and that performs heating operation by taking in air via a suction port, then conditioning the taken air, and then sending out the conditioned air via an blowout port in a wind direction that can be varied is characterized in that, based on the operating status of the air conditioner or the air conditioning status inside the room, the wind direction of the conditioned air can be varied between a substantially horizontal direction or a frontward-upward direction and a substantially straight downward direction or a rearward-downward direction.

[0013] With this configuration, when the air conditioner starts heating operation, the air taken in via the suction port is heated, and is then sent out via the blowout port, for example, in a frontward-upward direction. As the operating status of the air conditioner or the air conditioning status inside the room varies, the conditioned air comes to be sent out via the blowout port, for example, in a rearward-downward direction. Examples of the operating status of the air conditioner based on which the wind direction can be varied include: the temperature of the air sent out from the air conditioner; the temperature of the indoor heat exchanger provided in the indoor unit; the wind volume of the air sent out from the air conditioner; the operating frequency of the compressor that operates a refrigeration cycle; the current consumption or power consumption by the air conditioner; and the wind volume of the air taken into the outdoor unit. On the other hand, examples of the air conditioning status inside the room based on which the wind direction can be varied include: the temperature inside the room; the humidity inside the room; the purity of the air inside the room as evaluated based on the presence of odor-producing substances or the amount of dust present; and the ion concentration inside the room.

[0014] According to the present invention, preferably, in the air conditioner configured as described above, based on the operating status of the air conditioner or the air conditioning status inside the room, the wind direction of the conditioned air can be varied also between a substantially straight downward direction and a rearward-downward direction. With this configuration, when heating operation is started, the conditioned air is sent out via the blowout port, for example, in a frontward-upward direction. As the operating status of the air conditioner or the air conditioning status inside the room varies, the conditioned air comes to be sent out via the blowout port, for example, in a rearward-downward direction. As the operating status of the air conditioner or the air conditioning status inside the room further varies, the conditioned air comes to be sent out via the blowout port, for example, in a substantially straight downward direction.

[0015] According to the present invention, preferably, in the air conditioner configured as described above, based on the operating status of the air conditioner or the air conditioning status inside the room, the wind direction of the conditioned air can be varied also between a substantially straight downward direction and a frontward-downward direction. With this configuration, when heating operation is started, the conditioned air is sent out via the blowout port, for example, in a frontward-upward direction. As the operating status of the air conditioner or the air conditioning status inside the room varies, the conditioned air comes to be sent out via the blowout port, for example, in a substantially straight downward direction. As the operating status of the air conditioner or the air conditioning status inside the room further varies, the conditioned air comes to be sent out via the blowout port, for example, in a frontward-downward direction.

[0016] According to the present invention, preferably, in the air conditioner configured as described above, when the room is smaller than a predetermined size, the wind direction can be varied between a substantially horizontal direction or a frontward-upward direction and a substantially straight downward direction or a rearward-downward direction and, when the room is larger than the predetermined size, the wind direction can be varied between a substantially horizontal direction or a frontward-upward direction and a frontward-downward direction.

[0017] With this configuration, when the room is small, the conditioned air is sent out via the blowout port, for example, in a frontward-upward direction. As the operating status of the air conditioner or the air conditioning status inside the room varies, the conditioned air comes to be sent out via the blowout port, for example, in a rearward-downward direction. By contrast, when the room is large, the conditioned air is sent out via the blowout port, for example, in a frontward-upward direction. As the operating status of the air conditioner or the air conditioning status inside the room varies, the conditioned air comes to be sent out via the blowout port, for example, in a frontward-downward direction.

[0018] According to the present invention, preferably, in the air conditioner configured as described above, based on the operating status of the air conditioner or the air conditioning status inside the room, the wind speed of the conditioned air can be varied. With this configuration, when heating operation is started, the conditioned air is sent out via the blowout port, for example, in a frontward-upward direction. As the operating status of the air conditioner or the air conditioning status inside the room varies, the conditioned air comes to be sent out via the blowout port, for example, in a rearward-downward direction. As the operating status of the air conditioner or the air conditioning status inside the room further varies, the conditioned air comes to be sent out via the blowout port, for example, in a rearward-downward direction at a higher wind speed.

[0019] According to the present invention, preferably, in the air conditioner configured as described above, based on the operating status of the air conditioner or the air conditioning status inside the room, the wind volume of the conditioned air can be varied. With this configuration, when heating operation is started, the conditioned air is sent out via the blowout port, for example, in a frontward-upward direction. As the operating status of the air conditioner or the air conditioning status inside the room varies, the conditioned air comes to be sent out via the blowout port, for example, in a rearward-downward direction. As the operating status of the air conditioner or the air conditioning status inside the room further varies, the conditioned air comes to be sent out via the blowout port, for example, in rearward-downward direction at a lower wind volume.

[0020] According to the present invention, preferably, in the air conditioner configured as described above, when the operating status of the air conditioner or the air conditioning status inside the room fulfills a first condition, the wind direction of the conditioned air is set in a substantially horizontal direction or a frontward-upward direction; when the operating status of the air conditioner or the air conditioning status inside the room fulfills a second condition, the wind direction of the conditioned air is set in a substantially straight downward direction or a rearward-downward direction; and when the operating status of the air conditioner or the air conditioning status inside the room fulfills a third condition, the wind direction of the conditioned air is set in a direction more frontward than when the second condition is fulfilled.

[0021] According to the present invention, preferably, in the air conditioner configured as described above, the first condition requires that blowout temperature be lower than a predetermined value; the second condition requires that the blowout temperature be higher than the predetermined value and that the air conditioner be in a start-up state in which room temperature rises; and the third condition requires that the air conditioner be in a stable state in which the room temperature is stable.

[0022] With this configuration, when the blowout temperature is low, the conditioned air is sent out in a substantially horizontal direction or a frontward-upward direction. When the blowout temperature reaches a predetermined temperature that does not make the user feels cold even if exposed directly thereto, and thus a start-up state is reached in which the room temperature rises quickly, the conditioned air comes to be sent out in a substantially straight downward direction or a rearward-downward direction. When the room temperature stabilizes within a predetermined range around the user-specified temperature, and thus a stable state is reached, the conditioned air is sent out in a slightly frontward downward direction.

[0023] According to the present invention, preferably, in the air conditioner configured as described above, inhibiting means is provided that inhibits the conditioned air from being sent out in a rearward-downward direction or a substantially straight downward direction.

Advantages of the Invention

[0024] According to the present invention, based on the operating status of an air conditioner or the air conditioning status inside a room, the wind direction of the conditioned air can be varied. This prevents the user from being continuously hit by warm air, and thus helps alleviate discomfort and instead enhance comfort to the user. In a start-up state in which the room temperature rises, high-temperature air is sent out via the blowout port in a rearward-downward direction so as to quickly perform air conditioning; in a stable state in which the room temperature has stabilized, the wind direction, wind speed, and wind volume are so varied as to achieve enhanced comfort.

[0025] Moreover, according to the present invention, the wind direction can be varied based on the operating status of the air conditioner, such as the temperature of the air sent out via the blowout port, the temperature of the indoor heat exchanger, the operating frequency of the compressor, the current consumption or power consumption by the air conditioner, or the wind volume of the air sucked in via the suction port of the outdoor unit. For example, when the conditioned air is sent out at a high blowout temperature, it is sent out more rearward to reduce the high-temperature air that hits the user. This helps further alleviate discomfort to the user.

[0026] Moreover, according to the present invention, the wind direction can be varied based on the wind volume sent out via the blowout port. For example, when the wind volume is high, the conditioned air is sent out in a rearward-downward direction to achieve efficient heating while alleviating discomfort to the user. By contrast, when the wind volume is low, the conditioned air is sent out in a more frontward direction to make it reach so far as to achieve heating up to all corners of the room.

[0027] Moreover, according to the present invention, the wind direction, wind speed, and wind volume can be varied based on the air conditioning status inside the room, such as the temperature inside the room, the humidity inside the room, the ion concentration inside the room, or the purity of the air inside the room. For example, when the difference between the actual degree of air conditioning inside the room and the user-specified degree of air conditioning is large, the conditioned air is sent out in a more rearward direction to widely agitate the air all over the room in order to quickly achieve a higher degree of air conditioning up to all corners of the room. Thus, it is possible to achieve air conditioning all over the room in a short period. By contrast, when the difference between the actual degree of air conditioning inside the room and the user-specified degree of air conditioning is small, the conditioned air is sent out in a straight downward direction to reduce the part thereof unnecessarily sent out rearward in order to achieve efficient air conditioning.

[0028] Moreover, according to the present invention, inhibiting means is provided that inhibits the conditioned air from being sent out in a rearward-downward direction or a substantially straight downward direction. Thus, even if there is a wall or other obstacle under the indoor unit, it is possible to prevent air sent out downward from bouncing back to be taken in via the suction port, and thereby to minimize short circuiting. Thus, the wind direction can be controlled to suit the actual use condition.

[0029] Moreover, according to the present invention, in a start-up state in which the room temperature quickly rises, the wind direction of the conditioned air is set in a substantially straight downward direction or a rearward-downward direction; in a stable state, the wind direction of the conditioned air is set in a direction more frontward than in the start-up state. Thus, in a stable state, in which the wind volume is low, the conditioned air can be sent out to reach far.

[0030] Moreover, according to the present invention, when the blowout temperature is lower than a predetermined value, the conditioned air is sent out in a substantially horizontal direction or a frontward-upward direction. Thus, it is possible to realize an air conditioner

Brief Description of Drawings

[0031] [FIG. 1] A side sectional view showing a state of the indoor unit of the air conditioner of a first embodiment of the present invention, as observed when it is performing second air stream control.

[FIG. 2] A circuit diagram showing the refrigeration cycle of the air conditioner of the first embodiment of the present invention.

[FIG. 3] A block diagram showing the configuration of the air conditioner of the first embodiment of the present invention.

[FIG. 4] A block diagram show in the configuration of the controller of the air conditioner of the first embodiment of the present invention.

[FIG. 5] A side sectional view showing a state of the indoor unit of the air conditioner of the first embodiment of the present invention, as observed when it is performing first air stream control.

[FIG. 6] A side sectional view showing another state of the indoor unit of the air conditioner of the first embodiment of the present invention, as observed when it is performing the first air stream control.

[FIG. 7] An isobaric diagram showing the static pressure distribution near the blowout port of the indoor unit of the air conditioner of the first embodiment of the present invention, as observed when it is operating in a rearward-downward blowout state.

[FIG. 8] A see-through perspective view showing the behavior of air streams inside a room, as observed when the indoor unit of the air conditioner of the first embodiment of the present invention is operating in a rearward-downward blowout state.

[FIG. 9] A diagram showing the temperature distribution on a middle cross section of the room, as observed when the indoor unit of the air conditioner of the first embodiment of the present invention is operating in a rearward-downward blowout state.

[FIG. 10] A side sectional view showing a state of the indoor unit of the air conditioner of the first embodiment of the present invention, as observed when it is performing third air stream control.

[FIG. 11] A side sectional view showing another state of the indoor unit of the air conditioner of the first embodiment of the present invention, as observed when it is performing the second air stream control.

[FIG. 12] A side sectional view showing still another state of the indoor unit of the air conditioner of the first embodiment of the present invention, as observed when it is performing the second air stream control.

[FIG. 13] A side sectional view showing another state of the indoor unit of the air conditioner of a thirteenth embodiment of the present invention, as observed when it is performing the third air stream control.

[FIG. 14] A side sectional view showing still another state of the indoor unit of the air conditioner of the first embodiment of the present invention, as observed when it is performing the second air stream control.

[FIG. 15] A side sectional view showing still another state of the indoor unit of the air conditioner of the first embodiment of the present invention, as observed when it is performing the third air stream control.

[FIG. 16] A side sectional view showing a state of the indoor unit of the air conditioner of a second embodiment of the present invention, as observed when it is performing second air stream control.

[FIG. 17] A side sectional view showing a state of the indoor unit of the air conditioner of the second embodiment of the present invention, as observed when it is performing first air stream control.

[FIG. 18] A side sectional view showing another state of the indoor unit of the air conditioner of the second embodiment of the present invention, as observed when it is performing the first air stream control.

[FIG. 19] A side sectional view showing a state of the indoor unit of the air conditioner of the second embodiment of the present invention, as observed when it is performing third air stream control.

[FIG. 20] A side sectional view showing another state of the indoor unit of the air conditioner of the second embodiment of the present invention, as observed when it is performing the second air stream control.

[FIG. 21] A side sectional view showing another state of the indoor unit of the air conditioner of the second embodiment of the present invention, as observed when it is performing the third air stream control.

[FIG. 22] A side sectional view showing a state of the indoor unit of the air conditioner of a third embodiment of the present invention, as observed when it is performing second air stream control.

[FIG. 23] A side sectional view showing a state of the indoor unit of the air conditioner of the third embodiment of the present invention, as observed when it is performing first air stream control.

[FIG. 24] A side sectional view showing another state of the indoor unit of the air conditioner of the third embodiment of the present invention, as observed when it is performing the first air stream control.

[FIG. 25] A side sectional view showing a state of the indoor unit of the air conditioner of the third embodiment of the present invention, as observed when it is performing third air stream control.

[FIG. 26] A side sectional view showing another state of the indoor unit of the air conditioner of the third embodiment of the present invention, as observed when it is performing the third air stream control.

[FIG. 27] A see-through perspective view showing the behavior of air streams inside a room, as observed when the indoor unit of the air conditioner of the third embodiment of the present invention is operating in a rearward-downward blowout state.

[FIG. 28] A perspective view showing the air streams produced in a room when a conventional air conditioner is operated at a "high" wind volume.

[FIG. 29] A perspective view showing the air streams produced in a room when a conventional air conditioner is operated at a "low" wind volume.

[FIG. 30] A diagram showing the temperature distribution on a middle cross section of a room, as produced when a conventional air conditioner is operated at a "high" wind volume.

[FIG. 31] A diagram showing the temperature distribution on a middle cross section of a room, as produced when another conventional air conditioner is operated at a "low" wind volume.

List of Reference Symbols

[0032]

1	indoor unit
2	cabinet
3	front panel
4	suction port
5	blowout port
6	blowing passage
7	blowing fan
8	air filter
9	indoor heat exchanger
10	drain pan
12	vertical louver
25	eddy
60	controller
61	temperature sensor
62	compressor
63	four-way valve
64	outdoor heat exchanger
65	blowing fan
66	stopping mechanism
67	refrigerant piping
68	refrigerating cycle
71	CPU
72	input circuit
73	output circuit
74	memory
90	high static pressure part
98	imaginary surface

113a, 113b, 113c, 114a, 114b, 115a, 115b, wind deflectors

Best Mode for Carrying Out the Invention

[0033] Hereinafter, embodiments of the present invention will be described with reference to the accompanying drawings. For the sake of convenience, in the embodiments described below, such parts as are found also in the conventional example shown in FIGS. 28 and 29 described earlier are identified with common reference numerals.

<First Embodiment>

[0034] FIG. 1 is a side sectional view showing the air conditioner of a first embodiment of the present invention (taken along plane D shown in FIG. 8, which will be described later). The indoor unit 1 of the air conditioner has a main unit thereof held in a cabinet 2. The cabinet 2 is removably fitted with a front panel 3 that has a suction port 4 provided in a top face and a front face thereof.

[0035] The cabinet 2 has claws (unillustrated) provided on a rear face thereof, and is supported by those claws being engaged with a mount plate (unillustrated) fitted on a side wall W 1 inside a room. In a gap between a bottom end part of the front panel 3 and a bottom end part of the cabinet 2, a blowout port 5 is provided. The blowout port 5 is formed in a substantially rectangular shape extending in the width direction of the indoor unit 1, and is so provided as to face frontward and downward.

[0036] Inside the indoor unit 1, a blowing passage 6 is formed that leads from the suction port 4 to the blowout port 5. In the blowing passage 6, a blowing fan 7 is arranged that sends air. Used as the blowing fan 7 is, for example, a cross-flow fan. The blowing passage 6 has a front guide 6a that guides frontward-downward the air sent from the blowing fan 7. The front guide 6a is provided with a vertical louver 12 that permits the blowout angle to be varied in the left/right direction.

[0037] The blowout port 5 is provided with wind deflectors 113a, 113b, and 113c that are rotatably supported. The wind deflector 113c is formed as an extension of the lower wall of the front guide 6a, and is supported on the cabinet 2 by a rotary shaft 113f that rotates when driven by a drive motor (unillustrated). The wind deflector 113a is arranged in an upper part of the blowout port 5, and is rotatably supported by a rotary shaft 113d that rotates when driven by a drive motor (unillustrated).

[0038] The wind deflector 113b is arranged in a lower part of the blowout port 5, and is rotatably supported by a rotary shaft 113e that rotates when driven by a drive motor (unillustrated). The wind deflectors 113a and 113b rotate independently by being driven by their respective drive motors, and thereby change their orientations to vary the wind direction.

[0039] The wind deflectors 113b and 113c each have a curved cross-sectional shape so as to have a convex curved surface on one side and a concave curved surface on the other. The wind deflector 113a has one side thereof (the left side in the figure) formed into a substantially flat surface, has the other side thereof (the right side in the figure) formed into a gently convex surface, and is pivoted in a middle part thereof by the rotary shaft 113d. As will be described in detail later, the arrangement shown in the figure is one in which the conditioned air is sent out via the blowout port 5 in a rearward-downward direction.

[0040] In a position facing the front panel 3, an air filter 8 is provided that collects and removes dust contained in the air sucked in via the suction port 4. In the blowing passage 6, between the blowing fan 7 and the air filter 8, an indoor heat exchanger 9 is arranged. The indoor heat exchanger 9 is connected to a compressor 62 (see FIG. 2) that is arranged outdoor, and, when the compressor 62 is driven, a refrigeration cycle is operated.

[0041] When the refrigeration cycle is operated, during cooling operation, the indoor heat exchanger 9 is cooled to a temperature lower than the ambient temperature, and, during heating operation, the indoor heat exchanger 9 is heated to a temperature higher than the ambient temperature. Between the indoor heat exchanger 9 and the air filter 8, a temperature sensor 61 is provided that detects the temperature of the air sucked in. In a side part of the indoor unit 1, a controller 60 (see FIG. 3) is provided that controls the driving of the air conditioner. Below a front part and a rear part of the indoor heat exchanger 9, drain pans 10 are provided that collect condensed moisture that drips from the indoor heat exchanger 9 when cooling or drying operation is performed.

[0042] In a front-side drain pan 10, an ion generator 30 is arranged with a discharge surface 30a facing the blowing passage 6. The ions generated from the surface 30a of the ion generator 30 are released into the blowing passage 6, and are then blown out via the blowout port 5 into the room. The ion generator 30 has a discharge electrode, and generates, through corona discharge, positive ions consisting mainly of $H^+(H_2O)_n$ when the applied voltage is positive and negative ions consisting mainly of $O_2^-(H_2O)_m$ when the applied voltage is negative (where n and m are integers).

[0043] $H^+(H_2O)_n$ and $O_2^-(H_2O)_m$ flock on the surface of microorganisms, and surround airborne germs such as microorganisms present in air. They then collide to produce, on the surface of the airborne germs, active species, namely [•OH] (hydroxy radical) and H_2O_2 (hydrogen peroxide) as expressed by formulae (1) to (3) below (where n' and m' are integers). This destroys the airborne germs and achieves sterilization.

[0044]

$$H^+(H_2O)_n + O_2^-(H_2O)_m \rightarrow [\bullet OH] + 1/2\ O_2 + (n+m)H_2O \quad (1)$$

$$H^+(H_2O)_n + H^+(H_2O)_{n'} + O_2^-(H_2O)_m + O_2^-(H_2O)_{m'} \rightarrow 2\bullet OH + O_2 + (n+n'+m+m')H_2O \quad (2)$$

$$H^+(H_2O)_n + H^+(H_2O)_{n'} + O_2^-(H_2O)_m + O_2^-(H_2O)_{m'} \rightarrow H_2O_2 + O_2 + (n+n'+m+m')H_2O \quad (3)$$

[0045] According to the purpose of its use, the ion generator 30 can be operated in one of the following modes: a mode in which it generates more negative ions than positive ions; a mode in which it generates more positive ions than negative ions; and a mode in which it generates positive and negative ions in approximately equal proportions.

[0046] FIG. 2 is a circuit diagram showing the refrigeration cycle of the air conditioner. The outdoor unit (unillustrated), which is connected to the indoor unit 1 of the air conditioner, is provided with a compressor 62, a four-way valve 63, an outdoor heat exchanger 64, a blowing fan 65, and a stopping mechanism 66. One end of the compressor 62 is connected, through refrigerant piping 67, via the four-way valve 63 to the outdoor heat exchanger 64. The other end of the compressor 62 is connected, through the refrigerant piping 67, via the four-way valve 63 to the indoor heat exchanger 9. The outdoor heat exchanger 64 and the indoor heat exchanger 9 are connected together, through the refrigerant piping 67, via the stopping mechanism 66.

[0047] When cooling operation is started, the compressor 62 is driven and the blowing fan 7 is rotated. Thus, a refrigeration cycle 68 is formed in which the refrigerant flows from the compressor 62 to the four-way valve 63, to the outdoor heat exchanger 64, to the stopping mechanism 66, to the indoor heat exchanger 9, to the four-way valve 63, and back to the compressor 62.

[0048] As the refrigeration cycle 68 is operated, during cooling operation, the indoor heat exchanger 9 is cooled to a temperature lower than the ambient temperature. For heating operation, the four-way valve 63 is so switched as to rotate the blowing fan 65, so that the refrigerant flows in the direction reverse to the above-described direction. Specifically, a refrigeration cycle 68 is formed in which the refrigerant flows from the compressor 62 to the four-way valve 63, to the indoor heat exchanger 9, to the stopping mechanism 66, to the outdoor heat exchanger 64, to the four-way valve 63, and back to the compressor 62. Thus, the indoor heat exchanger 9 is heated to a temperature higher than the ambient temperature.

[0049] FIG. 3 is a block diagram showing the configuration of the air conditioner. The controller 60 comprises a microcomputer. Based on the operation by the user and the input from the temperature sensor 61, which detects the temperature of the air sucked in, the controller 60 controls the driving of the blowing fan 7, the compressor 62, the blowing fan 65, the vertical louver 12, the wind deflectors 113a, 113b, and 113c, and the ion generator 30.

[0050] FIG. 4 is a block diagram showing the detailed configuration of the controller 60. The controller 60 includes a CPU 71 that performs various kinds of calculation, and the CPU 71 is connected to an input circuit 72 that receives input signals and an output circuit 73 that outputs the calculation results of the CPU 71. Moreover, a memory 74 is provided in which the programs executed by the CPU 71 are stored and in which the calculation results are temporarily stored.

[0051] The output of the temperature sensor 61 is fed to the input circuit 72. The output circuit 73 is connected to the drive motors (unillustrated) that drive the rotary shafts 113d, 113e, and 113f(see FIG. 1) of the wind deflectors 113a, 113b, and 113c.

[0052] Moreover, the output of a photodetector (unillustrated) that receives operation signals from a remote control (unillustrated) is fed to the controller 60. Through predetermined operation of the remote control, irrespective of the result of detection by the temperature sensor 61, the wind deflectors 113a, 113b, and 113c can be driven. That is, the control by the controller 60 based on the temperature sensor 61 can be disabled so that the wind deflectors 113a, 113b, and 113c can be arranged at the desired orientations.

[0053] In the air conditioner configured as described above, when heating operation is started, the refrigeration cycle is operated, and the blowing fan 65 of the outdoor unit (unillustrated) is driven to rotate. Now, outdoor air is sucked into the outdoor unit (unillustrated). The refrigerant, which has absorbed heat through the outdoor heat exchanger 64, flows to the indoor heat exchanger 9 and heats it.

[0054] When a predetermined period has elapsed after the start of heating operation, or the indoor heat exchanger 9 has been heated to a predetermined temperature, the controller 60 drives the blowing fan 7 to rotate so that first air stream control is performed. Now, air is sucked into the indoor unit 1 via the suction port 4, and the dust contained in the air is removed by the air filter 8. The air sucked into the indoor unit 1 exchanges heat with the indoor heat exchanger 9 and is thereby heated, and is then sent out into the room while the right/left and up/down directions of the air is restricted by the vertical louver 12 and the wind deflectors 113a, 113b, and 113c.

[0055] In the first air stream control, the wind deflectors 113a, 113b, and 113c are arranged as shown in FIG. 5 or 6, and the conditioned air is sent out in a frontward-upward direction or a substantially horizontal direction, for example, at a wind speed of about 3 to 4 m/sec. Specifically, as shown in FIG. 5, the wind deflector 113a is so arranged that the flat-surface side thereof faces rearward-upward along the air stream flowing through the front guide 6a. The wind deflector 113b is arranged with the convex-surface side thereof down so as to be parallel to the air stream flowing through the front guide 6a and to divide the air stream into two parts. The wind deflector 113c is retracted from the air stream sent out via the blowout port 5, and is arranged under the cabinet 2.

[0056] Thus, the conditioned air that flows through the front guide 6a is bent so as to be sent out via the blowout port 5 in a frontward-upward direction as indicated by arrow E. On the other hand, when the wind deflector 113a is arranged at a horizontal orientation as shown in FIG. 6, the conditioned air is sent out via the blowout port 5 in a substantially horizontal direction as indicated by arrow D.

[0057] The conditioned air sent out via the blowout port 5 in a frontward-upward direction or a substantially horizontal direction reaches the ceiling of the room. Thereafter, by the Coanda effect, the air flows along the ceiling wall S, then along the wall surface W2 (see FIG. 8) opposite to the indoor unit 1, then along the floor surface F (see FIG. 8), and then along the side wall W 1 on which the indoor unit 1 is installed. Thus, with the first air stream control, at the start-up of heating operation, the user is not hit by insufficiently heated conditioned air, and is thereby prevented from feeling cold.

[0058] When another predetermined period has elapsed after the start of heating operation, or when the indoor heat exchanger 9 has been sufficiently heated, the controller 60 performs second air stream control. In the second air stream control, the wind deflectors 113a, 113b, and 113c are arranged as shown in FIG. 1 described previously. Thus, the conditioned air is sent out via the blowout port 5 in a rearward-downward direction, for example, at a wind speed of about 6 to 7 m/sec.

[0059] Specifically, the wind deflector 113a is driven by the drive motor so that the flat-surface side thereof faces frontward, and is so arranged that an end part thereof makes contact with the upper wall of the blowing passage 6 as if extending it. Another end part of the wind deflector 113a is arranged to point downward and makes contact with the rotary shaft 113e. The wind deflector 113b is arranged with the tip end thereof pointing rearward-downward so as to be concave to the blowing passage 6. The wind deflector 113c is arranged with the tip end thereof pointing rearward-downward so as to be convex to the blowing passage 6.

[0060] Thus, the air stream flowing through the front guide 6a is stopped by the wind deflectors 113a and 113b from flowing further frontward, and is instead so bent as to flow rearward-downward. FIG. 7 shows the static pressure distribution in the blowing passage 6 at this time. On the inner side of the wind deflectors 113a and 113b, in contact therewith, a high static pressure part 90 is formed where the static pressure is higher than at the front guide 6a.

[0061] Based on the result of detection by a static pressure sensor (unillustrated) that detects the static pressure in the blowing passage 6, the orientations of the wind deflectors 113a, 113b, and 113c are adjusted so that the isobaric line 90a of the high static pressure part 90 is formed along the air stream flowing along the wind deflectors 113a and 113b. Specifically, the isobaric line 90a of the high static pressure part 90 is formed substantially parallel to the line connecting the terminal end of the front guide 6a and the terminal end of the wind deflector 113b, so that, near the high static pressure part 90, the air stream is substantially parallel to the isobaric line 90a.

[0062] Thus, in terms of fluid mechanics, the high static pressure part 90 acts as a wall surface, and helps the wind deflectors 113a, 113b, and 113c to smoothly change the direction in which the conditioned air is sent out and thereby bend the air stream. Here, the isobaric line 90a of the high static pressure part 90 in contact with the wind deflectors 113a and 113b does not cross the flow line of the main stream of the air stream that flows, while being bent, through the blowing passage 6. This helps greatly reduce the pressure loss in the air stream.

[0063] As a result, despite a great change in the wind direction, the conditioned air can be sent out in a rearward-downward direction at a high wind volume. Meanwhile, in the high static pressure part 90, a low-speed, low-energy air stream branched off from the main stream flows along the wind deflectors 113a and 113b. This has little influence on the pressure loss.

[0064] It is possible to vary, by the use of the static pressure sensor, the orientations of the wind deflectors 113a, 113b, and 113c so that the static pressure near the wind deflectors 113a and 113b is at a predetermined value and then store the orientations of the wind deflectors 113a, 113b, and 113c in a database. This makes it possible to retrieve data suitable for particular operating conditions from the database to arrange the wind deflectors 113a, 113b, and 113c at predetermined orientations. This helps omit the static pressure sensor.

[0065] The main stream of the conditioned air that flows along the wind deflectors 113a, 113b, and 113c flows through the space surrounded by the high static pressure part 90 and the lower wall surface. That is, the high static pressure part 90 forms a wall surface of the stream passage. Thus, the air stream does not make contact with the wind deflectors 113a and 113b. This helps reduce the loss due to viscosity, and thus helps further increase the wind volume.

[0066] Moreover, the high static pressure part 90 forms the wall surface of the stream passage, and the high static pressure part 90 narrows the stream passage of the conditioned air into a nozzle-like shape, making the stream passage area smaller than in the front guide 6a. Thus, the nozzle acts to send out high-energy fluid via the blowout port 5. As a result, the wind speed of the air stream adjacent to the high static pressure part 90 does not change greatly; in this way, the change in the static pressure of the air stream is reduced to ensure a smooth flow of the air stream and to further reduce the pressure loss. This helps further increase the wind volume of the conditioned air sent out from the air conditioner.

[0067] Moreover, the stream passage area, which has thus been once narrowed by the high static pressure part 90, is then widened back on the downstream side of the wind deflectors 113a, 113b, and 113c. Thus, the cross-sectional area of the stream passage first decreases as one goes downstream to form a least-cross-sectional-area part (hereinafter referred to as the "throat part"). The stream passage, which then widens back, forms a so-called diffuser. This helps the blowing fan 7 to increase the static pressure, and thus helps further increase the wind volume. Moreover, as shown in FIG. 7, in the throat part of the stream passage, no high static pressure part 90 is formed, and thus no pressure loss occurs. Thus, by bending the stream passage there, it is possible to form a bent part free from pressure loss.

[0068] Incidentally, since the seam between the upper wall of the front guide 6a and the wind deflector 113a does not form a smoothly curved surface, an eddy 25 is produced in the high static pressure part 90, and this slightly lowers the blowing efficiency. Even then, it is possible to reduce the increase in the pressure loss and thereby enhance the blowing efficiency.

[0069] Furthermore, the wind deflector 113b is so arranged as to cross an imaginary surface 98 that extends the lower wall of the front guide 6a further outward from the blowout port 5. Thus, the lower end of the wind deflector 113a is located below the imaginary surface 98, and ensures that the air stream is directed rearward-downward. This prevents the air stream from being sent out in an unintended direction, and thus helps realize a highly reliable air conditioner.

[0070] FIG. 8 shows the behavior of air streams inside the room R as observed in a rearward-downward blowout state. The conditioned air goes down along the side wall W1, then flows along the floor surface F, then along the wall surface W2 opposite to the side wall W1, and then along the ceiling wall S as indicated by arrow C, and then returns to the suction port 4. This prevents the warm air sent out from rebounding, thus prevents a lowering of heating efficiency due to a short circuit, and thus helps sufficiently warm a lower part of the room R and thereby enhance comfort. Thus, in a start-up state, the room temperature inside the room R quickly rises.

[0071] Incidentally, in the first air stream control, the air sent out from the indoor unit 1 is set at a temperature so low that, when it directly hits the user, he feels cold. Thus, in the first air stream control, the room temperature does rise, but it does so slowly. In a start-up state, the air sent out from the indoor unit 1 reaches a temperature that does not cause the user to feel cold even if directly hit thereby, and the room temperature quickly rises from a temperature lower than the user-specified temperature.

[0072] FIG. 9 shows the temperature distribution inside the room when the second air stream control is performed. The user-specified temperature is 28 °C, and the room R is six-*tatami*- mat large (2 400 mm high by 3 600 mm wide by 2 400 mm deep). As with FIGS. 30 and 31 described earlier, measurements are taken at a total of 48 spots, that is, six by eight spots at 600 mm intervals in the height and width directions, respectively, on a middle cross section of the room R indicated by dash-and-dot lines D.

[0073] As shown in the figure, high-temperature conditioned air, flowing along the floor surface F, reaches a lower part of the user's body. Thus, the temperature in a central part of the floor surface of the room R is 33 °C to 35 °C, whereas, in the conventional example shown in FIGS. 30 and 31 described earlier, the temperature at the same position is 31 °C to 32°C (FIG. 30) and about 23 °C (FIG. 31). Thus, it is possible to raise the temperature around a lower part of the user's body, thereby alleviate discomfort to the user, and thereby greatly enhance comfort.

[0074] Moreover, by the Coanda effect, the conditioned air sent out from the indoor unit 1 flows along the wall surface, thus does not rebound, and thus does not produce a short circuit. Thus, no pool E of warm air (see FIG. 30) is produced as will be produced when the air around the indoor unit 1 is overheated. Thus, the temperature near the suction port 4 is about the same as the user-specified temperature of 28 °C. In this way, it is possible to achieve enhanced air conditioning efficiency, and to make it easy to check whether or not the temperature inside the room has been sufficiently raised.

[0075] Next, when another predetermined period has elapsed after the start of the second air stream control, or when the temperature sensor 61 detects that the difference between the temperature of the air sucked in via the suction port 4 and the user-specified temperature has become small, the controller 60 performs third air stream control. In the third air stream control, the operating frequency of the compressor 62 is lowered, and the wind deflectors 113a, 113b, and 113c are arranged as shown in FIG. 10 so that the conditioned air is sent out in a rearward-downward direction as indicated by arrow C', for example, at a wind speed of about 6 to 7 m/sec.

[0076] Specifically, the wind deflector 113c is rotated in the direction indicated by arrow K in FIG. 10 to narrow the area of the blowout port 5, and the rotation rate of the blowing fan 7 is so adjusted as to maintain the wind speed. Thus, while the same wind speed as in the second air stream control is maintained, the wind volume is gradually lowered to about 70%. Here, even though the wind volume is lowered, by the Coanda effect, the conditioned air (warm air) sent out from the indoor unit 1 in a rearward-downward direction does not rebound but continues to go down along the side wall W1. Thus, the conditioned air does not directly pour into the living space, but flows along the floor surface F to reach a lower part of the user's body.

[0077] Thus, the user does not feel discomfort due to the wind directly hitting him. Moreover, even through the wind volume is lowered, the wind speed is maintained. Thus, the warm air reaches all corners of the room R such as the boundary region between the wall surface W2 and the floor surface F. Thus, the room temperature inside the room R stabilizes within a predetermined range around the user-specified temperature, establishing a stable state.

[0078] In the third air stream control, if the wind speed is lowered when the wind volume is lowered, the warm air may not reach all corners of the room R such as the boundary region between the cabinet wall surface W2 and the floor surface F. It is therefore preferable that the wind speed be maintained.

[0079] While the third air stream control is being performed, if a window of the room R is opened, or heating operation is temporarily suspended for the defrosting of the outdoor unit, or otherwise the room temperature inside the room R becomes lower than the user-specified temperature, the air conditioner shifts into a start-up state to perform the second air stream control. Thereafter, when a predetermined period has elapsed, or it is detected that the difference between the room temperature and the user-specified temperature has become small, the third air stream control is performed. This is reported to achieve heating operation.

[0080] Some users want to be exposed directly to warm air immediately after the start of heating operation or before the room temperature inside the room R reaches the desired temperature. On the other hand, once the room temperature inside the room R has reached the desired temperature, some users want to keep the room temperature at the desired temperature without feeling the discomfort of being exposed directly to warm air.

[0081] In these cases, it is advisable first to send out the conditioned air in a frontward-downward direction as in the conventional example shown in FIG. 28 described earlier, and then to send it out in a rearward-downward direction as shown in FIGS. 1 and 10. That is, in a start-up state, the conditioned air is sent out in a frontward-downward direction as shown in FIG. 28. This permits the user to be exposed directly to warm air. Then, in a stable state, the conditioned air is sent out in a rearward-downward direction. This permits the user to keep the room temperature at the desired temperature without being exposed directly to warm air. This helps greatly enhance user convenience.

[0082] Moreover, by operating the remote control (unillustrated), the user can vary the orientations of the vertical louver 12 and the wind deflectors 113a, 113b, and 113c. This permits the user to freely select the wind direction of the conditioned air.

[0083] In the second air stream control, instead of the arrangement shown in FIG. 1 described previously, the arrangement shown in FIG. 11 may be adopted where the flat-surface side of the wind deflector 113a is arranged to face the blowing passage 6. This permits the wind deflectors 113a and 113b to be arranged along the front panel 3, and thus helps improve the appearance of the indoor unit 1. In this case, the high static pressure part 90 is formed by being surrounded by the frontward-upward inclined upper wall of the blowing passage 6 and the wind deflectors 113a and 113b, and thus a large eddy 25 develops in the high static pressure part 90.

[0084] Thus, here, compared with the arrangement shown in FIG. 1, the blowing efficiency is slightly lower, but it is still possible to reduce the increase in the pressure loss compared with that conventionally experienced. Likewise, in the third air stream control, instead of adopting the arrangement shown in FIG. 10 described previously, the wind deflector 113a may be arranged along the front panel 3.

[0085] Moreover, in the second and third air stream control, in a case where the room R in which the indoor unit 1 is installed is large, the controller 60 performs different control. Control is switched by operation of a selector switch or the like provided on the indoor unit 1 or on the remote control.

[0086] In a case where the room R is large and thus the distance from the side wall W1, on which the indoor unit 1 is installed, to the wall surface W2 opposite to the side wall W1 is comparatively long, when the conditioned air is sent out via the blowout port 5 in a rearward-downward direction, warm air may not reach all corners of the room R such as the boundary region between the wall surface W2 and the floor surface F. To avoid this, in the second air stream control in a start-up state, the wind deflectors 113a, 113b, and 113c are arranged as shown in FIG. 12.

[0087] Specifically, the wind deflectors 113b and 113c are arranged more frontward than in the arrangement shown in FIG. 1 described previously. The conditioned air is sent out via the blowout port 5 in a substantially straight downward direction as indicated by arrow B, for example, at a wind speed of about 7 to 8 m/sec.

[0088] In a stable state, in the third air stream control, the wind deflectors 113a, 113b, and 113c are arranged as shown in FIG. 13. Specifically, the wind deflector 113c is rotated in the direction indicated by arrow K from the arrangement shown in FIG. 12 to narrow the area of the blowout port 5, and the rotation rate of the blowing fan 7 is adjusted accordingly. This lowers the wind volume to, for example, about 70% of the wind volume in the second air stream control, and the conditioned air is sent out via the blowout port 5 in a substantially straight downward direction as indicated by arrow B' at a wind speed of 7 to 8 m/sec. Thus, even in a case where the room R is large, warm air reaches all corners of the room R.

[0089] In the second and third air stream control, the wind deflectors 113a, 113b, and 113c may be arranged as shown in FIGS. 14 and 15, respectively. Specifically, in the second air stream control in a start-up state, as shown in FIG. 14, the lower ends of the wind deflectors 113a, 113b, and 113c are arranged more frontward than in FIG. 12. The conditioned air is sent out via the blowout port 5 in a direction more frontward than straight downward, that is, in a frontward-downward direction as indicated by arrow A2, for example, at a wind speed of about 6 to 7 m/sec.

[0090] In the third air stream control in a stable state, as shown in FIG. 15, from the arrangement shown in FIG. 14, the wind deflector 113a is rotated in the direction indicated by arrow J and the wind deflector 113c is rotated in the direction indicated by arrow K to narrow the area of the blowout port 5, and the rotation rate of the blowing fan 7 is adjusted accordingly. This lowers the wind volume to, for example, about 70% of the wind volume in the second air stream control, and the conditioned air is sent out via the blowout port 5 in a frontward-downward direction as indicated by arrow A2' at a wind speed of 7 to 8 m/sec. Thus, even in a case where the room R is large, warm air reaches all corners of the room R.

[0091] In the second and third air stream control, the wind speed may be increased by arranging the wind deflectors 113a, 113b, and 113c as shown in FIGS. 1 and 10, respectively, described previously. Specifically, in a start-up state the wind deflectors 113a, 113b, and 113c are arranged as shown in FIG. 1, and the conditioned air is sent out via the blowout port 5 in a rearward-downward direction as indicated by arrow C, for example, at a wind speed of about 9 to 10 m/sec.

[0092] In a stable state, the wind deflectors 113a, 113b, and 113c are arranged as shown in FIG. 10, and the conditioned air is sent out via the blowout port 5 in a direction indicated by arrow C, for example, at a wind speed of about 9 to 10 m/sec. Thus, even in a case where the room R is large, warm air reaches all corners of the room R. In this way, in a case where the room R is large, either by setting the wind direction more frontward or by increasing the wind speed, it is possible to obtain the same effects as in a case where the room R is small.

<Second Embodiment>

[0093] FIG. 16 is a side sectional view showing the indoor unit 1 of the air conditioner of a second embodiment of the present invention. Such parts as find their counterparts in the first embodiment shown in FIGS. 1 to 15 are identified with common reference numerals and symbols. In this embodiments, instead of the wind deflectors 113a, 113b, and 113c provided in the first embodiment, wind deflectors 114a and 114b are provided.

[0094] The wind deflectors 114a and 114b are arranged in the blowout port 5, and are each formed as a flat plate having flat surfaces on both sides. The wind deflectors 114a and 114b are rotatably supported by rotary shafts 114c and 114d, which rotate by being driven by drive motors (unillustrated). Thus, the wind deflectors 114a and 114b are built as wind direction plates that, when driven by the drive motors, change their orientations to vary the wind direction. The rotary shaft 114c is provided in a substantially middle part of the wind deflector 114a, and the rotary shaft 114d is provided in an end part of the wind deflector 114b. The arrangement shown in the figure is one in which the conditioned air is sent out in a rearward-downward direction.

[0095] In the air conditioner configured as described above, when heating operation is started, the refrigeration cycle is operated, and the blowing fan 65 of the outdoor unit (unillustrated) is driven to rotate. Now, outdoor air is sucked into the outdoor unit (unillustrated). The refrigerant, which has absorbed heat through the outdoor heat exchanger 64, flows to the indoor heat exchanger 9 and heats it.

[0096] When a predetermined period has elapsed after the start of heating operation, or the indoor heat exchanger 9 has been heated to a predetermined temperature, the controller 60 drives the blowing fan 7 to rotate so that first air stream control is performed. Now, air is sucked into the indoor unit 1 via the suction port 4, and the dust contained in the air is removed by the air filter 8. The air sucked into the indoor unit 1 exchanges heat with the indoor heat exchanger 9 and is thereby heated, and is then sent out into the room while the right/left and up/down directions of the air is restricted by the vertical louver 12 and the wind deflectors wind deflectors 114a and 114b.

[0097] In the first air stream control, the wind deflectors 114a and 114b are arranged as shown in FIG. 17 or 18, and the conditioned air is sent out in a frontward-upward direction or a substantially horizontal direction at a wind speed of about 3 to 4 m/sec. Specifically, as shown in FIG. 17, the wind deflector 114a is arranged with the front end thereof located above the rear end thereof so as to be substantially parallel to the upper wall of the blowing passage 6, which is inclined upward near the blowout port 5. The wind deflector 114b is arrange with a shaft-side end part thereof is located more frontward-downward than a free-side end part thereof.

[0098] Thus, the conditioned air that flows through the front guide 6a is bent and sent out via the blowout port 5 in a frontward-upward direction as indicated by arrow E. When the wind deflector 114a is set at a horizontal orientation as shown in FIG. 18, the conditioned air is sent out via the blowout port 5 in a substantially horizontal direction as indicated by arrow D.

[0099] The conditioned air sent out via the blowout port 5 in a frontward-upward direction or a substantially horizontal direction reaches the ceiling of the room. Thereafter, by the Coanda effect, the conditioned air flows along the ceiling surface, then along the wall surface W2 (see FIG. 8) opposite to the indoor unit 1, then along the floor surface F (see FIG. 8), and then along the side wall W 1 on which the indoor unit 1 is installed. Thus, with the first air stream control, at the start-up of heating operation, the user is not hit by insufficiently heated conditioned air, and is thereby prevented from feeling cold.

[0100] When another predetermined period has elapsed after the start of heating operation, or when the indoor heat exchanger 9 has been sufficiently heated, the controller 60 performs second air stream control. In the second air stream control, the wind deflectors 114a and 114b are arranged as shown in FIG. 16 described previously. Thus, the conditioned air is sent out via the blowout port 5 in a rearward-downward direction, for example, at a wind speed of about 6 to 7 m/sec.

[0101] Specifically, the wind deflector 114a is driven by the drive motor so as to be arranged with one end thereof located close to the upper wall of the blowing passage 6 so as to extend the upper wall downward. Another end part of the wind deflector 114a is arranged close to the rotary shaft 114d so as to point downward. The wind deflector 114b is arranged with the tip end thereof pointing rearward-downward.

[0102] Thus, the air stream flowing along the front guide 6a is stopped by the wind deflectors 114a and 114b from flowing further frontward, and thus a high static pressure part 90 is formed adjacent to the wind deflectors 114a and 114b. As in the first embodiment, the isobaric line 90a (see fig 7) of the high static pressure part 90 is formed along the flow direction of the conditioned air facing the wind deflectors 114a and 114b. Thus, in terms of fluid mechanics, the high static pressure part 90 acts as a wall surface, and helps smoothly change the direction in which the conditioned air is sent out so that it is sent out via the blowout port 5 in a rearward-downward direction.

[0103] Thus, as in the first embodiment, in a start-up state, it is possible to raise the temperature around a lower part of the user's body, thereby alleviate discomfort to the user, and thereby greatly enhance comfort. Moreover, it is also possible to achieve enhanced air conditioning efficiency, and to make it easy to check whether or not the temperature inside the room has been sufficiently raised.

[0104] Moreover, the high static pressure part 90 narrows the stream passage, which then widens back on the downstream side. Furthermore, the wind deflector 114b is so arranged as to cross the imaginary surface 98 that extends the lower wall of the front guide 6a further outward from the blowout port 5. This makes it possible to obtain the same effects as in the first embodiment.

[0105] Next, when another predetermined period has elapsed after the start of heating operation, or when the temperature sensor 61 detects that the difference between the temperature of the air sucked in via the suction port 4 and the user-specified temperature has become small, the controller 60 performs third air stream control. In the third air stream control, the wind deflectors 114a and 114b are arranged as shown in FIG. 19 so that, with the blowing volume of the blowing fan 7 lowered, the conditioned air is sent out in a substantially straight downward direction as indicated by arrow B, for example, at a wind speed of about 5 to 6 m/sec.

[0106] Specifically, the tip end of the wind deflector 114b is arranged more frontward than in the arrangement shown in FIG. 16 so as to point substantially straight downward, and the blowing volume and the wind speed are increased. Thus, in a stable state, the user does not feel the discomfort of being directly hit by wind, and enhanced comfort is obtained. Even when the blowing volume lowers, the indoor unit 1 sends out the conditioned air slightly more frontward (in a substantially straight downward direction) than in a start-up state, and thus warm air reaches far from the indoor unit 1. Incidentally, in the first embodiment, in the third air stream control in a stable-state, the stream passage can be narrowed to lower the blowing volume while maintaining the wind speed. This is more preferable because doing so permits warm air to reach farther.

[0107] While the third air stream control is being performed, if a window of the room R is opened, or heating operation is temporarily suspended for the defrosting of the outdoor unit, or otherwise the room temperature inside the room R becomes lower than the user-specified temperature, the air conditioner shifts into a start-up state to perform the second air stream control. Thereafter, when a predetermined period has elapsed, or it is detected that the difference between the room temperature and the user-specified temperature has become small, the third air stream control is performed. This is reported to achieve heating operation.

[0108] Moreover, by operating the remote control (unillustrated), the user can vary the orientations of the vertical louver 12 and the wind deflectors 114a and 114b. This permits the user to freely select the wind direction of the conditioned air.

[0109] In the second air stream control, instead of the arrangement shown in FIG. 16 described previously, the arrangement shown in FIG. 20 may be adopted where the wind deflector 114a is arranged along the front panel 3. This helps improve the appearance of the indoor unit 1. In this case, the high static pressure part 90 is formed by being surrounded by the frontward-upward inclined upper wall of the blowing passage 6 and the wind deflectors 114a and 114b, and thus a large eddy 25 develops in the high static pressure part 90.

[0110] Thus, here, compared with the arrangement shown in FIG. 16, the blowing efficiency is slightly lower, but it is still possible to reduce the increase in the pressure loss compared with that conventionally experienced. Likewise, in the third air stream control, instead of adopting the arrangement shown in FIG. 19 described previously, the wind deflector 114a may be arranged along the front panel 3.

[0111] Moreover, in the second and third air stream control, in a case where the room R in which the indoor unit 1 is installed is large, the controller 60 performs different control. Control is switched by operation of a selector switch or the like provided on the indoor unit 1 or on the remote control.

[0112] In a case where the room R is large and thus the distance from the side wall W1, on which the indoor unit 1 is installed, to the wall surface W2 opposite to the side wall W1 is comparatively long, when the conditioned air is sent out via the blowout port 5 in a rearward-downward direction, warm air may not reach all corners of the room R such as the boundary region between the wall surface W2 and the floor surface F. To avoid this, in the second air stream control in a start-up state, the wind deflectors 114a and 114b are arranged as shown in FIG. 19 described previously.

[0113] Specifically, the wind deflector 114b is arranged more frontward than in the arrangement shown in FIG. 16 described previously. The conditioned air is sent out via the blowout port 5 in a substantially straight downward direction as indicated by arrow B, for example, at a wind speed of about 7 to 8 m/sec.

[0114] In a stable state, in the third air stream control, the wind deflectors 114a and 114b are arranged as shown in FIG. 21. Specifically, the wind deflector 114b is arranged more frontward than in the arrangement shown in FIG. 19 described previously. The conditioned air is sent out via the blowout port 5 in a direction more frontward than straight downward, that is, in a frontward-downward direction as indicated by arrow B, for example, at a wind speed of 6 to 7 m/sec. Thus, even in a case where the room R is large, warm air reaches all corners of the room R.

<Third Embodiment>

[0115] FIG. 22 is a side sectional view showing the indoor unit 1 of the air conditioner of a third embodiment of the present invention. Such parts as find their counterparts in the second embodiment shown in FIGS. 16 to 21 are identified with common reference numerals and symbols. In this embodiments, instead of the wind deflectors 114a and 114b provided in the second embodiment, wind deflectors 115a and 115b are provided.

[0116] Moreover, a rotation rate detector (unillustrated) is provided that detects the rotation rate of the blowing fan 7 provided in the indoor unit 1 and thereby detects the wind volume of the conditioned air sent out via the blowout port 5. In FIG. 4 described previously, the output of the rotation rate detector is fed to the controller 60, and, based on the result of detection by the rotation rate detector, the wind deflectors 115a and 115b are driven. In other respects, the configuration here is the same as that of the second embodiment.

[0117] The wind deflectors 115a and 115b are arranged in the blowout port 5, and are each formed as a flat plate having flat surfaces on both sides. The wind deflectors 115a and 115b are rotatably supported by rotary shafts 115c and 115d, which rotate by being driven by drive motors (unillustrated). Thus, the wind deflectors 115a and 115b are built as wind direction plates that, when driven by the drive motors, change their orientations to vary the wind direction. The rotary shaft 115c is provided in a substantially middle part of the wind deflector 115a, and the rotary shaft 115d is provided in a substantially middle part of the wind deflector 115b, at a predetermined distance therefrom. The arrangement shown in the figure is one in which the conditioned air is sent out in a rearward-downward direction.

[0118] In the air conditioner configured as described above, when heating operation is started, the refrigeration cycle is operated, and the blowing fan 65 of the outdoor unit (unillustrated) is driven to rotate. Now, outdoor air is sucked into the outdoor unit (unillustrated). The refrigerant, which has absorbed heat through the outdoor heat exchanger 64, flows to the indoor heat exchanger 9 and heats it.

[0119] When a predetermined period has elapsed after the start of heating operation, or the indoor heat exchanger 9 has been heated to a predetermined temperature, the controller 60 drives the blowing fan 7 to rotate so that first air stream control is performed. Now, air is sucked into the indoor unit 1 via the suction port 4, and the dust contained in the air is removed by the air filter 8. The air sucked into the indoor unit 1 exchanges heat with the indoor heat exchanger 9 and is thereby heated, and is then sent out into the room while the right/left and up/down directions of the air is restricted by the vertical louver 12 and the wind deflectors wind deflectors 115a and 115b.

[0120] In first air stream control, the rotation rate of the blowing fan 7 is set, for example, at 600 rpm, and, through detection by the rotation rate detector, the wind deflectors 115a and 115b are arranged as shown in FIGS. 23 or 24. The conditioned air is sent out in a frontward-upward direction or a substantially horizontal direction at a wind speed of about 3 to 4m /sec. Specifically, as shown in FIG. 23, the wind deflector 115a is arranged with the front end thereof located above the rear end thereof so as to be substantially parallel to the upper wall of the blowing passage 6 that is inclined upward near the blowout port 5. The wind deflector 115b is arranged with an outer end part thereof located more frontward-downward than an inner end part thereof.

[0121] Thus, the conditioned air that flows through the front guide 6a is so bent as to be sent out via the blowout port 5 in a frontward-upward direction as indicated by arrow E. When the wind deflector 115a is arranged in a parallel orientation as shown in FIG. 24, the conditioned air is sent out via the blowout port 5 in a substantially horizontal direction as indicated by arrow D.

[0122] The conditioned air sent out via the blowout port 5 in a frontward-upward direction or a substantially horizontal direction reaches the ceiling of the room. Thereafter, by the Coanda effect, the conditioned air flows along the ceiling surface, then along the wall surface W2 (see FIG. 8) opposite to the indoor unit 1, then along the floor surface F (see FIG. 8), and then along the side wall W1 on which the indoor unit 1 is installed. Thus, with the first air stream control, at the start-up of heating operation, the user is not hit by insufficiently heated conditioned air, and is thereby prevented from feeling cold.

[0123] When another predetermined period has elapsed after the start of heating operation, or when the indoor heat exchanger 9 has been sufficiently heated, the controller 60 performs second air stream control. In the second air stream control, the rotation rate of the blowing fan 7 is set, for example, at 1200 rpm, and, through detection by the rotation rate detector, the wind deflectors 115a and 115b are arranged as shown in FIG. 22 described previously. The conditioned air is sent out in a rearward-downward direction at a wind speed of about 6 to 7 m/sec.

[0124] Specifically, the wind deflector 115a is driven by the drive motor so as to be arranged with one end thereof in contact with the upper wall of the blowing passage 6 so as to extend the upper wall downward. The wind deflector 115b is arranged with the tip end thereof pointing substantially straight downward or rearward-downward.

[0125] Thus, the air stream flowing through the front guide 6a is stopped by the wind deflectors 115a and 115b from flowing further frontward, and thus a high static pressure part 90 is formed adjacent to the wind deflectors 115a and 115b. As in the first and second embodiments, the isobaric line 90a (see fig 7) of the high static pressure part 90 is formed along the flow direction of the conditioned air facing the wind deflectors 115a and 115b. Thus, in terms of fluid mechanics, the high static pressure part 90 acts as a wall surface, and helps smoothly change the direction in which the conditioned air is sent out so that it is sent out via the blowout port 5 in a rearward-downward direction.

[0126] Thus, as in the first and second embodiments, in a start-up state, it is possible to raise the temperature around a lower part of the user's body, thereby alleviate discomfort to the user, and thereby greatly enhance comfort. Moreover, it is also possible to achieve enhanced air conditioning efficiency, and to make it easy to check whether or not the temperature inside the room has been sufficiently raised.

[0127] Moreover, the high static pressure part 90 narrows the stream passage, which then widens back on the downstream side. Furthermore, the wind deflector 115b is so arranged as to cross the imaginary surface 98 that extends the lower wall of the front guide 6a further outward from the blowout port 5. This makes it possible to obtain the same effects as in the first and second embodiments.

[0128] Next, when another predetermined period has elapsed after the start of heating operation, or when the temperature sensor 61 detects that the difference between the temperature of the air sucked in via the suction port 4 and the user-specified temperature has become small, the controller 60 performs third air stream control. In the third air stream control, the rotation rate of the blowing fan 7 is set, for example, at 900 rpm, and, through detection by the rotation rate detector, the wind deflectors 115a and 115b are arranged as shown in FIG. 25. The conditioned air is sent out in a substantially straight downward direction as indicated by arrow B at a wind speed of about 5 to 6 m/sec.

[0129] Specifically, the rotation rate of the blowing fan 7 is lowered so that the tip end of the wind deflector 115b is arranged more frontward than in the arrangement shown in FIG. 22 so as to point substantially straight downward or slightly frontward. Thus, in a stable state, the user does not feel the discomfort of being directly hit by wind, and enhanced comfort is obtained. Even when the blowing volume lowers, the indoor unit 1 sends out the conditioned air slightly more frontward (in a substantially straight downward direction) than in a start-up state, and thus warm air reaches far from the indoor unit 1.

[0130] While the third air stream control is being performed, if a window of the room R is opened, or heating operation is temporarily suspended for the defrosting of the outdoor unit, or otherwise the room temperature inside the room R becomes lower than the user-specified temperature, the air conditioner shifts into a start-up state to perform the second air stream control. Thereafter, when a predetermined period has elapsed, or it is detected that the difference between the room temperature and the user-specified temperature has become small, the third air stream control is performed. This is reported to achieve heating operation.

[0131] Moreover, by operating the remote control (unillustrated), the user can vary the orientations of the vertical louver 12 and the wind deflectors 115a and 115b. This permits the user to freely select the wind direction of the conditioned air.

[0132] Moreover, in the second and third air stream control, in a case where the room R in which the indoor unit 1 is installed is large, the controller 60 performs different control. Control is switched by operation of a selector switch or the like provided on the indoor unit 1 or on the remote control.

[0133] In a case where the room R is large and thus the distance from the side wall W1, on which the indoor unit 1 is installed, to the wall surface W2 opposite to the side wall W1 is comparatively long, when the conditioned air is sent out via the blowout port 5 in a rearward-downward direction, warm air may not reach all corners of the room R such as the boundary region between the wall surface W2 and the floor surface F. To avoid this, in the second air stream control in a start-up state, the wind deflectors 115a and 115b are arranged as shown in FIG. 25 described previously.

[0134] Specifically, when the rotation rate of the blowing fan 7 becomes equal to, for example, 1 200 rpm, through detection by the rotation rate detector, the wind deflector 115b is arranged more frontward than in the arrangement shown in FIG. 22d described previously. The conditioned air is sent out via the blowout port 5 in a substantially straight downward direction as indicated by arrow B, for example, at a wind speed of about 7 to 8 m/sec.

[0135] In a stable state, in the third air stream control, the wind deflectors 115a and 115b are arranged as shown in FIG. 26. Specifically, when the rotation rate of the blowing fan 7 becomes equal to, for example, 900 rpm, through detection by the rotation rate detector, the wind deflector 115b is arranged more frontward than in the arrangement shown in FIG. 25 described previously. The conditioned air is sent out via the blowout port 5 in a direction more frontward than straight downward, that is, in a frontward-downward direction as indicated by arrow B, for example, at a wind speed of 6 to 7 m/sec. Thus, even in a case where the room R is large, warm air reaches all corners of the room R.

[0136] A similar rotation rate detector may be provided in the first or second embodiment so that, based on the result of detection by the rotation rate detector, the wind direction, wind speed, and wind volume can be varied.

<Fourth Embodiment>

[0137] Next, a fourth embodiment of the present invention will be described. The air conditioner of this embodiment differs from that of the third embodiment in that, instead of the rotation rate detector, a frequency detector (unillustrated) is provided. The frequency detector detects the operating frequency of the compressor 62 (see FIG. 2). In FIG. 4 described previously; the output of the frequency detector is fed to the controller 60, and, based on the result of detection by the frequency detector, the wind deflectors 115a and 115b are driven. In other respects, the configuration here is the same as that of the third embodiment.
[0138] With this configuration, based on the operating frequency of the compressor 62, the arrangement of the wind deflectors 115a and 115b can be varied. In the second air stream control in a start-up state, the operating frequency is raised and, when the operating frequency becomes, for example, 70 Hz or higher, through detection by the frequency detector, the wind deflectors 115a and 115b are arranged, for example, as shown in FIG. 22 described previously. On the other hand, in the third air stream control in a stable state, the operating frequency is lowered and, when the operating frequency becomes, for example, 40 Hz to 70 Hz, through detection by the frequency detector, the wind deflectors 115a and 115b are arranged, for example, as shown in FIG. 25.
[0139] In heating operation, when the operating frequency of the compressor 62 is high, heating performance is high, and thus the temperature of the indoor heat exchanger 9 is high; when the operating frequency of the compressor 62 is low, heating performance is low, and thus the temperature of the indoor heat exchanger 9 is low. Thus, in the same way as described previously, part of the conditioned air having a high blowout temperature is sent out more rearward. This reduces the high-temperature air that hits the user, and thus helps further reduce discomfort to the user. A frequency detector may be provided in the first or second embodiment.

<Fifth Embodiment>

[0140] Next, a fifth embodiment of the present invention will be described. The air conditioner of this embodiment differs from that of the third embodiment in that, instead of the rotation rate detector, a blowout temperature detector (unillustrated) comprising a temperature sensor for detecting the blowout temperature of the conditioned air is provided in the blowing passage 6. Moreover, in FIG. 4 described previously, instead of the output of the temperature sensor 61, the output of the blowout temperature detector is fed to the controller 60, and, based on the result of detection by the blowout temperature detector, the wind deflectors 115a and 115b are driven. In other respects, the configuration here is the same as that of the third embodiment.
[0141] With this configuration, based on the blowout temperature of the conditioned air, the arrangement of the wind deflectors 115a and 115b can be varied. When the temperature of the indoor heat exchanger has not risen and the blowout temperature is lower than 36 °C, the first air stream control is performed. In the second air stream control in a start-up state, the operating frequency of the compressor is increased to raise the blowout temperature and, when the blowout temperature becomes 45 °C or higher, through detection by the blowout temperature detector, the wind deflectors 115a and 115b are arranged, for example, as shown in FIG. 22 described previously.
[0142] In the third air stream control in a start-up state, the operating frequency of the compressor 62 is lowered and, when the blowout temperature becomes 36 °C to 45 °C, through detection by the blowout temperature detector, the wind deflectors 115a and 115b are arranged, for example, as shown in FIG. 25 described previously. Thus, in the same way as described previously, part of the conditioned air having a high blowout temperature is sent out more rearward. This reduces the high-temperature air that hits the user, and thus helps further reduce discomfort to the user. A blowout temperature detector may be provided in the first or second embodiment.

<Sixth Embodiment>

[0143] Next, a sixth embodiment of the present invention will be described. The air conditioner of this embodiment differs from that of the third embodiment in that, instead of the rotation rate detector, a heat exchanger temperature detector (unillustrated) comprising a temperature sensor for detecting the temperature of the indoor heat exchanger 9 is provided. Moreover, in FIG. 4 described previously, the output of the heat exchanger temperature detector is fed to the controller 60, and, based on the result of detection by the heat exchanger temperature detector, the wind deflectors 115a and 115b are driven. In other respects, the configuration here is the same as that of the third embodiment.
[0144] With this configuration, based on the temperature of the indoor heat exchanger 9, the arrangement of the wind deflectors 115a and 115b can be varied. For example, when the temperature of the indoor heat exchanger 9 is lower than 40 °C, the first air stream control is performed. In the second air stream control in a start-up state, the operating frequency of the compressor 62 is increased to raise the temperature of the indoor heat exchanger 9 and, when the

temperature becomes 50 °C or higher, through detection by the heat exchanger temperature detector, the wind deflectors 115a and 115b are arranged, for example, as shown in FIG. 22 described previously.

[0145] In the third air stream control in a start-up state, the operating frequency of the compressor 62 is lowered and, when the temperature of the indoor heat exchanger 9 becomes 40 °C to 50 °C, through detection by the heat exchanger temperature detector, the wind deflectors 115a and 115b are arranged, for example, as shown in FIG. 25 described previously. Thus, in the same way as described previously, part of the conditioned air having a high blowout temperature is sent out more rearward. This reduces the high-temperature air that hits the user, and thus helps further reduce discomfort to the user. A heat exchanger temperature detector may be provided in the first or second embodiment.

<Seventh Embodiment>

[0146] Next, a seventh embodiment of the present invention will be described. The air conditioner of this embodiment differs from that of the third embodiment in that, instead of the rotation rate detector, a current consumption detector is provided. The current consumption detector is built with a current transformer or the like that generates a secondary voltage proportional to a current, and detects the current consumption or power consumption of the air conditioner when it is operating. In FIG. 4 described previously, the output of the power consumption detector is fed to the controller 60, and, based on the result of detection by the power consumption detector, the wind deflectors 115a and 115b are driven. In other respects, the configuration here is the same as that of the third embodiment.

[0147] With this configuration, based on the current consumption by the air conditioner, the arrangement of the wind deflectors 115a and 115b can be varied. In the second air stream control in a start-up state, the operating frequency of the input circuit 72 is increased and, when the current consumption or power consumption by the air conditioner becomes 12 A or more or 1 200 W or more, through detection by the current consumption detector, the wind deflectors 115a and 115b are arranged, for example, as shown in FIG. 22 described previously.

[0148] In the third air stream control in a stable state, the operating frequency of the compressor 62 is lowered and, when the current consumption or power consumption by the air conditioner becomes 7A to 12A or 700 W to 1 200 W, through detection by the current consumption detector, the wind deflectors 115a and 115b are arranged, for example, as shown in FIG. 25.

[0149] When the current consumption or power consumption by the air conditioner in operation is high, the frequency of the compressor 62 (see FIG. 2) is considered to be high, and thus, in heating operation, the temperature of the indoor heat exchanger 9 becomes high; when the current consumption or power consumption by the air conditioner in operation is low, the frequency of the compressor 62 is considered to be low, and thus, in heating operation, the temperature of the indoor heat exchanger 9 becomes low. Thus, in the same way as described previously, part of the conditioned air having a high blowout temperature is sent out more rearward. This reduces the high-temperature air that hits the user, and thus helps further reduce discomfort to the user. A current consumption detector may be provided in the first or second embodiment.

<Eighth Embodiment>

[0150] Next, an eighth embodiment of the present invention will be described. The air conditioner of this embodiment differs from that of the third embodiment in that, instead of the rotation rate detector, an outdoor rotation rate detector is provided. The outdoor rotation rate detector detects the rotation rate of the blowing fan 65 (see FIG. 2) provided in the outdoor unit and thereby detects the wind volume of the air sucked in via the suction port (unillustrated) of the outdoor unit. In FIG. 4 described previously, the output of the outdoor rotation rate detector is fed to the controller 60, and, based on the result of detection by the outdoor rotation rate detector, the wind deflectors 115a and 115b are driven. In other respects, the configuration here is the same as that of the third embodiment.

[0151] With this configuration, based on the rotation rate of the outdoor blowing fan 65, the arrangement of the wind deflectors 115a and 115b can be varied. In the second air stream control, for example, when the rotation rate of the outdoor blowing fan 65 becomes 1 000 rpm or more, through detection by the outdoor rotation rate detector, the wind deflectors 115a and 115b are arranged as shown in FIG. 22 described previously. In the third air stream control, for example, when the rotation rate of the outdoor blowing fan 65 becomes 500 to 1 000 rpm or more, through detection by the outdoor rotation rate detector, the wind deflectors 115a and 115b are arranged as shown in FIG. 25 described previously.

[0152] In heating operation, when the operating frequency of the compressor 62 (see fog. 2) is high, the wind volume or rotation rate of the blowing fan 65 is set high, thus heating performance is high, and thus the temperature of the indoor heat exchanger 9 is high; when the operating frequency of the compressor 62 is low, the wind volume or rotation rate of the blowing fan 65 is set low, thus heating performance is low, and thus the temperature of the indoor heat exchanger 9 is low. Thus, in the same way as described previously, part of the conditioned air having a high blowout temperature is sent out more rearward. This reduces the high-temperature air that hits the user, and thus helps further reduce discomfort to the user. An outdoor rotation rate detector may be provided in the first or second embodiment.

<Ninth Embodiment>

[0153] Next, a ninth embodiment of the present invention will be described. The air conditioner of this embodiment differs from that of the third embodiment in that, instead of the rotation rate detector, a humidity sensor is provided. The humidity sensor is provided between the indoor heat exchanger 9 and the air filter 8, and detects the humidity of the air sucked in. In FIG. 4 described previously, instead of the output of the temperature sensor 61, the output of the humidity sensor is fed to the controller 60, and, based on the result of detection by the humidity sensor, the wind deflectors 115a and 115b are driven. In other respects, the configuration here is the same as that of the third embodiment.

[0154] With this configuration, based on the humidity of the air sucked in, the arrangement of the wind deflectors 115a and 115b can be varied. For example, when the difference between the relative humidity of the sucked air and the user-specified humidity is 20% or more, the second air stream control is performed; when the difference between the relative humidity of the sucked air and the user-specified humidity is less than 20%, third air stream control is performed.

[0155] Thus, when the difference between the relative humidity of the sucked air and the user-specified humidity is large, the conditioned air is sent out more rearward to widely agitate the air all over the room in order to quickly achieve a proper humidity balance up to all corners of the room. On the other hand, when the difference between the relative humidity of the sucked air and the user-specified humidity is small, the conditioned air is sent out in a substantially straight downward direction to reduce the part thereof unnecessarily sent out rearward in order to achieve efficient air conditioning. A humidity sensor may be provided in the first or second embodiment.

<Tenth Embodiment>

[0156] Next, a tenth embodiment of the present invention will be described. The air conditioner of this embodiment differs from that of the third embodiment in that, instead of the rotation rate detector, an ion sensor (unillustrated) is provided. The ion sensor is provided between the indoor heat exchanger 9 and the air filter 8, and detects the ion concentration in the air sucked in. In FIG. 4 described previously, instead of the output of the temperature sensor 61, the output of the ion sensor is fed to the controller 60, and, based on the result of detection by the ion sensor, the wind deflectors 115a and 115b are driven. In other respects, the configuration here is the same as that of the third embodiment.

[0157] With this configuration, based on the ion concentration in the sucked air, the arrangement of the wind deflectors 115a and 115b can be varied. For example, when the difference between the ion concentration in the sucked air and the user-specified ion concentration is 2 000 ions/cm^3 or more, the second air stream control is performed; when the difference between the ion concentration in the sucked air and the user-specified ion concentration is less than 2 000 ions/cm^3, the third air stream control is performed

[0158] Thus, when the difference between the ion concentration in the sucked air and the user-specified ion concentration is large, the conditioned air containing ions in large quantities is sent out in more rearward to widely agitate the air all over the room in order to quickly achieve a proper ion balance up to all corners of the room. On the other hand, when the difference between the ion concentration in the sucked air and the user-specified ion concentration is small, the conditioned air is sent out in a substantially straight downward direction to reduce the part thereof unnecessarily sent out rearward in order to achieve efficient air conditioning. An ion sensor may be provided in the first or second embodiment.

<Eleventh Embodiment>

[0159] Next, an eleventh embodiment of the present invention will be described. The air conditioner of this embodiment differs from that of the third embodiment in that, instead of the rotation rate detector, a dust sensor (purity detecting means) is provided. The dust sensor is provided between the indoor heat exchanger 9 and the air filter 8. The dust sensor detects the amount of dust in the air sucked in, and thereby detects the purity of the air inside the room. In FIG. 4 described previously, instead of the output of the temperature sensor 61, the output of the dust sensor is fed to the controller 60, and, based on the result of detection by the dust sensor, the wind deflectors 115a and 115b are driven. In other respects, the configuration here is the same as that of the third embodiment.

[0160] With this configuration, based on the amount of dust contained in the sucked air, the arrangement of the wind deflectors 115a and 115b can be varied. For example, when the amount of dust in the sucked air is larger than a predetermined value, the second air stream control is performed; when the amount of dust in the sucked air is smaller than the predetermined value, the third air stream control is performed.

[0161] Thus, when the amount of dust contained in the sucked air is large, the conditioned air is sent out more rearward to widely agitate the air all over the room. This makes it possible to suck dust present inside the room into the indoor unit to quickly purify air with the air filter 8. Thus, it is possible to purify the air all over the room in a short period. On the other hand, when the amount of dust contained in the sucked air is small, the conditioned air is sent out in a substantially straight downward direction to reduce the part thereof unnecessarily sent out rearward in order to achieve efficient air conditioning. Instead of the air filter 8 (see FIG. 1), a HEPA filter or an electric dust collector may be used to obtain a higher air purifying effect. A dust sensor may be provided in the first or second embodiment.

<Twelfth Embodiment>

[0162] Next, a twelfth embodiment of the present invention will be described. The air conditioner of this embodiment differs from that of the third embodiment in that, instead of the rotation rate detector, an odor sensor (purity detecting means) is provided. The odor sensor is provided between the indoor heat exchanger 9 and the air filter 8. The odor sensor detects the amount of odor-producing substances contained in the air sucked in, and thereby detects the purity of the air inside the room. In FIG. 4 described previously, instead of the output of the temperature sensor 61, the output of the odor sensor is fed to the controller 60, and, based on the result of detection by the odor sensor, the wind deflectors 115a and 115b are driven. In other respects, the configuration here is the same as that of the third embodiment.
[0163] With this configuration, based on the amount of dust contained in the sucked air, the arrangement of the wind deflectors 115a and 115b can be varied. For example, when the amount of dust in the sucked air is larger than a predetermined value, the second air stream control is performed; when the amount of dust in the sucked air is smaller than the predetermined value, the third air stream control is performed.
[0164] Thus, when the amount of order-producing substances contained in the sucked air is large, the conditioned air is sent out more rearward to widely agitate the air all over the room. This makes it possible to suck dust present inside the room into the indoor unit to quickly purify air with the air filter 8. Thus, it is possible to purify the air all over the room in a short period. On the other hand, when the amount of order-producing substances contained in the sucked air is small, the conditioned air is sent out in a substantially straight downward direction to reduce the part thereof unnecessarily sent out rearward in order to achieve efficient air conditioning. An order sensor may be provided in the first or second embodiment.

<Thirteenth Embodiment>

[0165] In this embodiment, the indoor unit 1 of the first embodiment is so modified as to be built as a so-called corner air conditioner that is installed in the corner L formed between two adjacent walls W3 and W4 of a room R, in contact with the ceiling wall S. Even in this case, it is possible to obtain the same effects as described above. Alternatively, the indoor unit of any of the second to twelfth embodiments may be built as a corner air conditioner.
[0166] It should be understood that the present invention may be carried out in any manners other than specifically described above as the first to thirteenth embodiments; that is, many modifications and variations are possible within the scope and spirits of the present invention.

Industrial Applicability

[0167] The present invention finds application in air conditioners that take air into the cabinet thereof, then condition the taken air, and then send out the conditioned air into a room.

Claims

1. An air conditioner that is installed on a wall surface inside a room and that performs heating operation by taking in air via a suction port, then conditioning the taken air, and then sending out the conditioned air via an blowout port in a wind direction that can be varied,
   characterized in
   that, based on operating status of the air conditioner or air conditioning status inside the room, the wind direction of the conditioned air can be varied between a substantially horizontal direction or a frontward-upward direction and a substantially straight downward direction or a rearward-downward direction.

2. The air conditioner of claim 1,
   further **characterized in**
   that, based on the operating status of the air conditioner or the air conditioning status inside the room, the wind direction of the conditioned air can be varied also between a substantially straight downward direction and a rearward-downward direction.

3. The air conditioner of claim 1,
further **characterized in**
that, based on the operating status of the air conditioner or the air conditioning status inside the room, the wind direction of the conditioned air can be varied also between a substantially straight downward direction and a frontward-downward direction.

4. The air conditioner of claim 1,
further **characterized in**
that, when the room is smaller than a predetermined size, the wind direction can be varied between a substantially horizontal direction or a frontward-upward direction and a substantially straight downward direction or a rearward-downward direction and, when the room is larger than the predetermined size, the wind direction can be varied between a substantially horizontal direction or a frontward-upward direction and a frontward-downward direction.

5. The air conditioner of claim 1,
further **characterized in**
that, based on the operating status of the air conditioner or the air conditioning status inside the room, wind speed of the conditioned air can be varied.

6. The air conditioner of claim 1,
further **characterized in**
that, based on the operating status of the air conditioner or the air conditioning status inside the room, wind volume of the conditioned air can be varied.

7. The air conditioner of claim 1,
further **characterized in**
that, when the operating status of the air conditioner or the air conditioning status inside the room fulfills a first condition, the wind direction of the conditioned air is set in a substantially horizontal direction or a frontward-upward direction,
when the operating status of the air conditioner or the air conditioning status inside the room fulfills a second condition, the wind direction of the conditioned air is set in a substantially straight downward direction or a rearward-downward direction, and
when the operating status of the air conditioner or the air conditioning status inside the room fulfills a third condition, the wind direction of the conditioned air is set in a direction more frontward than when the second condition is fulfilled.

8. The air conditioner of claim 7,
further **characterized in**
that the first condition requires that blowout temperature be lower than a predetermined value,
the second condition requires that the blowout temperature be higher than the predetermined value and that the air conditioner be in a start-up state in which room temperature rises, and
the third condition requires that the air conditioner be in a stable state in which the room temperature is stable.

9. The air conditioner of one of claims 1 to 7,
further **characterized by** comprising
an ion generator for generating ions, and
further **characterized in**
that, along with the conditioned air, the ions are sent out into the room via the blowout port.

10. The air conditioner of claim 9,
further **characterized by** comprising
an ion sensor for detecting ion concentration inside the room and,
further **characterized in**
that the air conditioning status inside the room based on which the wind direction can be varied is evaluated based on the ion concentration detected by the ion sensor.

11. The air conditioner of one of claims 1 to 5,
further **characterized in**
that the operating status of the air conditioner based on which the wind direction can be varied is evaluated based on the wind volume of the conditioned air sent out from the blowout port.

12. The air conditioner of claim 11,
further **characterized by** comprising
a rotation rate detector for detecting rotation rate of a blower that takes in air inside the room via the suction port and sends it out via the blowout port, and
further **characterized in**
that the operating status of the air conditioner based on which the wind direction can be varied is evaluated based on a result of detection by the rotation rate detector.

13. The air conditioner of one of claims 1 to 7,
further **characterized by** comprising
a heat exchanger temperature detector for detecting temperature of an indoor heat exchanger that conditions air temperature by exchanging heat with the air taken in, and
further **characterized in**
that the operating status of the air conditioner based on which the wind direction can be varied is evaluated based on a result of detection by the heat exchanger temperature detector.

14. The air conditioner of one of claims 1 to 7,
further **characterized by** comprising
a blowout temperature detector for detecting temperature of the air sent out via the blowout port, and
further **characterized in**
that the operating status of the air conditioner based on which the wind direction can be varied is evaluated based on a result of detection by the blowout temperature detector.

15. The air conditioner of one of claims 1 to 7,
further **characterized by** comprising
a frequency detector for detecting operating frequency of a compressor that operates a refrigeration cycle, and
further **characterized in**
that the operating status of the air conditioner based on which the wind direction can be varied is evaluated based on a result of detection by the frequency detector.

16. The air conditioner of one of claims 1 to 7,
further **characterized by** comprising
a current consumption detector for detecting power consumption or current consumption by the air conditioner, and
further **characterized in**
that the operating status of the air conditioner based on which the wind direction can be varied is evaluated based on a result of detection by the current consumption detector.

17. The air conditioner of one of claims 1 to 7,
further **characterized by** comprising
an outdoor unit that takes in outdoor air to exchange heat therewith, and
further **characterized in**
that the operating status of the air conditioner based on which the wind direction can be varied is evaluated based on wind volume of the air taken in by the outdoor unit.

18. The air conditioner of claim 17,
further **characterized in**
that the outdoor unit has an outdoor blower for taking in outdoor air,
further **characterized by** comprising
an outdoor rotation rate detector for detecting rotation rate of the outdoor blower, and
further **characterized in**
that the operating status of the air conditioner based on which the wind direction can be varied is evaluated based on a result of detection by the outdoor rotation rate detector.

19. The air conditioner of one of claims 1 to 7,
further **characterized by** comprising
a temperature sensor for detecting temperature of the air taken in via the suction port, and
further **characterized in**
that the air conditioning status inside the room based on which the wind direction can be varied is evaluated based

on a result of detection by the temperature sensor.

20. The air conditioner of one of claims 1 to 7,
further **characterized by** comprising
a temperature sensor for detecting temperature of the air taken in via the suction port, and
further **characterized in**
that the air conditioning status inside the room based on which the wind direction can be varied is evaluated based on a difference between a result of detection
by the temperature sensor and a user-specified temperature.

21. The air conditioner of one of claims 1 to 7,
further **characterized in**
that the air conditioning status inside the room based on which the wind direction can be varied is evaluated based on length of time that has elapsed after start of the heating operation.

22. The air conditioner of one of claims 1 to 7,
further **characterized by** comprising
a humidity sensor for detecting humidity inside the room, and
further **characterized in**
that the air conditioning status inside the room based on which the wind direction can be varied is evaluated based on a result of detection by the humidity sensor.

23. The air conditioner of one of claims 1 to 7,
further **characterized by** comprising
purity detecting means for detecting purity of air inside the room, and
further **characterized in**
that the air conditioning status inside the room based on which the wind direction can be varied is evaluated based on a result of detection by the purity detecting means.

24. The air conditioner of claim 23,
further **characterized in**
that the purity detecting means is an odor sensor for detecting an odor-producing substance contained in air inside the room or a dust sensor for detecting amount of dust contained in air inside the room.

25. The air conditioner of one of claims 1 to 7,
further **characterized by** comprising
inhibiting means for inhibiting the conditioned air from being sent out in a rearward-downward direction. direction or a substantially straight downward direction.

26. An air conditioner that is installed on a wall surface inside a room and that performs heating operation by taking in air via a suction port, then conditioning the taken air, and then sending out the conditioned air via an blowout port in a wind direction that can be varied,
characterized in
that, in a start-up state in which blowout temperature is higher than a predetermined value and room temperature rises, a wind direction of the conditioned air is set in a substantially straight downward direction or in a rearward-downward direction and, in a stable state in which the room temperature is stable, the wind direction of the conditioned air is set in a direction more frontward than in the start-up state.

27. The air conditioner of claim 26,
further **characterized in**
that, when the blowout temperature is lower than the predetermined value, the wind direction of the conditioned air is set in a substantially horizontal direction or a frontward-upward direction.

28. The air conditioner of claim 26,
further **characterized in**
that, in the stable state, when the room temperature becomes a predetermined value apart from the user-specified temperature, the wind direction is set in a same direction as in the start-up state.

29. An air conditioning method wherein heating operation is performed by taking in air via a suction port of an air conditioner installed on a wall surface inside a room, then conditioning the taken air, and then sending out the conditioned air via a blowout port in a wind direction that can be varied,
characterized in
that, based on operating status of the air conditioner or air conditioning status inside the room, the wind direction of the conditioned air can be varied between a substantially horizontal direction or a frontward-upward direction and a substantially straight downward direction or a rearward-downward direction.

30. The air conditioning method of claim 29,
further **characterized in**
that, based on the operating status of the air conditioner or the air conditioning status inside the room, the wind direction of the conditioned air can be varied also between a substantially straight downward direction and a rearward-downward direction.

31. The air conditioning method of claim 29,
further **characterized in**
that, based on the operating status of the air conditioner or the air conditioning status inside the room, the wind direction of the conditioned air can be varied also between a substantially straight downward direction and a frontward-downward direction.

32. The air conditioning method of claim 29,
further **characterized in**
that, when the room is smaller than a predetermined size, the wind direction can be varied between a substantially horizontal direction or a frontward-upward direction and a substantially straight downward direction or a rearward-downward direction and, when the room is larger than the predetermined size, the wind direction can be varied between a substantially horizontal direction or a frontward-upward direction and a frontward-downward direction.

FIG.1

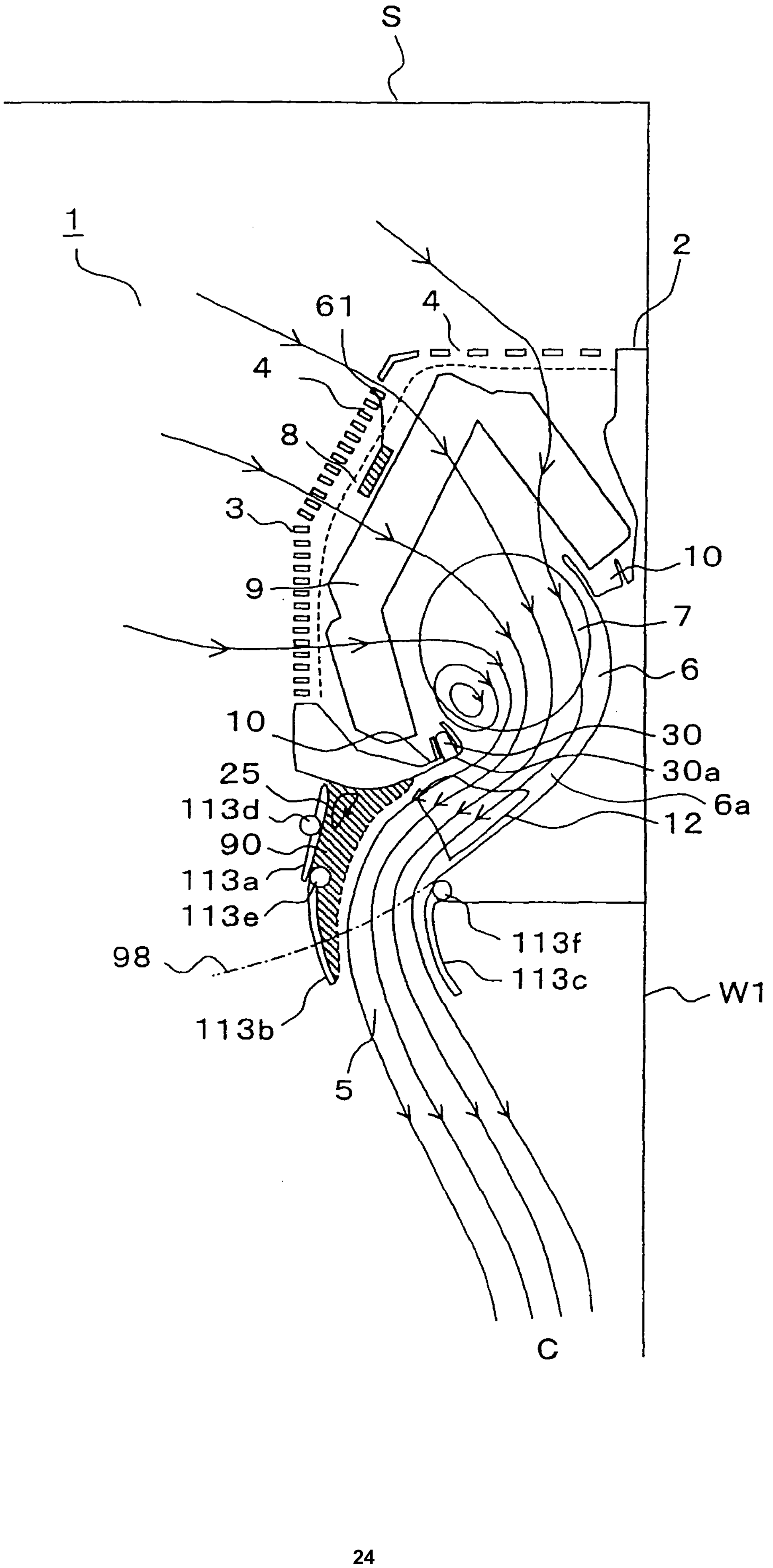

S
1
2
61
4
4
8
3
10
9
7
6
10
30
30a
25
6a
113d
12
90
113a
113e
113f
98
113c
W1
113b
5
C

FIG.2

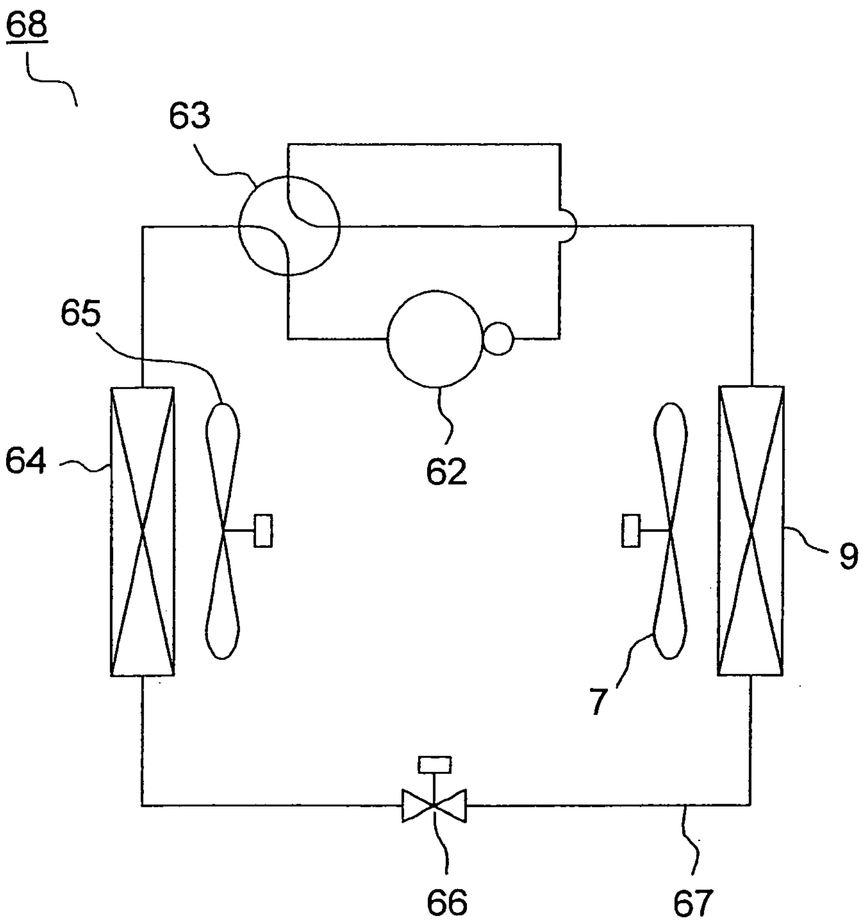


FIG.3

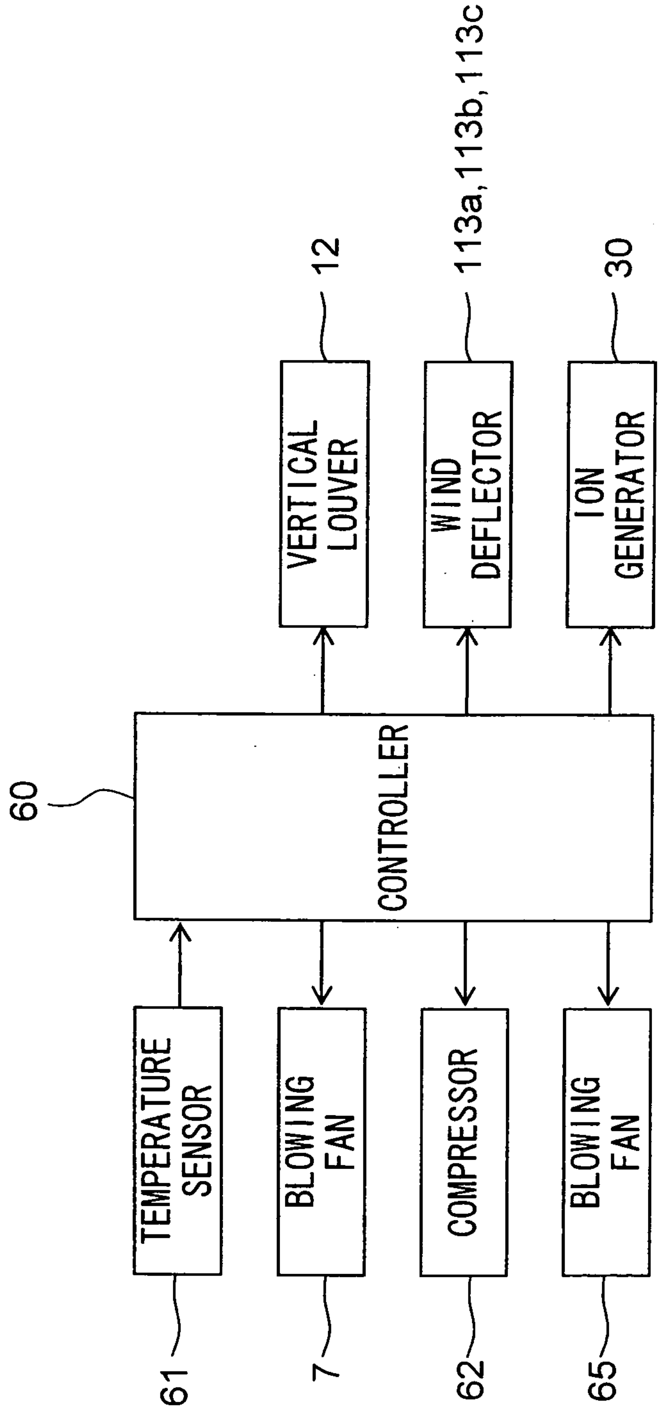

CONTROLLER
60
TEMPERATURE SENSOR
61
BLOWING FAN
7
COMPRESSOR
62
BLOWING FAN
65
VERTICAL LOUVER
12
WIND DEFLECTOR
113a,113b,113c
ION GENERATOR
30

FIG.4

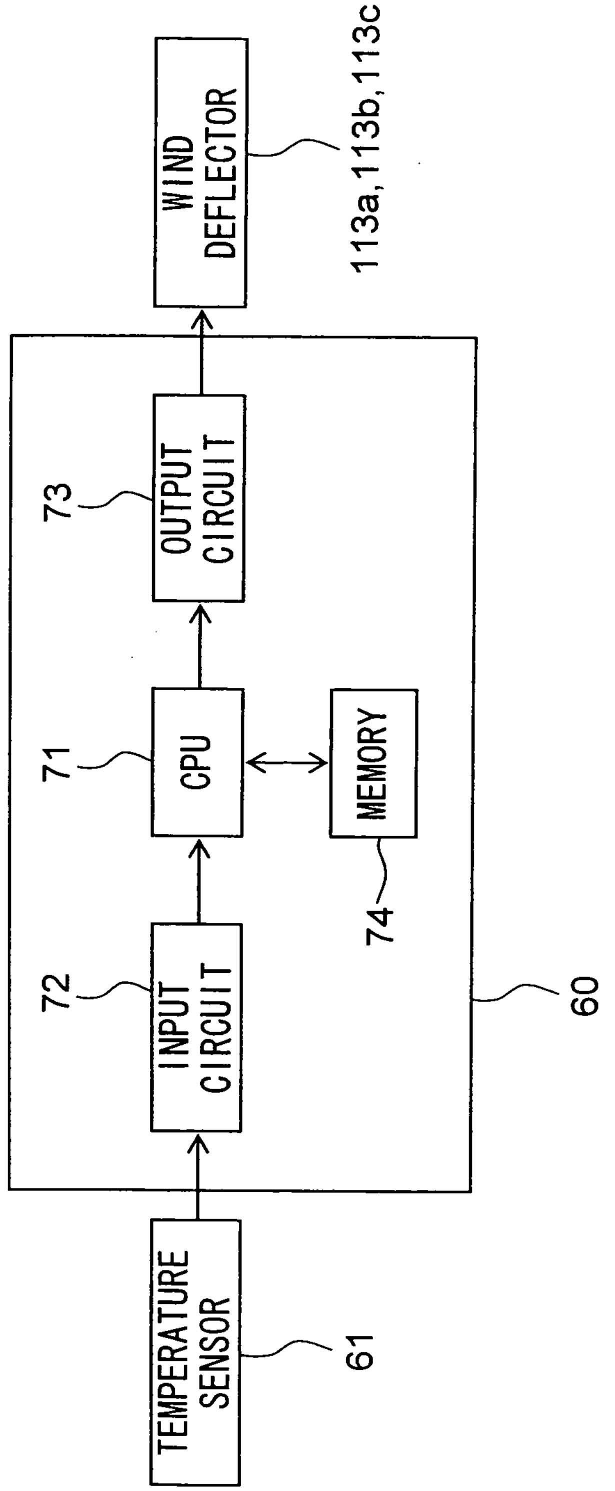

TEMPERATURE SENSOR
61
INPUT CIRCUIT
72
CPU
71
MEMORY
74
OUTPUT CIRCUIT
73
60
WIND DEFLECTOR
113a,113b,113c

FIG.5

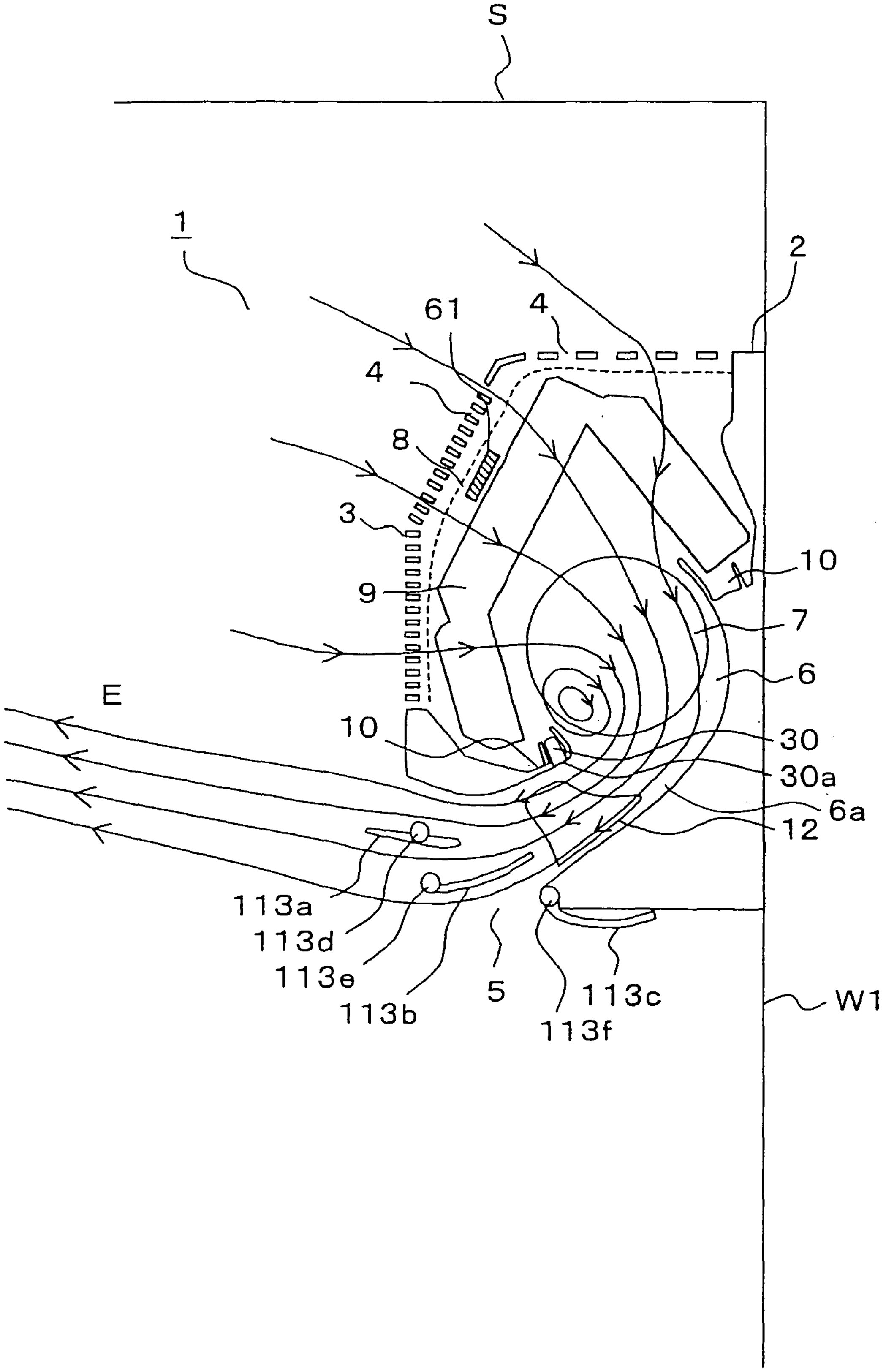

S
1
2
61
4
4
8
3
9
10
7
6
30
30a
6a
12
10
E
113a
113d
113e
113b
5
113c
113f
W1

FIG.6

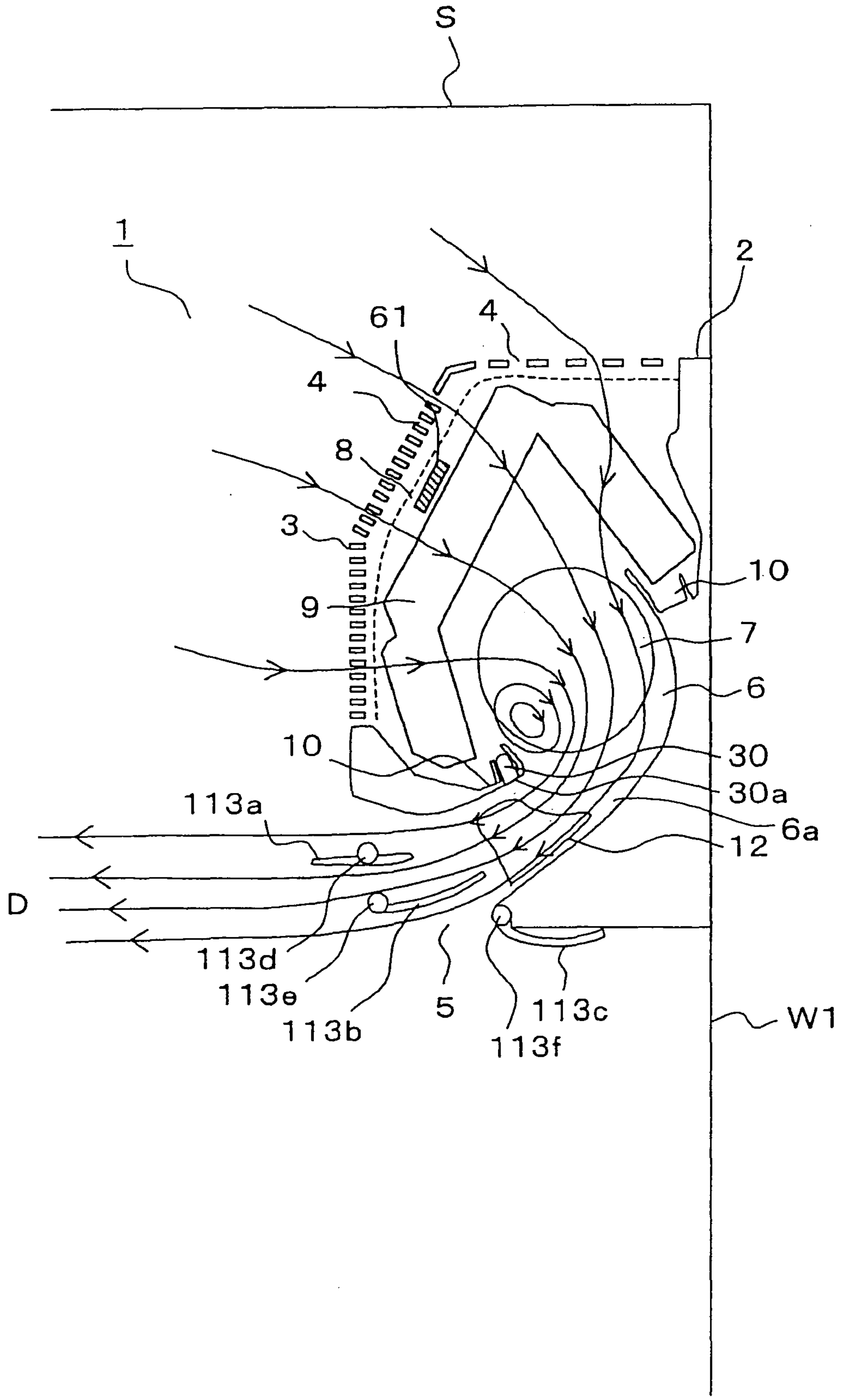

S
1
2
61
4
4
8
3
9
10
7
6
10
30
30a
6a
12
113a
D
113d
113e
113b
5
113c
113f
W1

FIG.7

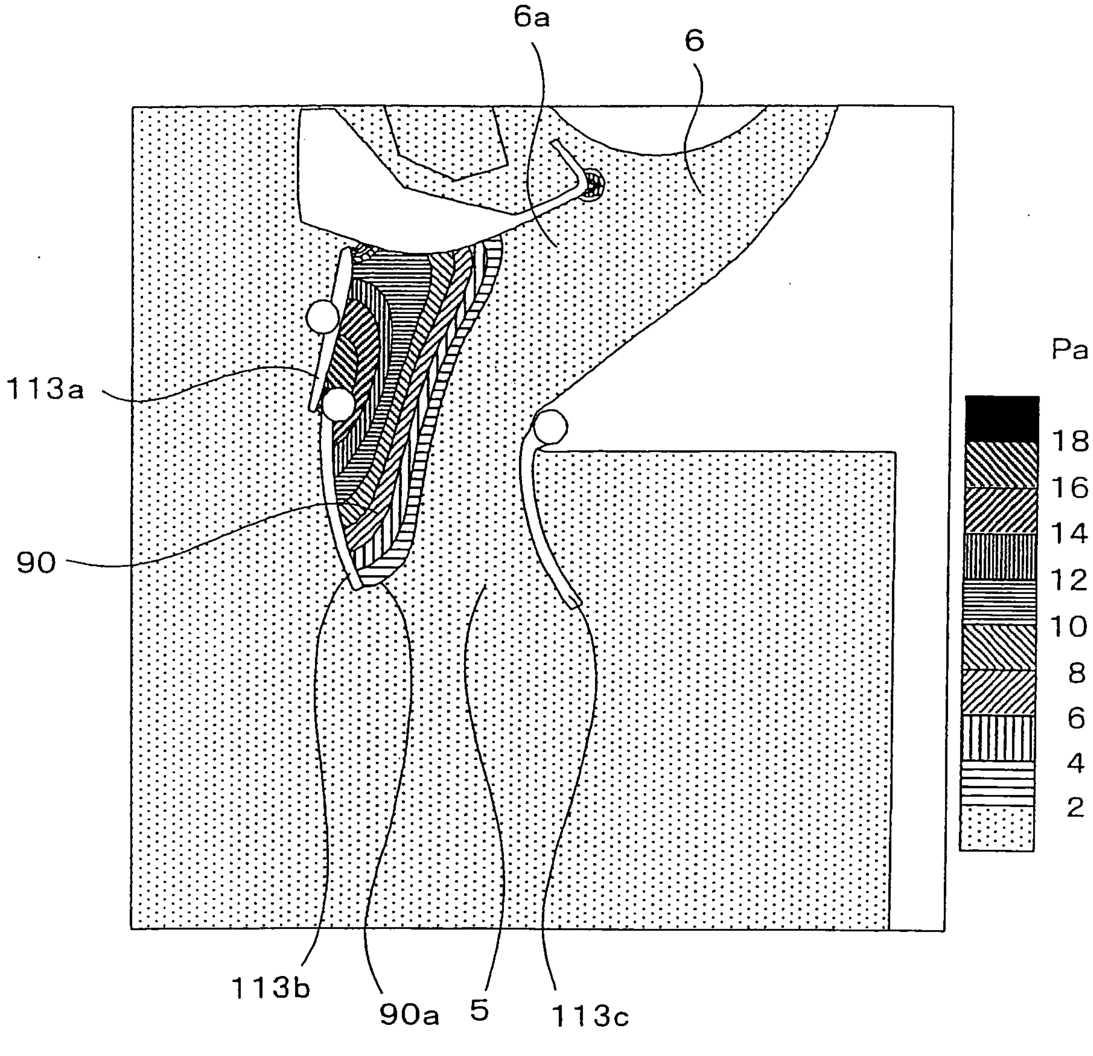


FIG.8

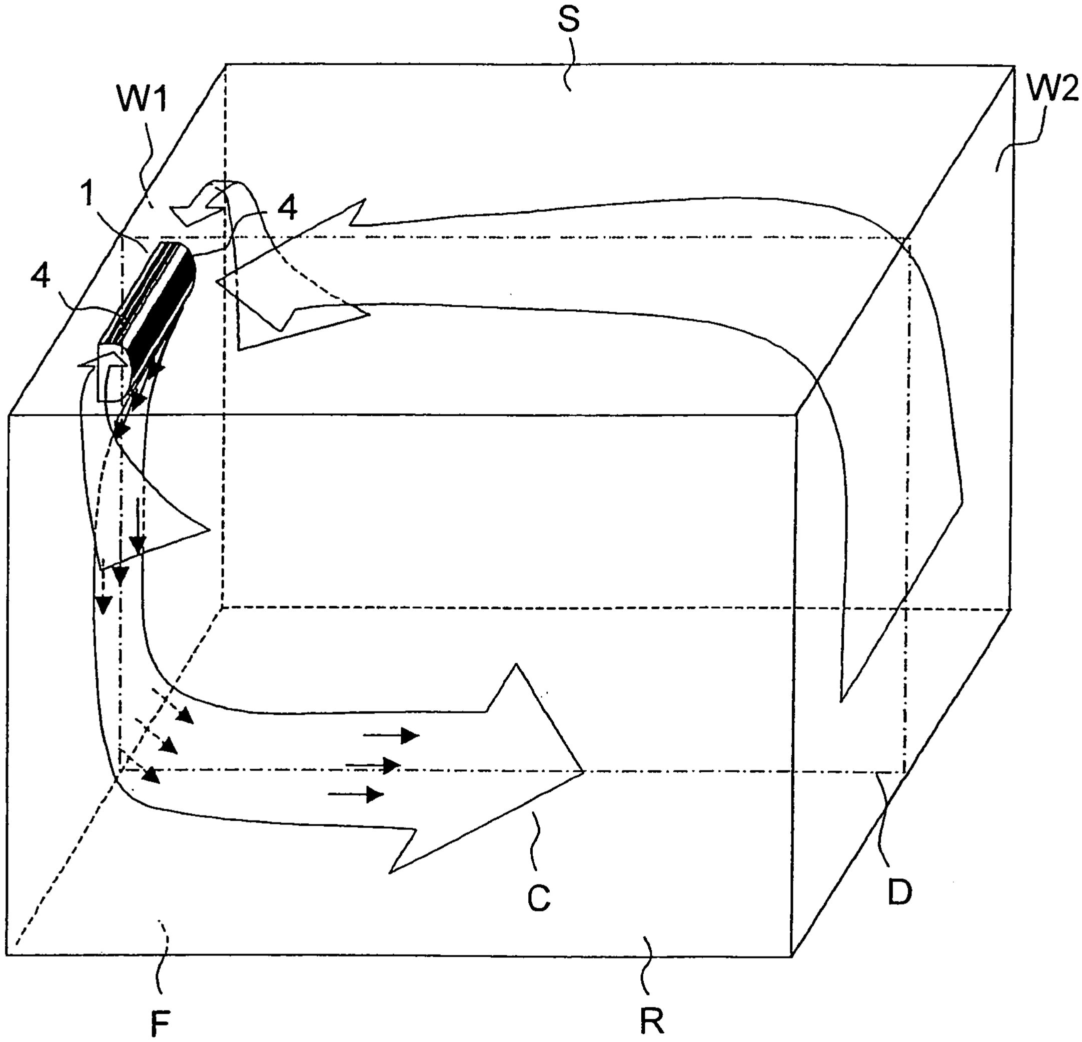


FIG.9

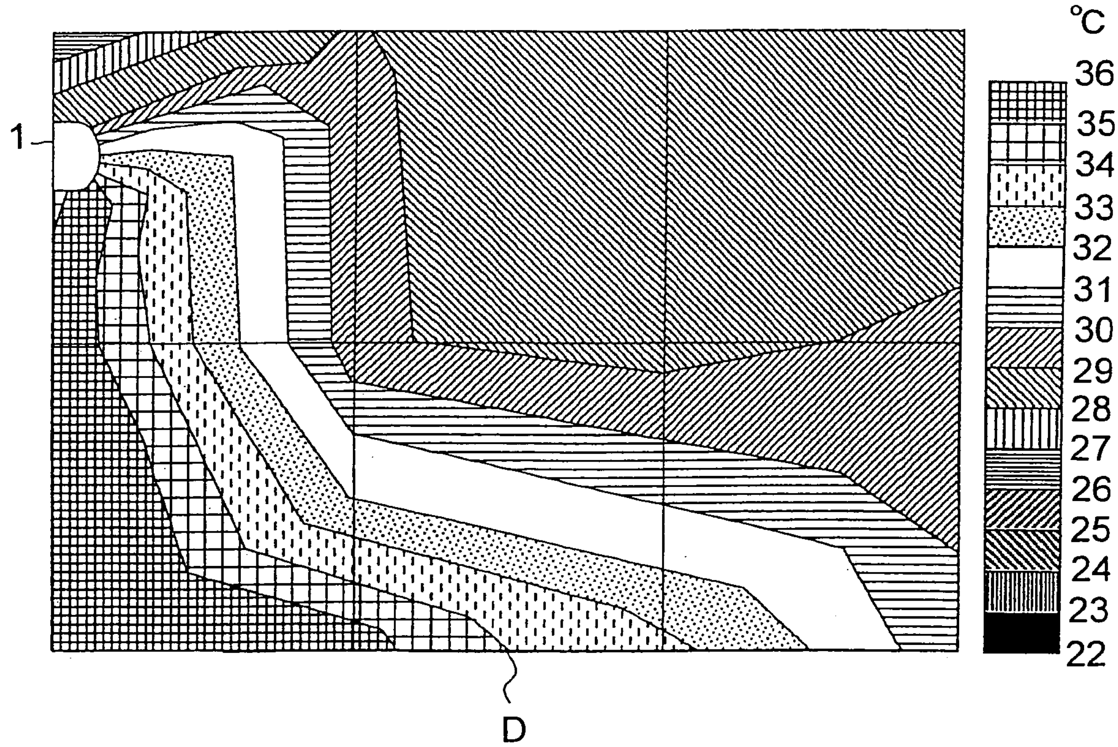


FIG.10

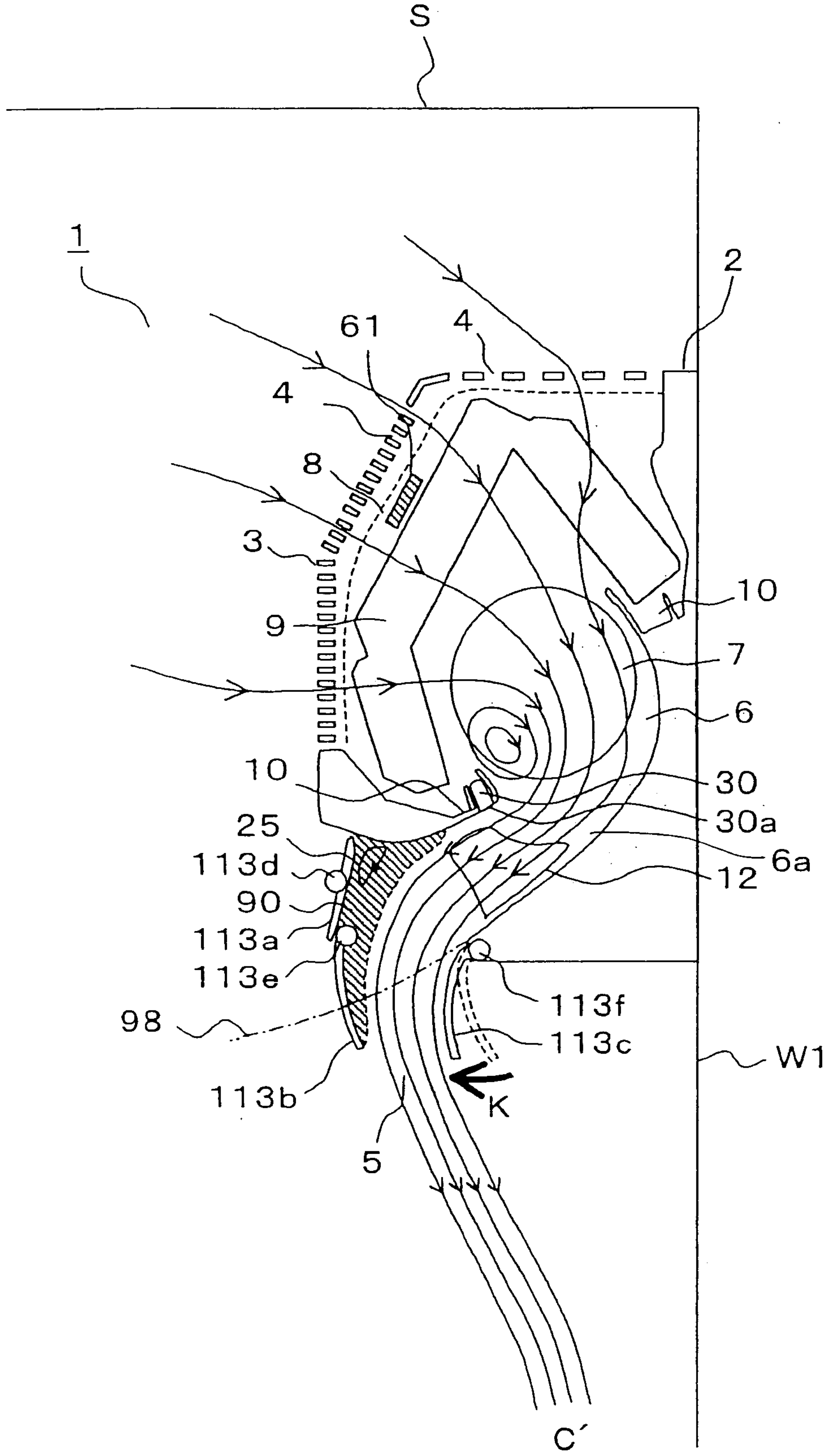

S
1
2
61
4
4
8
3
9
10
10
7
6
30
30a
6a
12
25
113d
90
113a
113e
98
113f
113c
W1
113b
K
5
C´

FIG.11

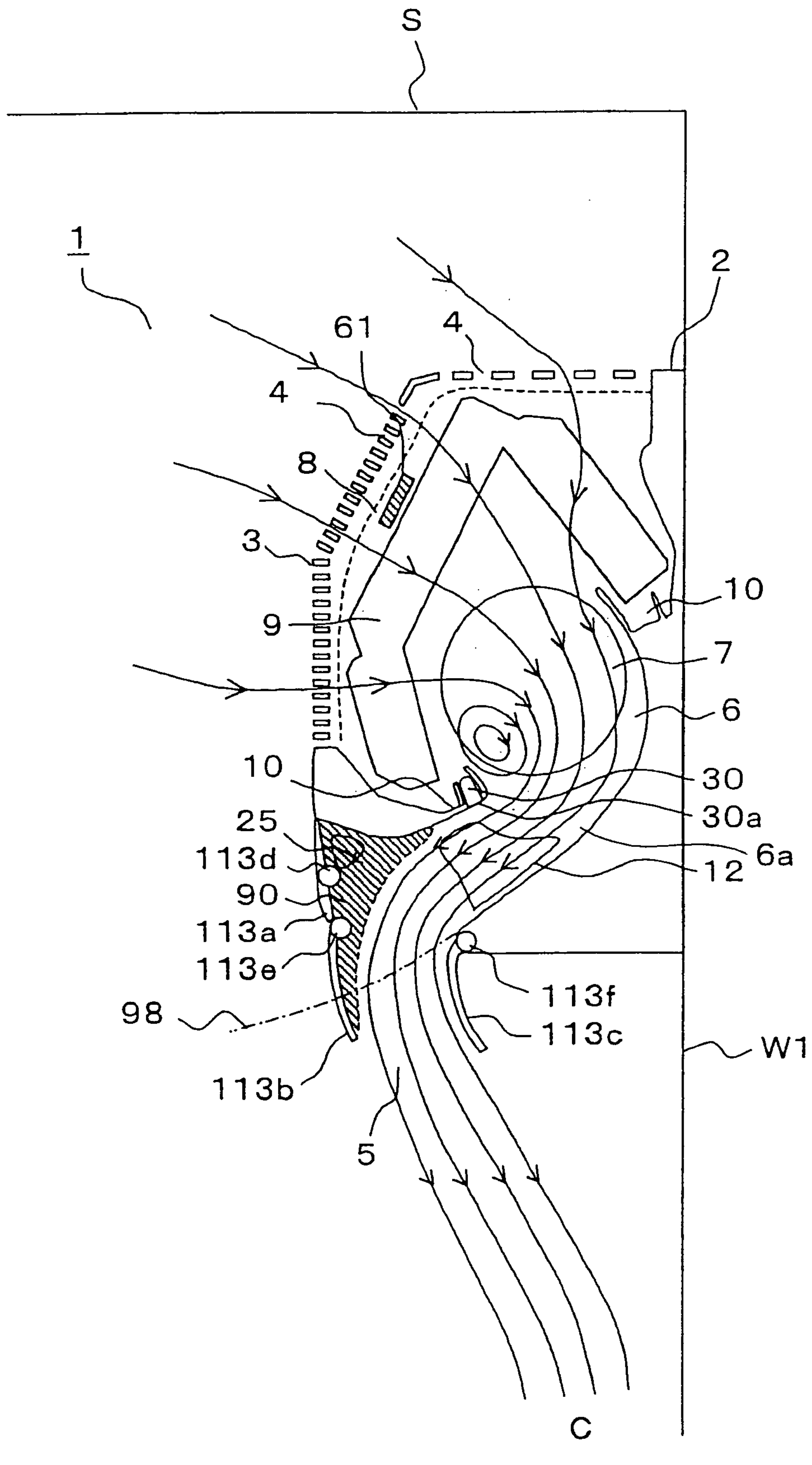
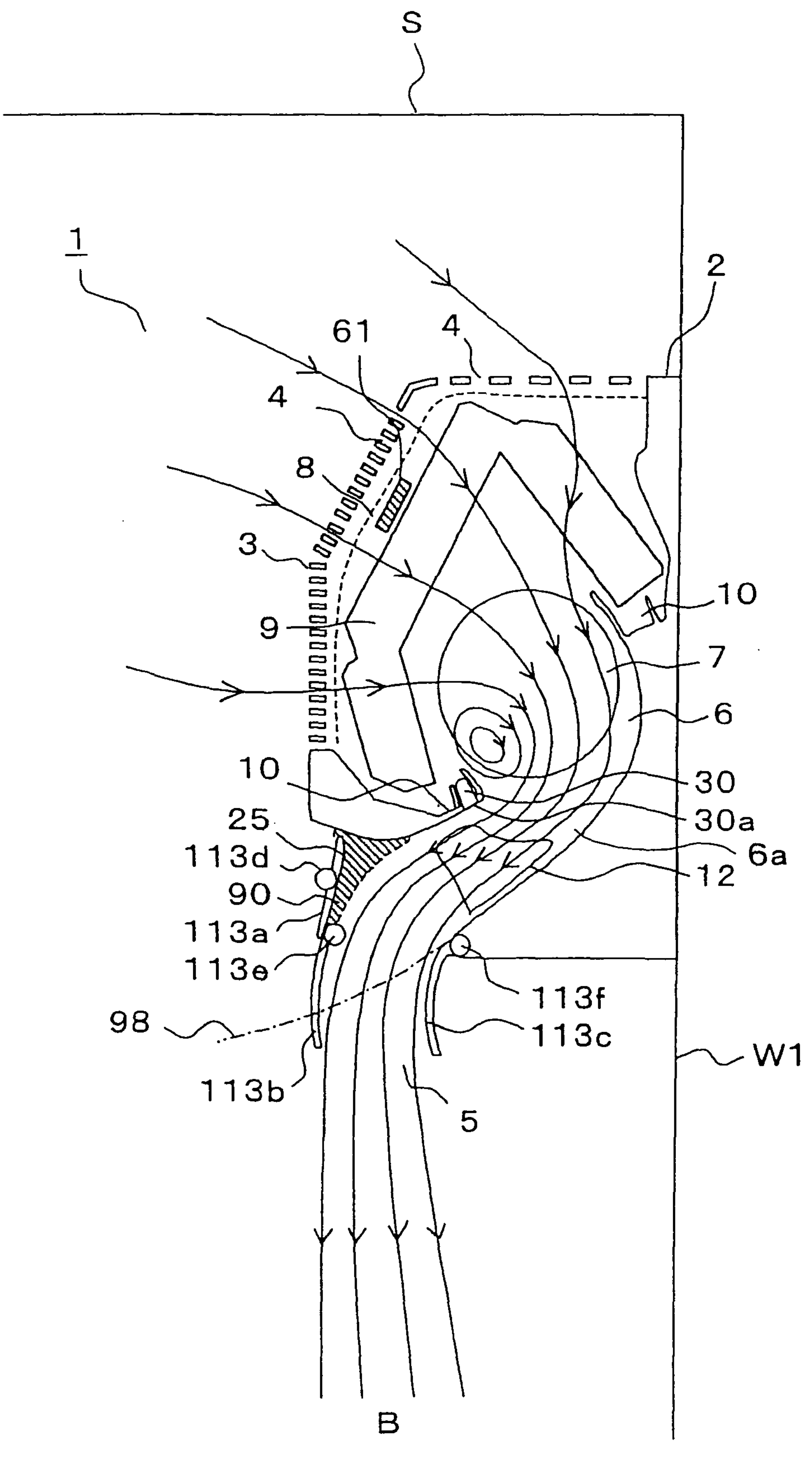

S
1
2
61
4
4
8
3
9
10
7
6
10
30
30a
25
6a
113d
12
90
113a
113e
113f
98
113c
W1
113b
5
C

FIG.12



S
1
2
61
4
4
8
3
9
10
7
6
10
30
30a
25
6a
12
113d
90
113a
113e
113f
98
113c
W1
113b
5
B

FIG.13

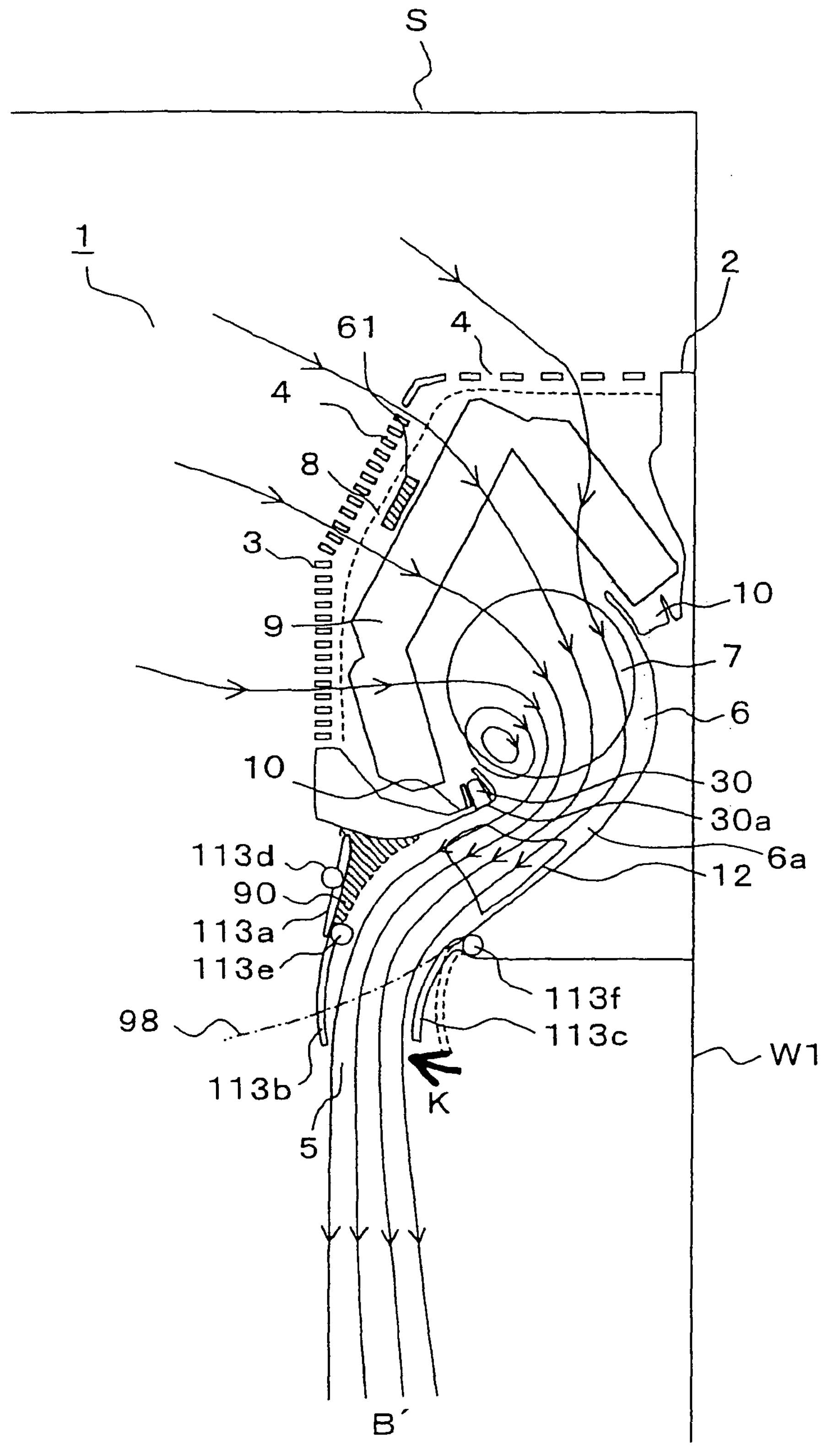

S
1
2
61
4
4
8
3
9
10
10
7
6
30
30a
6a
12
113d
90
113a
113e
113f
98
113c
W1
113b
K
5
B´

FIG.14

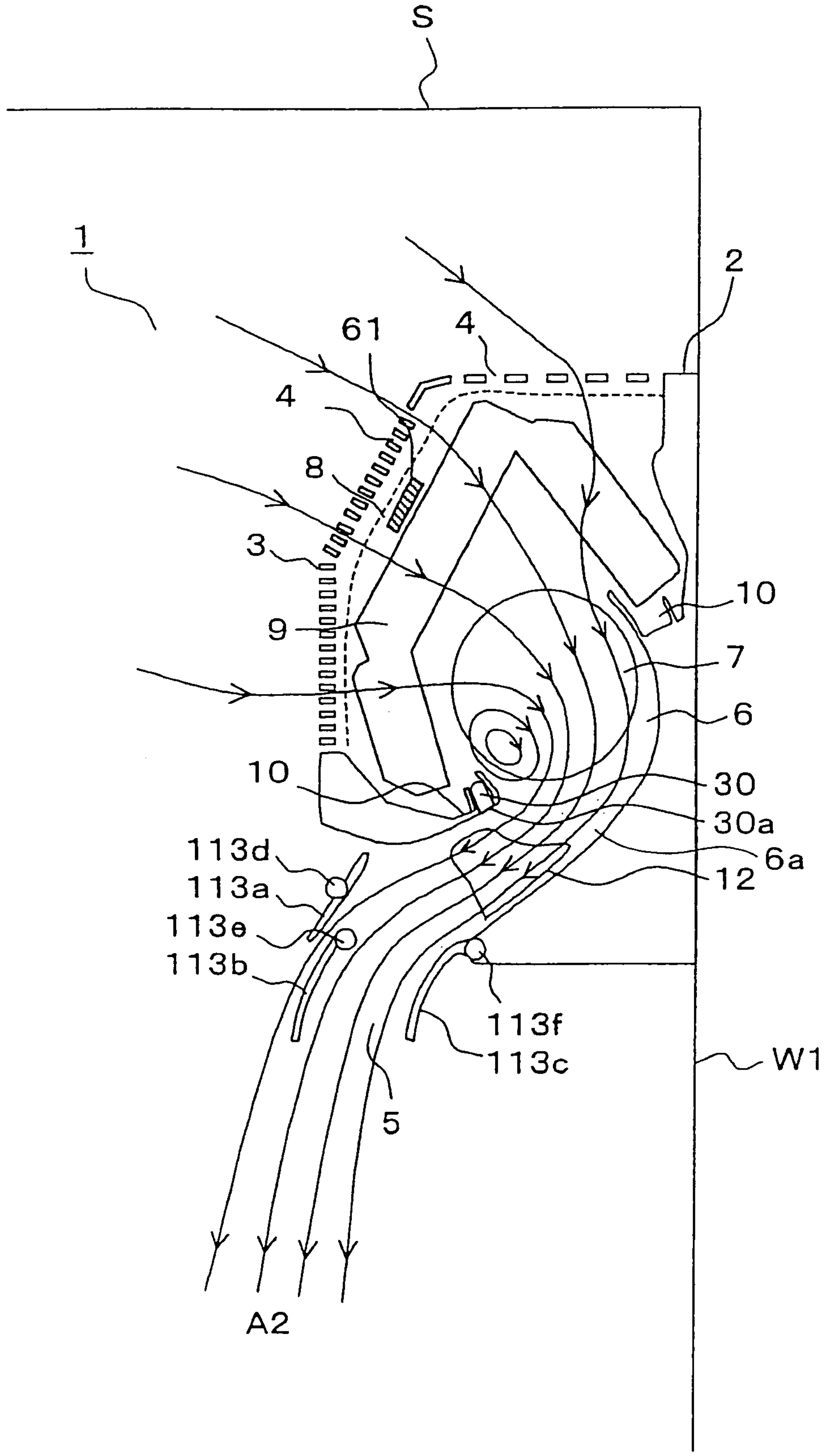

S
1
2
61
4
4
8
3
9
10
10
7
6
30
30a
6a
12
113d
113a
113e
113b
113f
113c
5
W1
A2

FIG.15

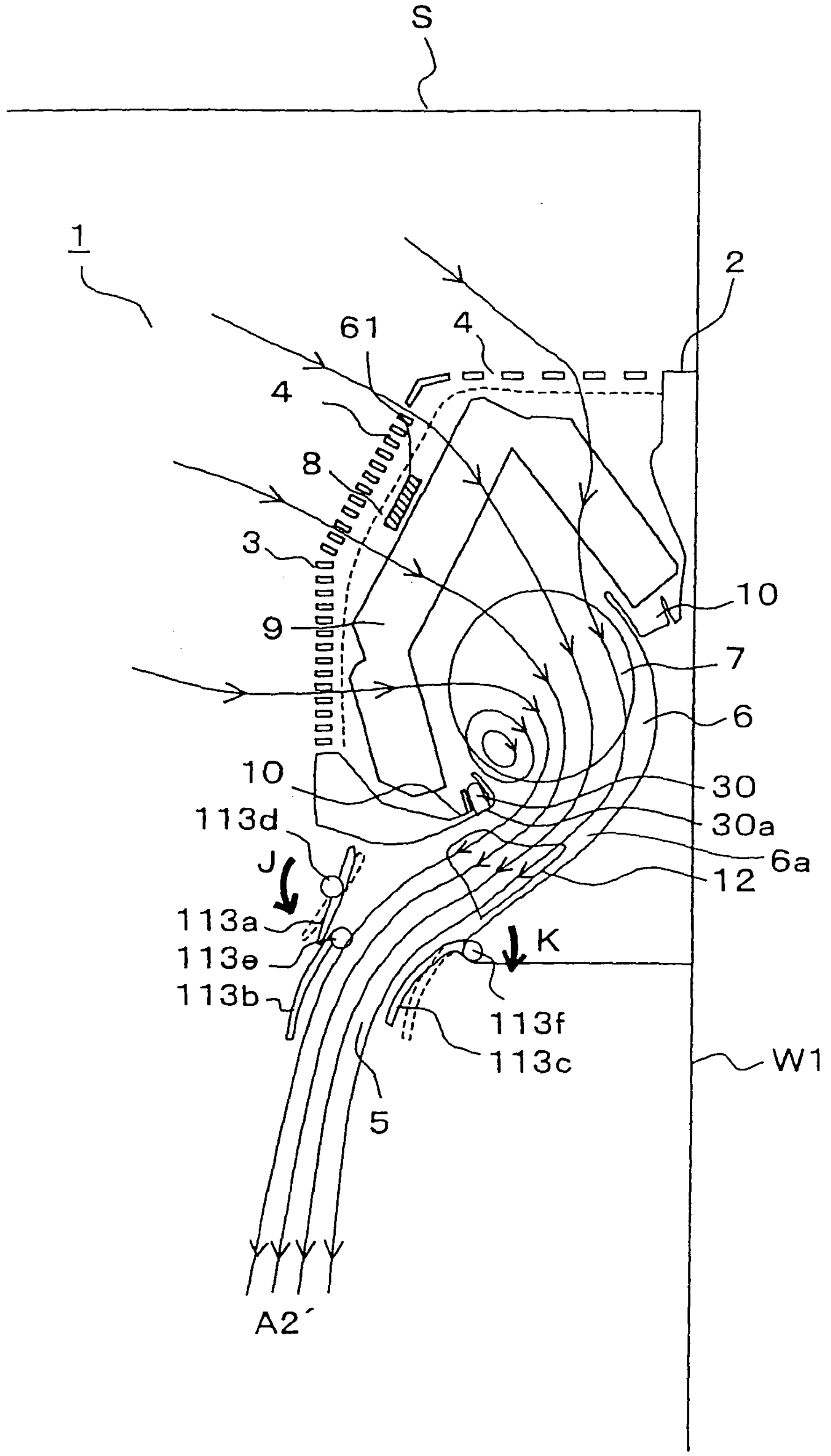

S
1
2
61
4
4
8
3
9
10
7
6
10
30
30a
113d
6a
J
12
113a
113e
K
113b
113f
113c
W1
5
A2´

FIG.16

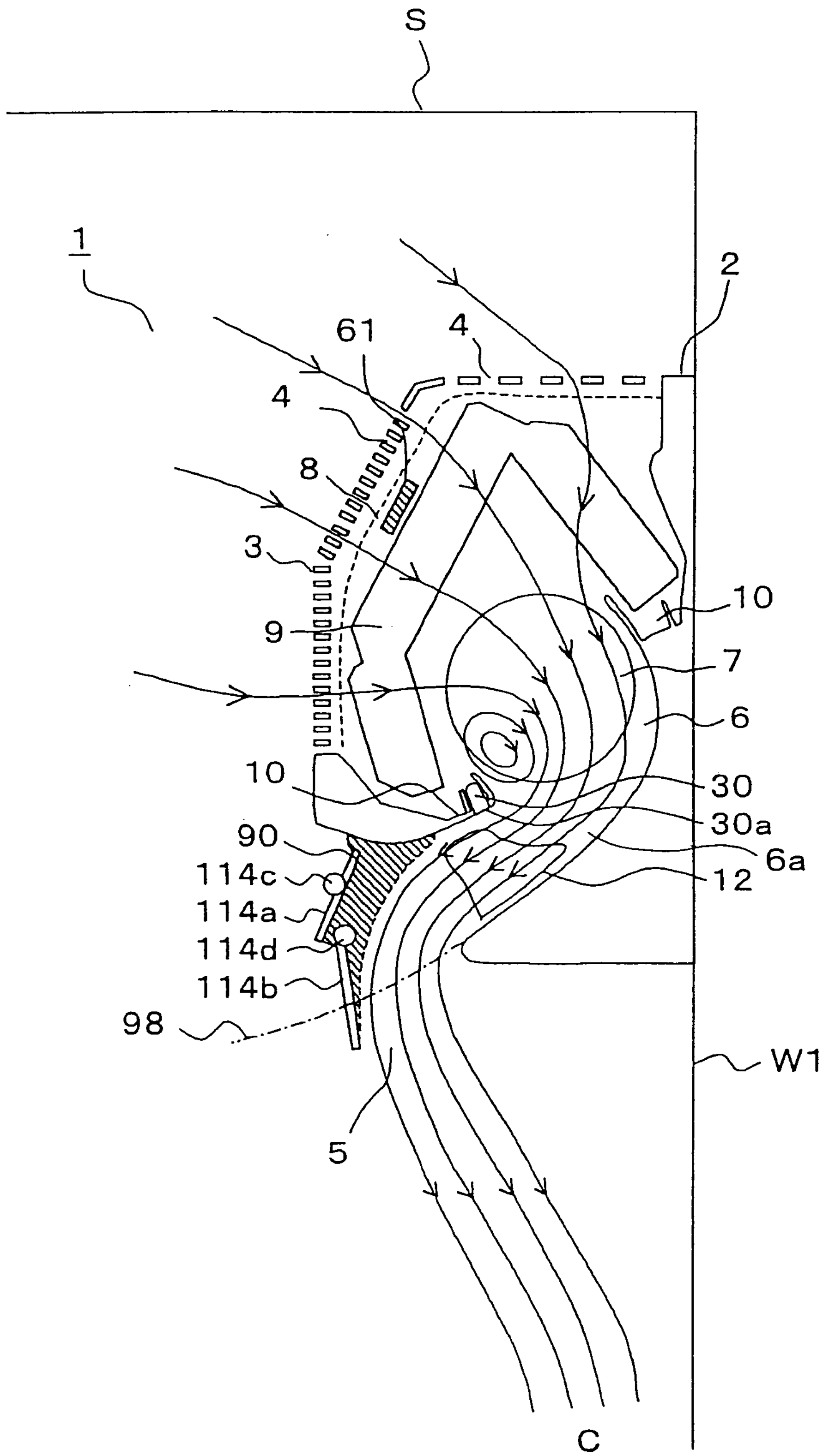


FIG.17

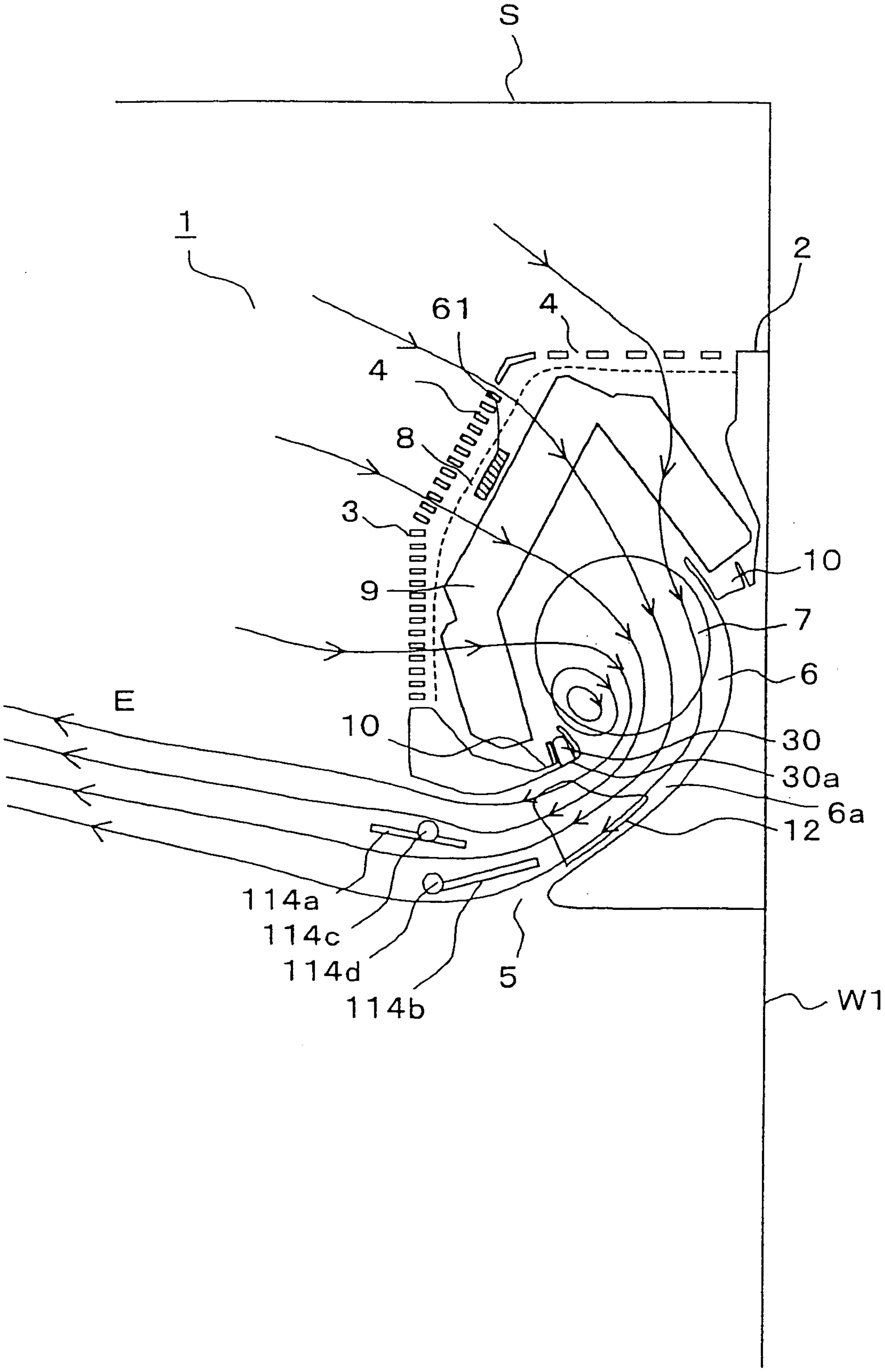


FIG.18

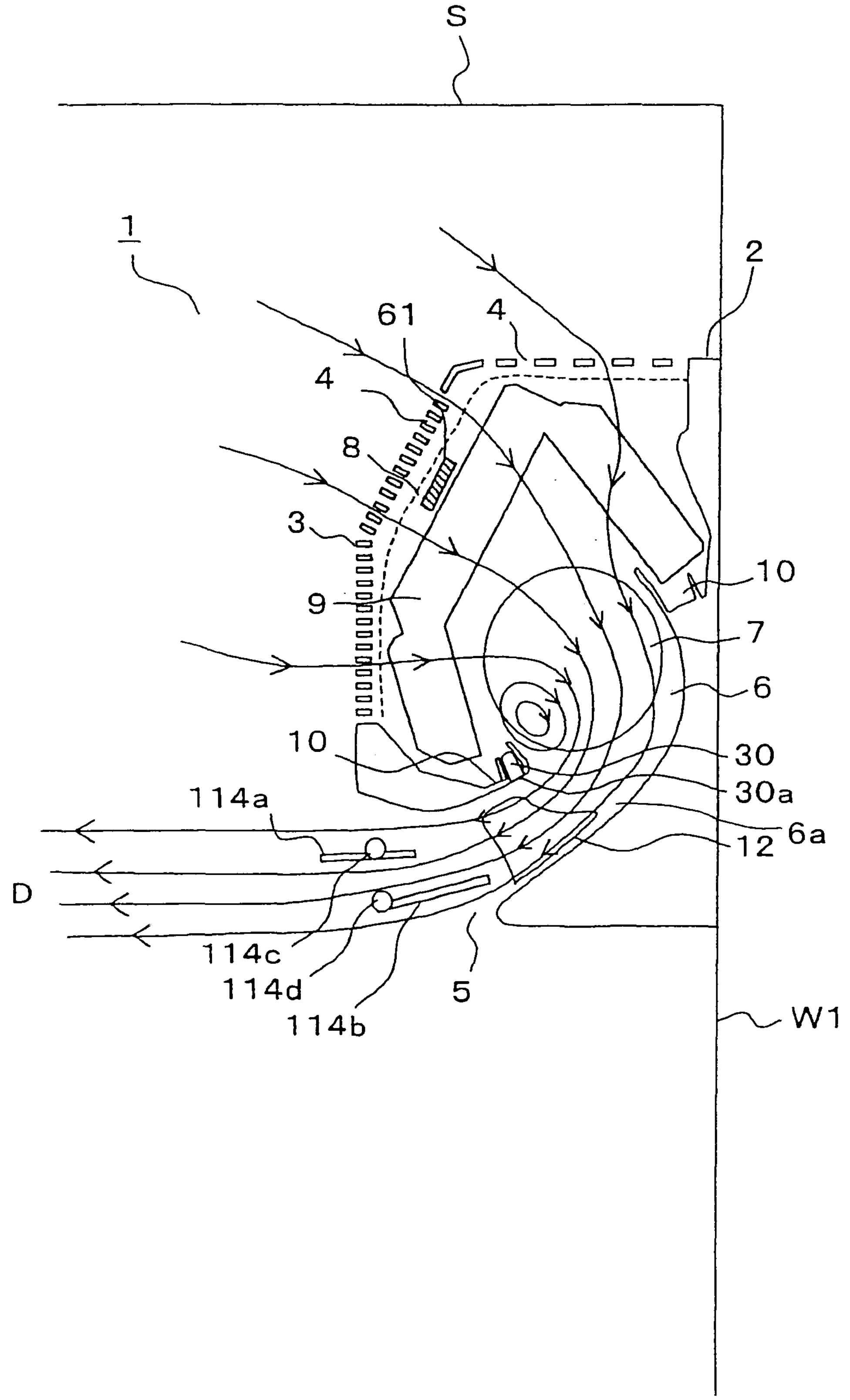


FIG.19

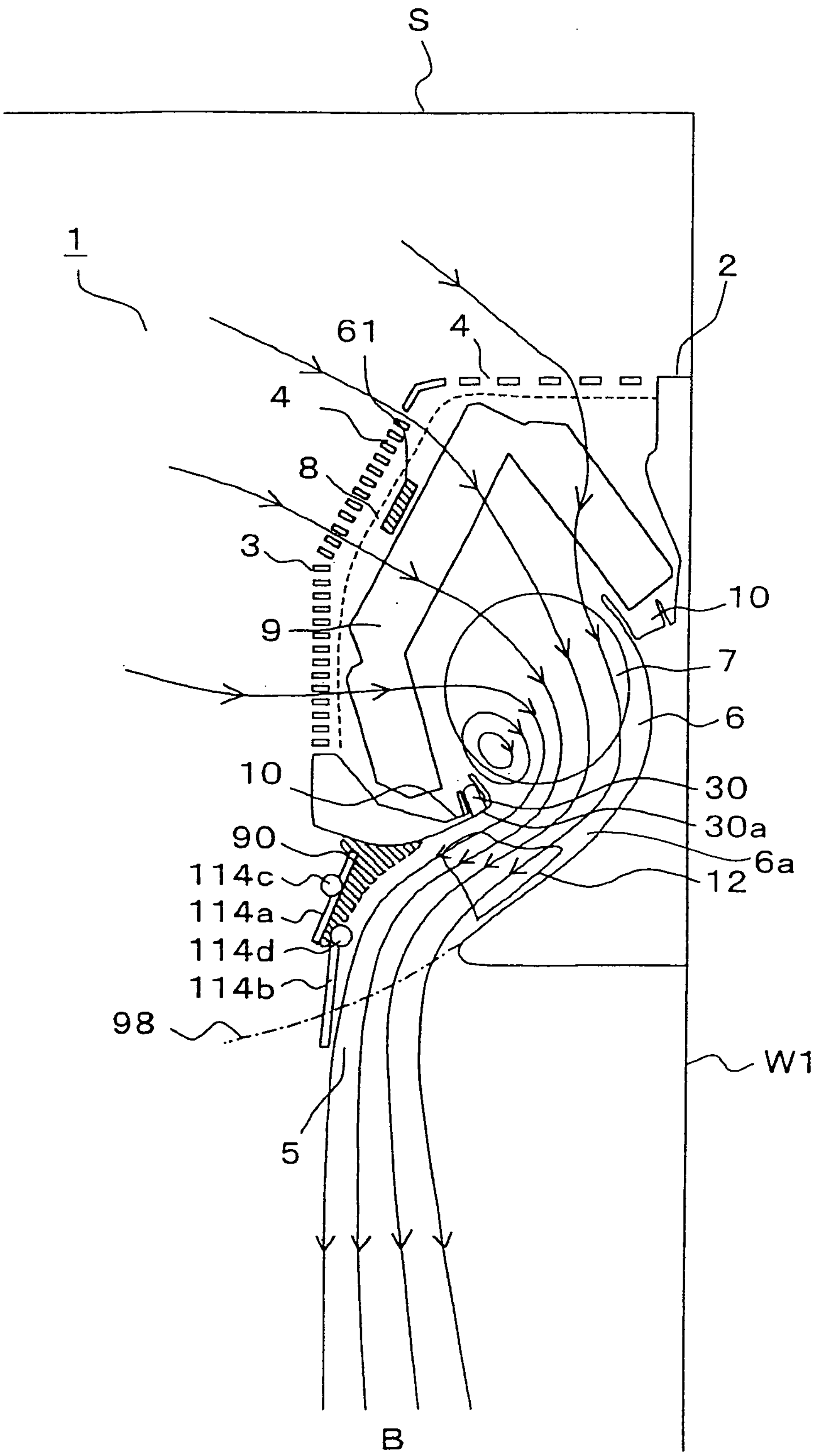


FIG.20

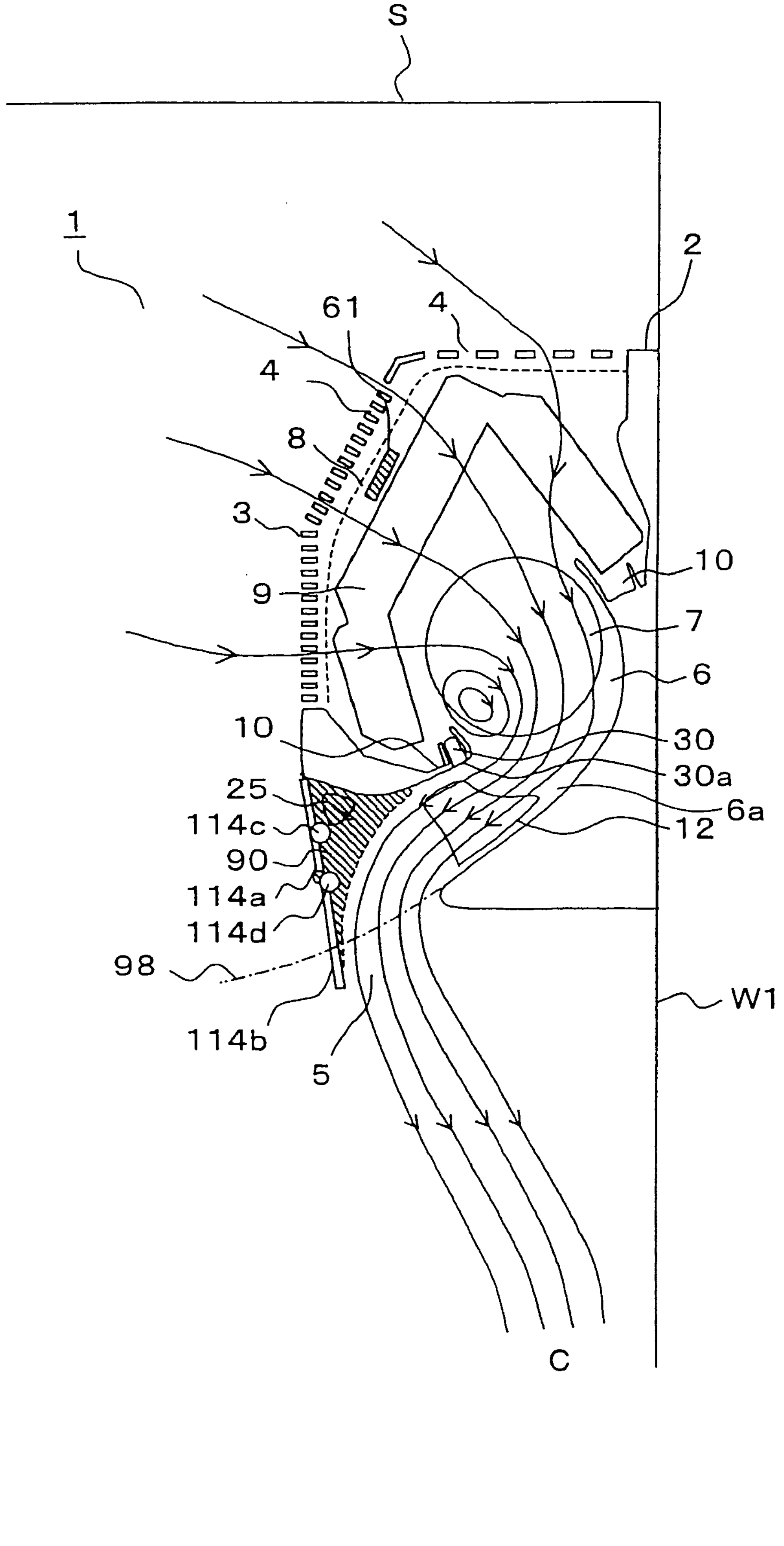

S
1
2
61
4
4
8
3
9
10
7
6
10
30
30a
25
6a
114c
12
90
114a
114d
98
W1
114b
5
C

FIG.21

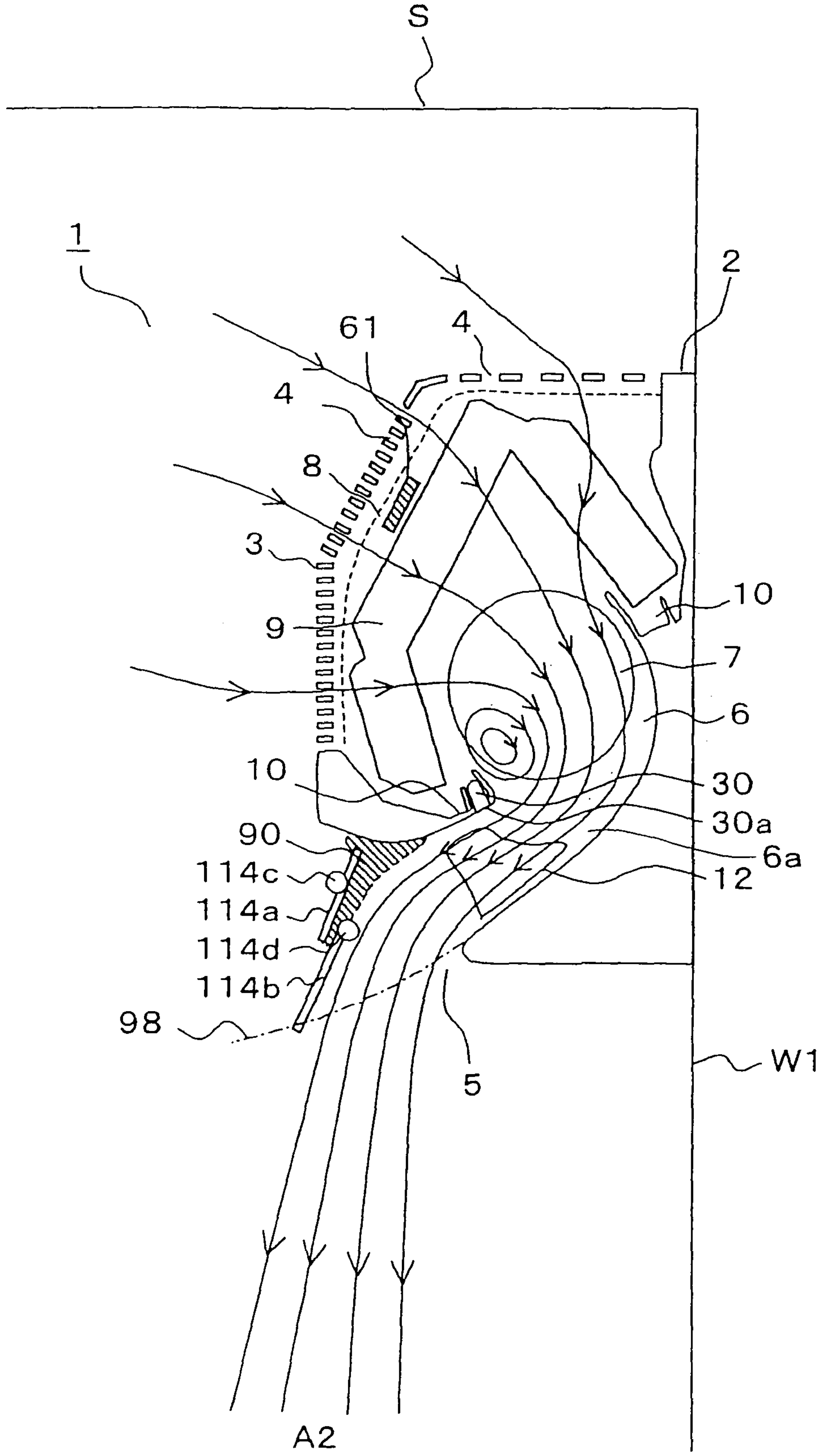

S
1
2
61
4
4
8
3
9
10
7
6
10
30
30a
6a
12
90
114c
114a
114d
114b
98
5
W1
A2

FIG.22

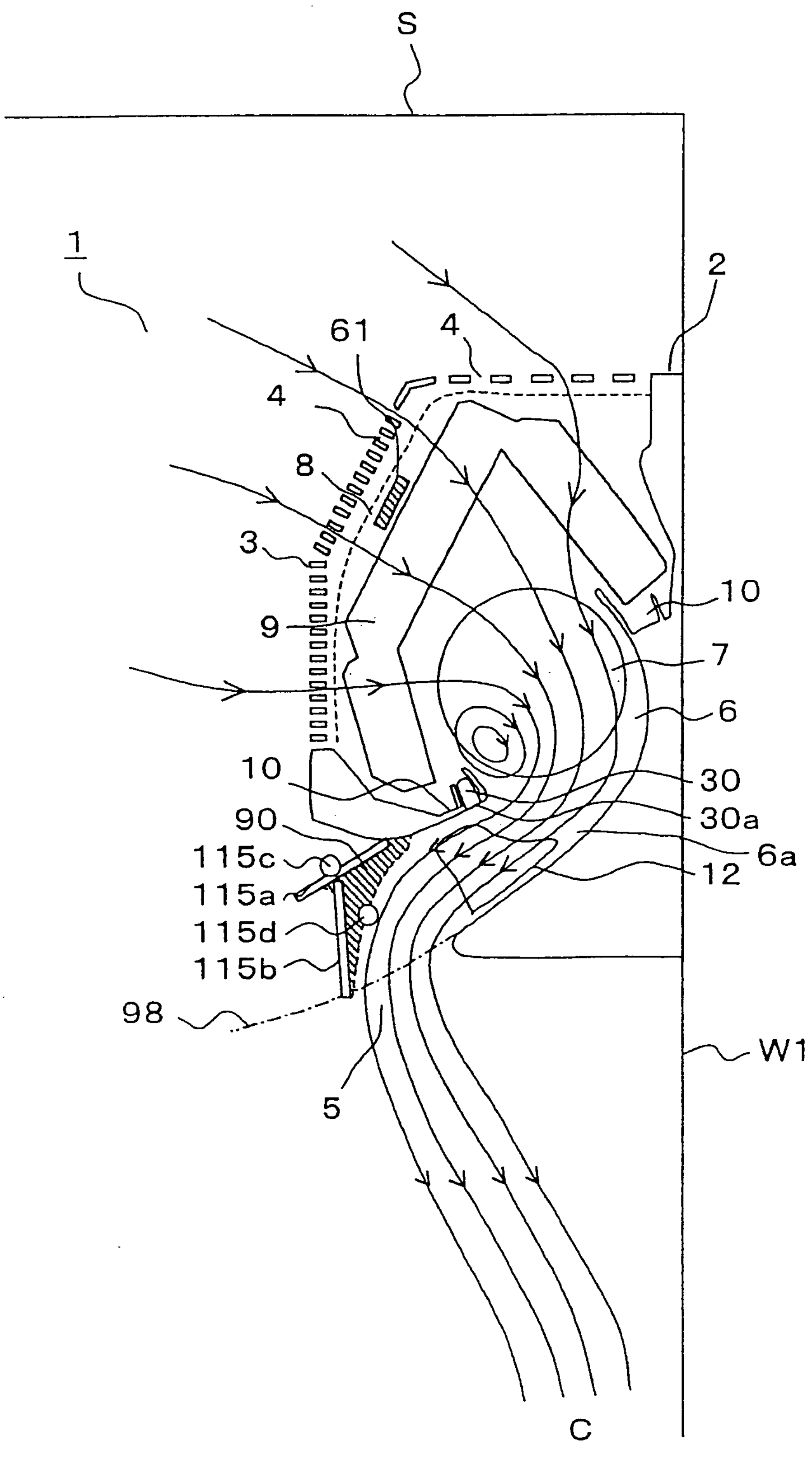


FIG.23

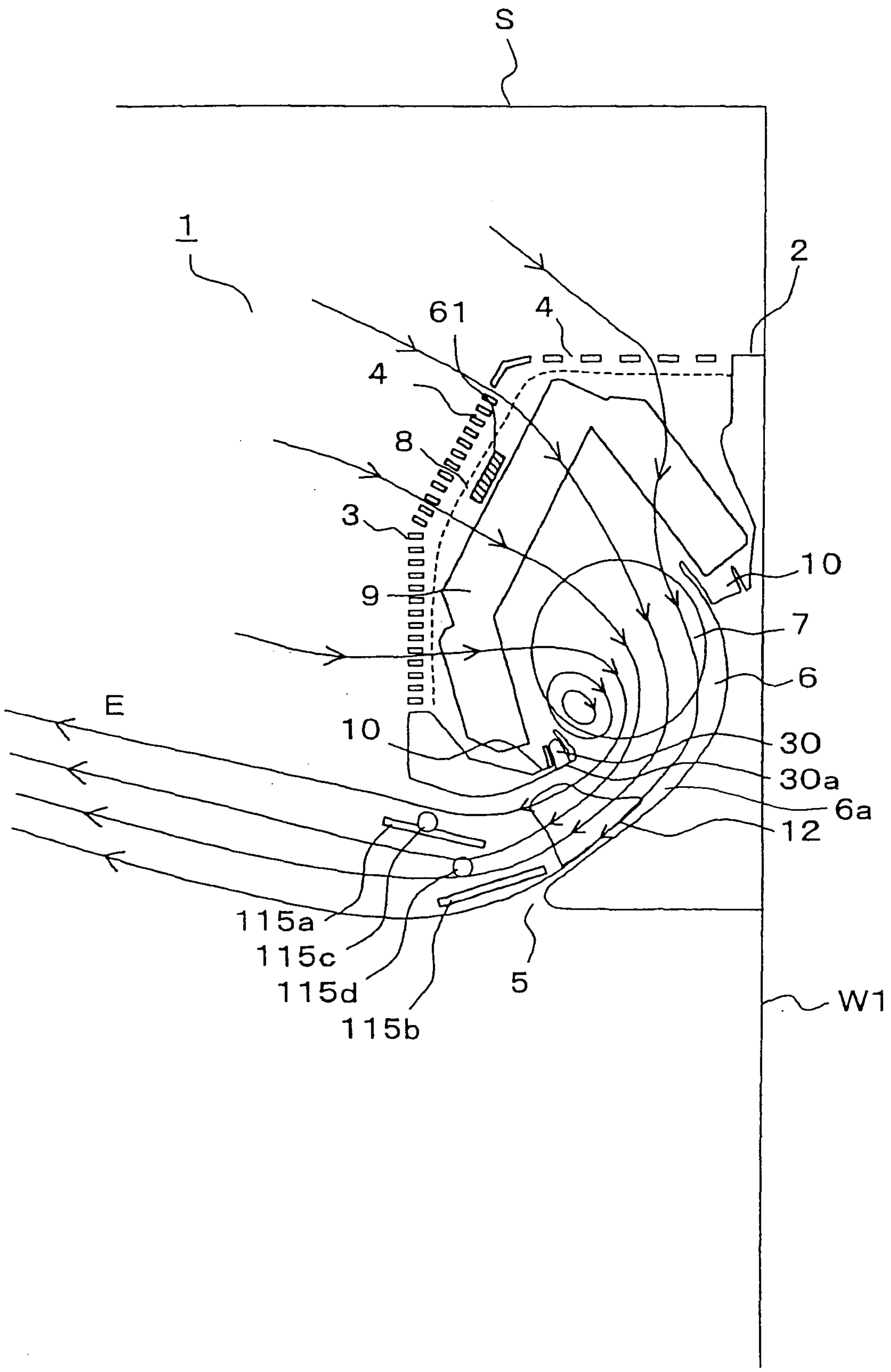


FIG.24

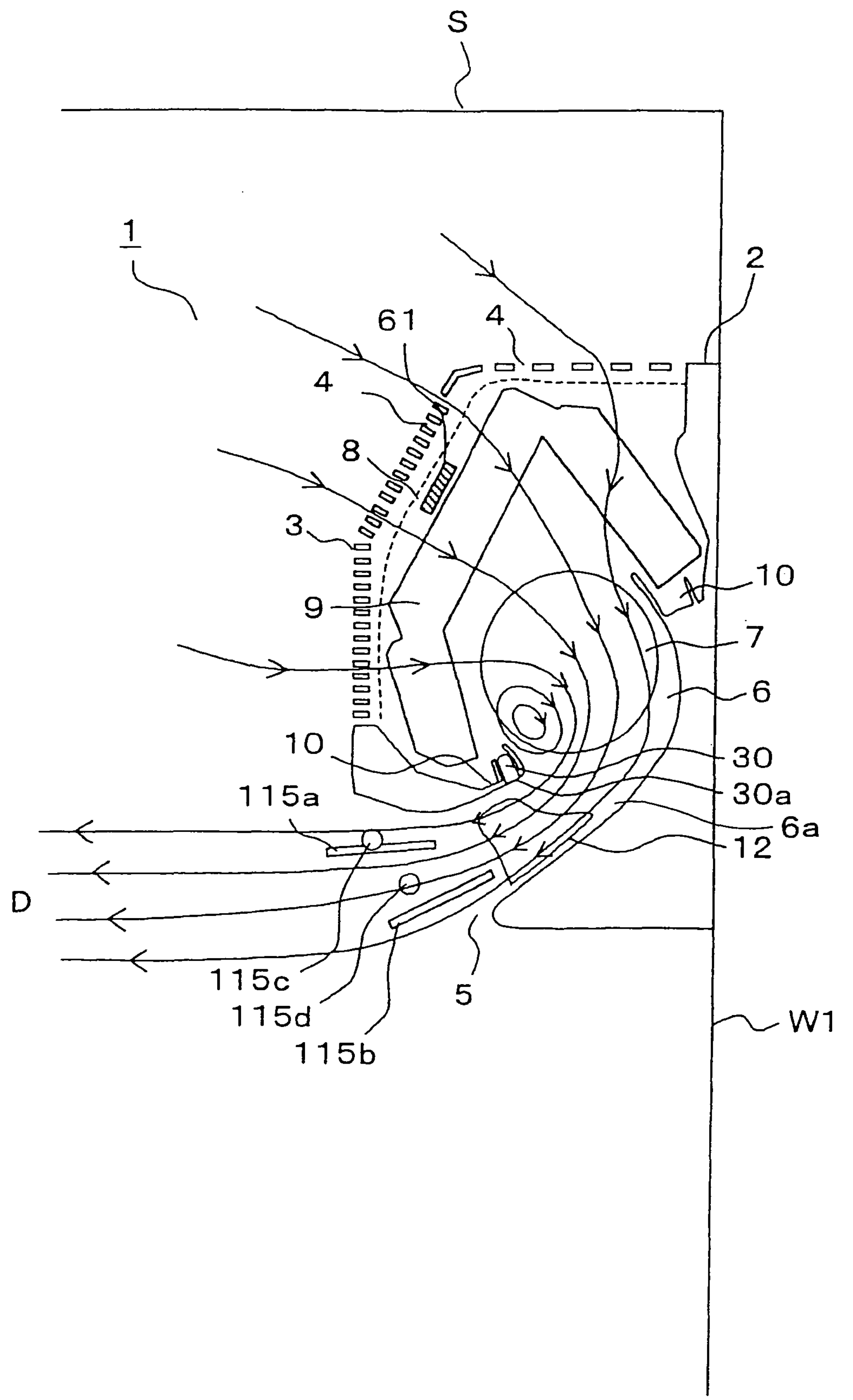


FIG.25

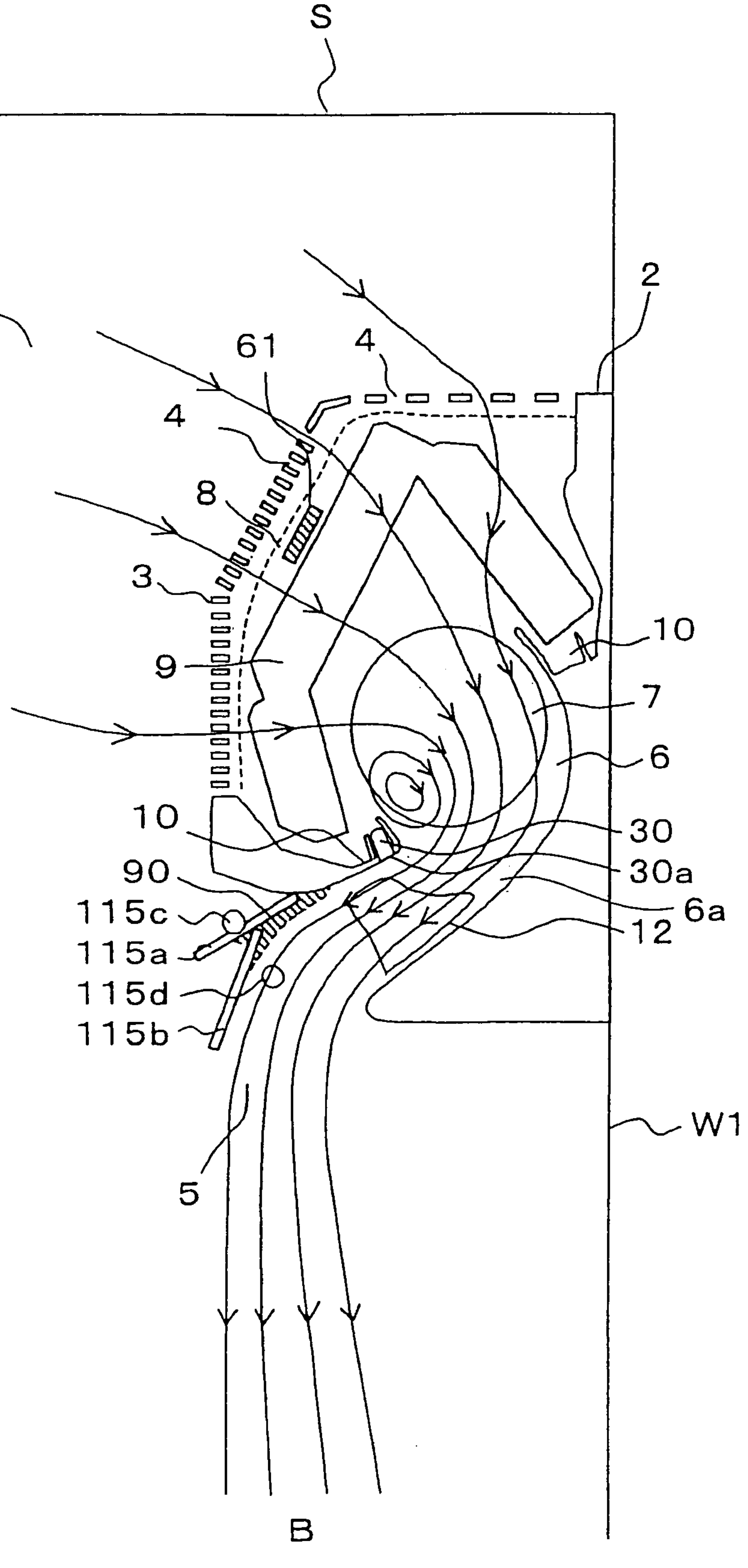


FIG.26

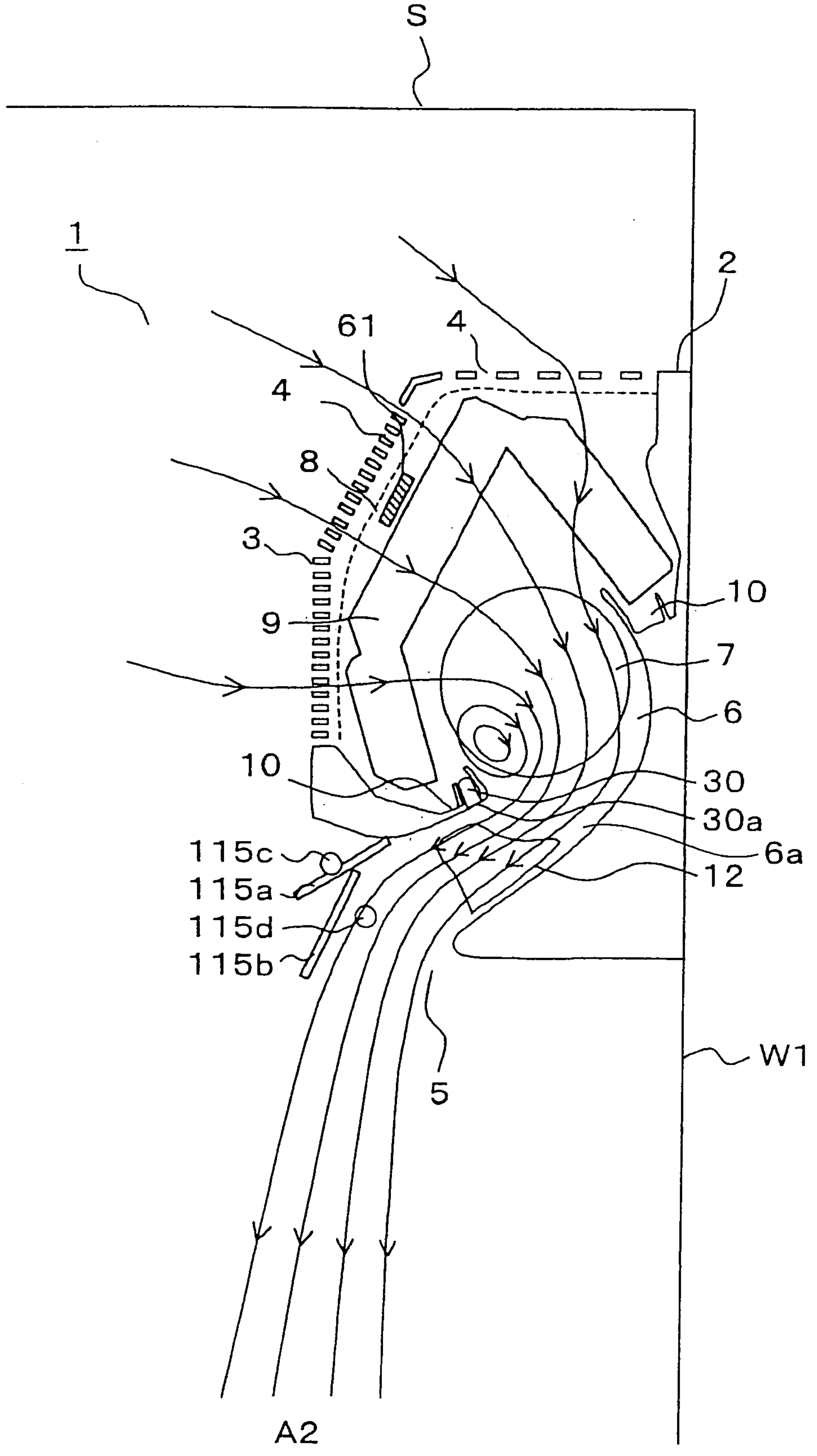


FIG.27

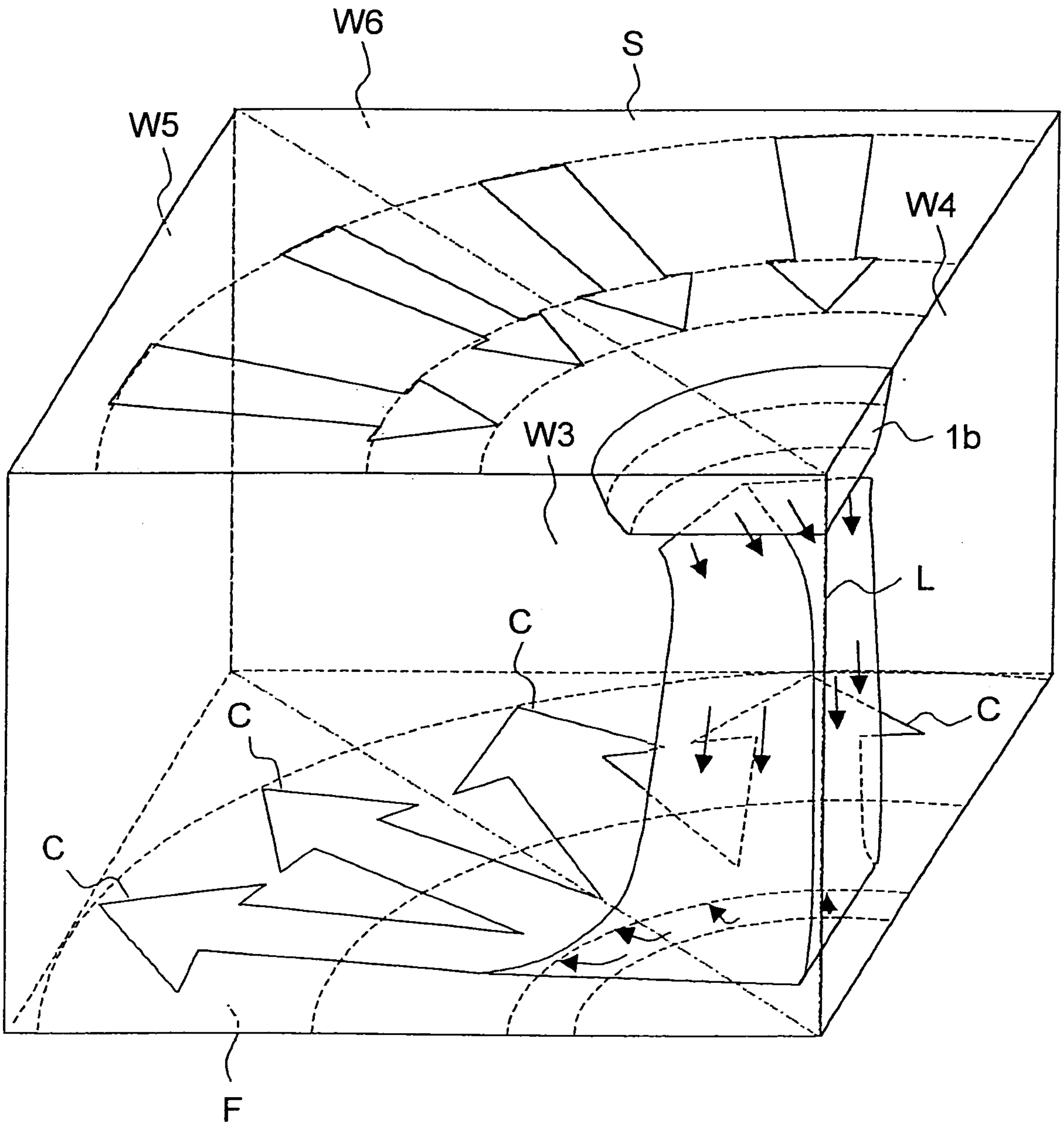


FIG.28

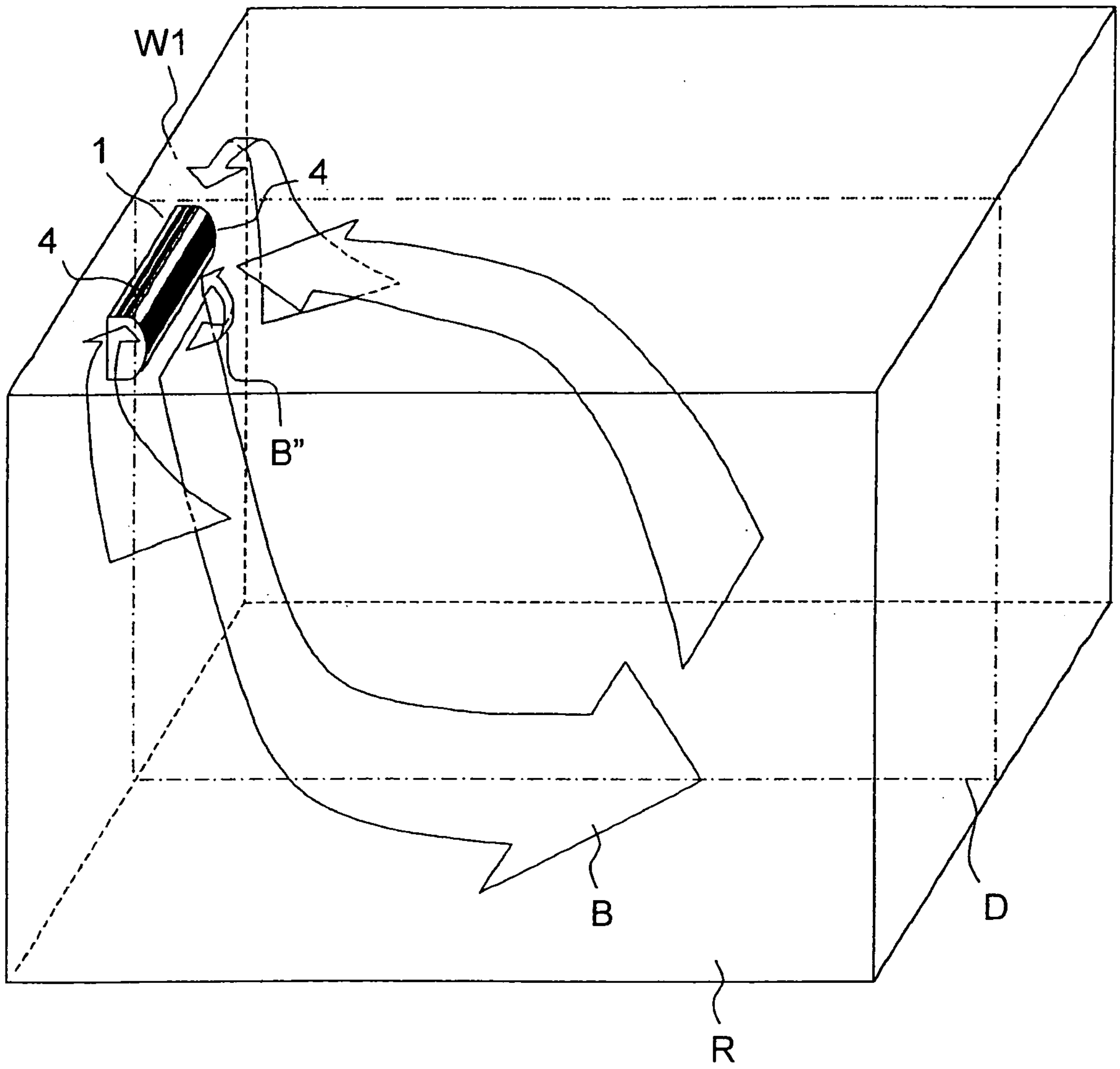


FIG.29

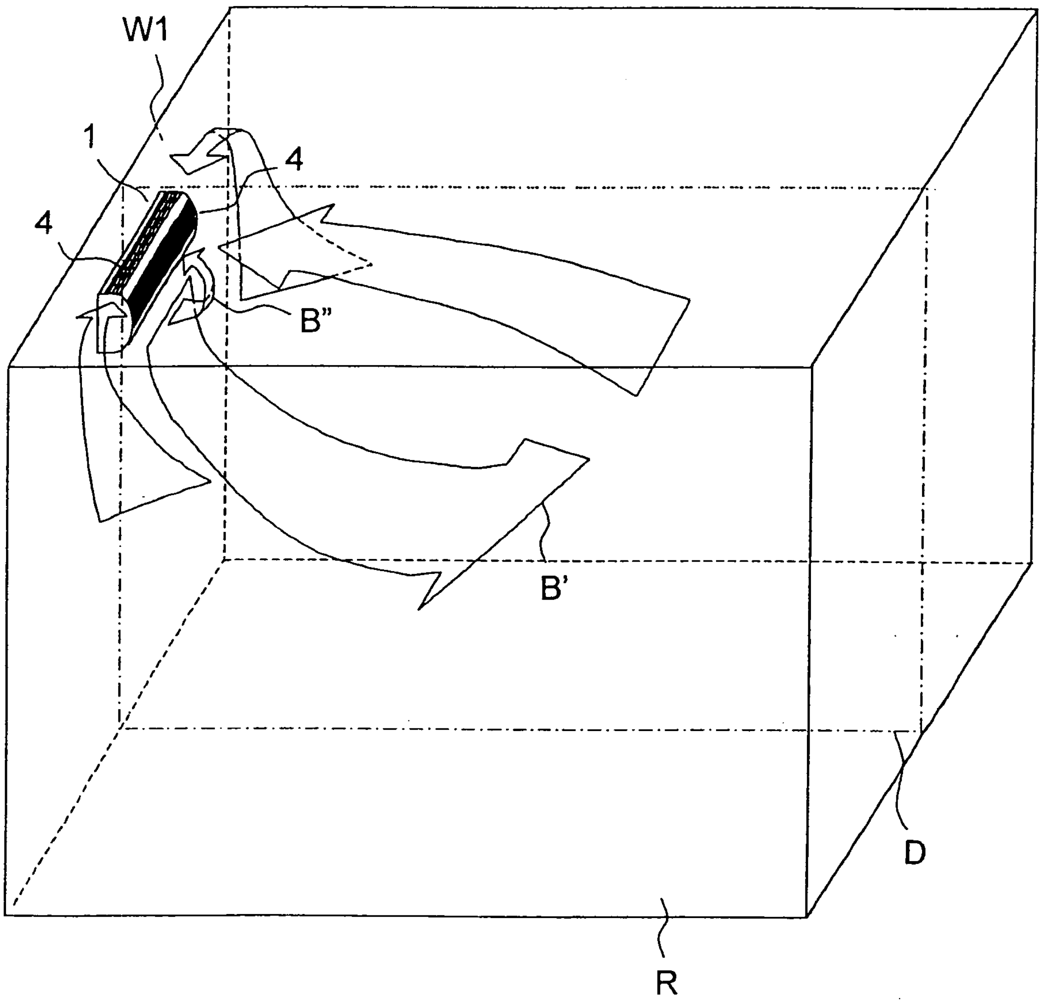


FIG.30

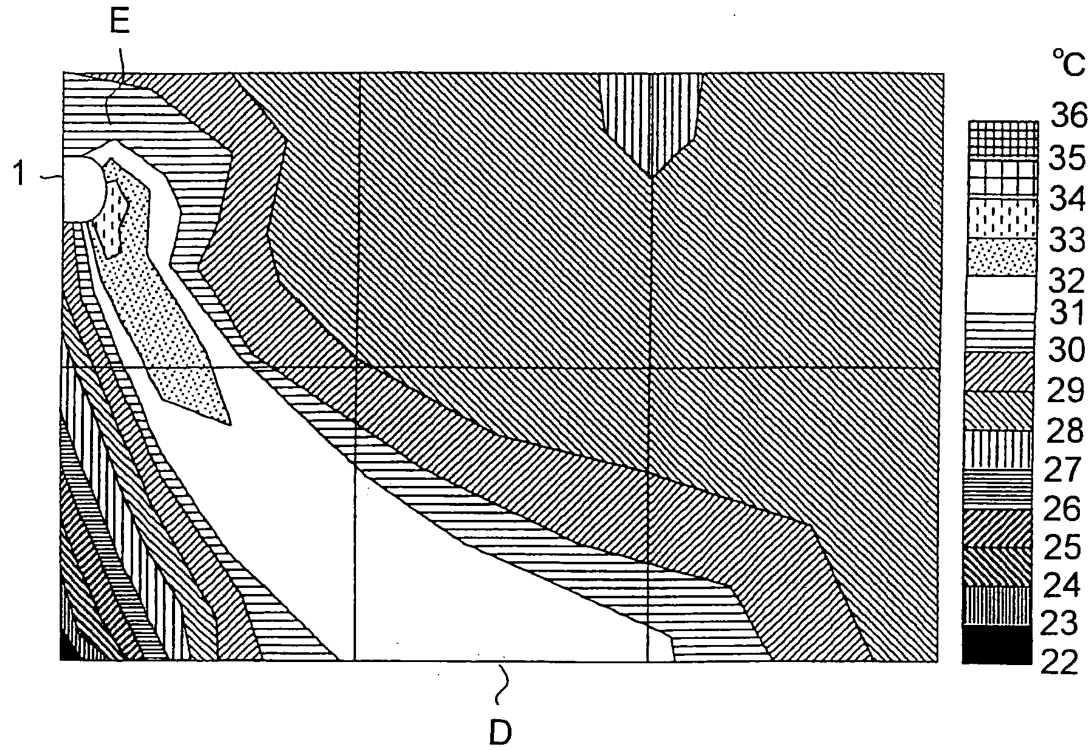
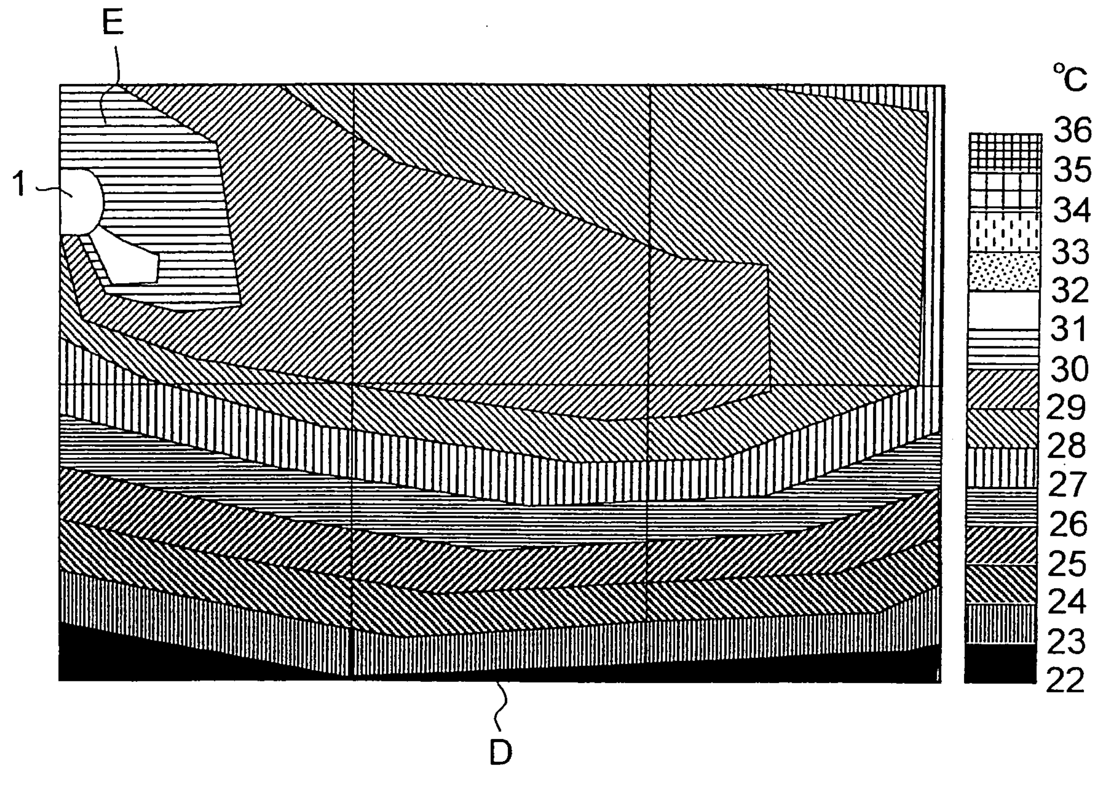


FIG.31



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/017594

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] F24F11/02

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)
Int.Cl[7] F24F11/02

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

Jitsuyo Shinan Koho	1926-1996	Toroku Jitsuyo Shinan Koho	1994-2005
Kokai Jitsuyo Shinan Koho	1971-2005	Jitsuyo Shinan Toroku Koho	1996-2005

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.
X Y	JP 10-19300 A (Toshiba Corp.), 23 January, 1998 (23.01.98), Full text (Family: none)	1-3,5,6 4,7-32
Y	JP 2002-357352 A (Toshiba Carrier Corp.), 13 December, 2002 (13.12.02), Full text (Family: none)	1-32
Y	JP 2002-286243 A (Kabushiki Kaisha Korona), 03 October, 2002 (03.10.02), Full text (Family: none)	9,10

[X] 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
22 February, 2005 (22.02.05)	08 March, 2005 (08.03.05)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/017594

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 2003-185225 A (Fujitsu General Ltd.), 03 July, 2003 (03.07.03), Full text (Family: none)	22
Y	JP 2001-38122 A (Sanyo Electric Co., Ltd.), 13 February, 2001 (13.02.01), Full text (Family: none)	23,24

Form PCT/ISA/210 (continuation of second sheet) (January 2004)

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 2002266437 A **[0002]**
- JP 3311932 B **[0005]**