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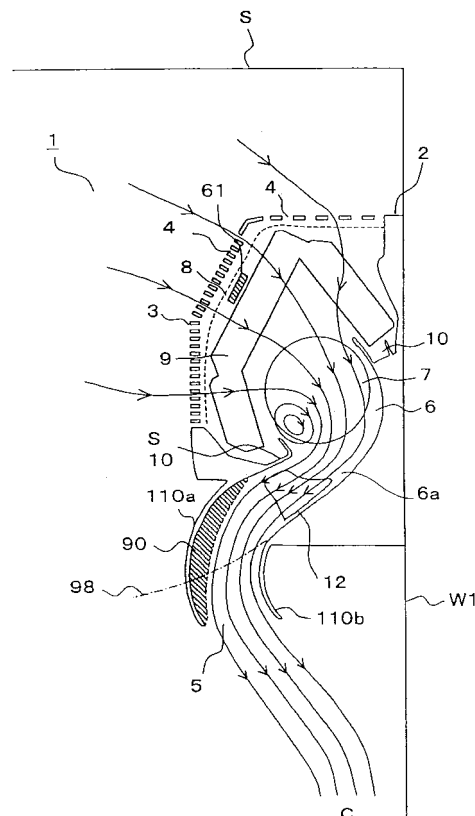
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(54) **AIR CONDITIONER**

(57) In a frontward direction relative to a front guide (6a) that guides conditioned air in a frontward-downward direction within a blowing passage (6), wind deflectors 110a and 110b are provided. When the conditioned air is sent out through the blowout port (5) in a straight downward direction or a rearward-downward direction, the wind deflectors 110a and 110b are so arranged that the static pressure distribution near them has a high static pressure part (90) where the static pressure is higher than in the front guide (6a) and that the isobars (90a) of the high static pressure part (90) run along the flow direction of the conditioned air flowing while facing the wind deflectors 110a and 110b.

FIG.2



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Description**Technical Field**

5 **[0001]** The present invention relates to an air conditioner that takes in air into a cabinet thereof, then conditions the taken air, and then sends out the conditioned air into a room.

Background Art

10 **[0002]** FIG. 47 is a side cross-sectional view showing the indoor unit of the conventional air conditioner described in Japanese Patent Application filed as No. 2002-266437. Usually, the indoor unit 1 of the air conditioner is installed in a position higher than the user's height, and has the main unit thereof held in a cabinet 2. 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 W1 inside a room.

15 **[0003]** 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. In the 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 formed in a substantially rectangular shape extending in the width direction of the indoor unit 1.

20 **[0004]** 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 out air. 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 through 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.

25 **[0005]** The indoor heat exchanger 9 is connected to a compressor (unillustrated) that is arranged outdoor, and, when the compressor is driven, a refrigeration cycle is operated. 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.

30 **[0006]** 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 into the cabinet 2. The temperature sensor 61 detects the temperature of the air sucked in through the suction port 4 so that, according to its difference from the target room temperature specified by the user (hereinafter referred to as the "user-specified temperature"), the operating frequency of the refrigeration cycle and the wind volume sent by the blowing fan 7 are controlled.

35 **[0007]** 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 during cooling or drying operation. The front-side drain pan 10 is fitted to the front panel 3, and the rear-side drain pan 10 is formed integrally with the cabinet 2.

40 **[0008]** In the blowing passage 6, near the blowout port 5, horizontal louver elements 11a and 11b are provided to face outward. The horizontal louver elements 11a and 11b permit the blowout angle in the up/down direction to be varied freely between a substantially horizontal direction and a rearward-downward direction. Behind the horizontal louver elements 11a and 11b, vertical louver elements 12 are provided that permit the blowout angle in the left/right direction to be varied.

45 **[0009]** In the air conditioner configured as described above, when the air conditioner is started to perform heating operation, the blowing fan 7 is driven to rotate, and the refrigerant from the outdoor unit (unillustrated) flows to the indoor heat exchanger 9 to operate the refrigeration cycle. Now, air is sucked through the suction port 4 into the indoor unit 1, and the dust contained in the air is removed by the air filter 8.

50 **[0010]** The air sucked into the indoor unit 1 exchanges heat with the indoor heat exchanger 9 and is thereby heated. The air then passes through the blowing passage 6, and then has its direction in the left/right and up/down directions restricted by the vertical louver elements 12 and the horizontal louver elements 11a and 11b. Thus, the conditioned air is sent out through the blowout port 5 into the room in a frontward-downward direction as indicated by arrow A.

55 **[0011]** When, for example, the difference between the temperature inside the room and the user-specified temperature is small, the wind direction is set in a substantially straight downward direction by the horizontal louver elements 11a and 11b as shown in FIG. 48. Thus, the conditioned air is sent out through the blowout port 5 in a substantially straight downward direction as indicated by arrow B1. This permits the conditioned air to reach the floor surface inside the room and spread all over the floor surface.

60 **[0012]** Moreover, since warm air has a low specific gravity, part of the air stream sent out through the blowout port 5 bounces back and rises as indicated by arrow B3. This causes problems such as a lowering of heating performance due to a short circuit and uneven heating in which, while an upper part of a room is heated, a lower part thereof is not heated as desired.

65 **[0013]** As a solution, Japanese Patent Application filed as No. 2003-005378 describes an air conditioner that can send out the conditioned air rearward through the blowout port 5 as shown in FIG. 49. With this configuration, the air sent out through the blowout port 5 in a rearward-downward direction as indicated by arrow C flows, by the Coanda effect, along

the side wall W1 to reach the floor surface. This helps prevent the warm air sent out downward from bouncing back, and thus helps improve heating efficiency and comfort.

[0014] On the other hand, Patent Publication 1 listed below discloses an air conditioner that permits the orientation of a wind direction plate to be varied so that the conditioned air can be sent out in a substantially straight downward direction.

Patent Publication 1: JP-B-3 311 932.

Disclosure of the Invention

Problems to be Solved by the Invention

[0015] FIG. 50 shows the static pressure distribution near the blowout port 5 as observed when, in the conventional air conditioner described above, the conditioned air is sent out through the blowout port 5 in a frontward-downward direction. According to this figure, the static pressure distribution near the blowout port 5 is even. By contrast, when the conditioned air is sent out through the blowout port 5 in a substantially straight downward direction, the conditioned air that flows through the blowing passage 6 has its wind direction changed by about 45° by the horizontal louver elements 11a and 11b so as to be directed in a straight downward direction. FIG. 51 shows the static pressure distribution near the blowout port 5 as observed in this case. As this figure shows, in the blowing passage 6, a high static pressure part 90 (indicated by hatching in FIG. 48) is produced where the static pressure is far higher than elsewhere.

[0016] The conditioned air that flows through the blowing passage 6 passes through the high static pressure part 90. In other words, the conditioned air flows such that the isobars of the static pressure in the high static pressure part 90 cross the stream lines of the air stream. This causes a large pressure loss, and thus lowers blowing efficiency. Specifically, assuming that the rotation rate of the blowing fan 7 is equal, the wind volume lowers to about 70 to 80% of the maximum wind volume (obtained when the conditioned air is blown out in a frontward-downward direction as described above). That is, under the condition that the isobars of the high static pressure part 90 cross the air stream, when the air stream passes through the high static pressure part 90, a large pressure loss is produced. This is the cause of the so-called bending loss.

[0017] In a case where the conditioned air is sent out through the blowout port 5 in a rearward-downward direction, the conditioned air that flows through the blowing passage 6 has its wind direction changed by about 90° by the horizontal louver elements 11a and 11b so as to be directed in a rearward-downward direction. FIG. 52 shows the static pressure distribution near the blowout port 5 as observed in this case. As this figure shows, in the blowing passage 6, a high static pressure part 90 (indicated by hatching in FIG. 49) is produced where the static pressure is higher than in the case shown in FIG. 51. Thus, assuming that the rotation rate of the blowing fan 7 is equal, the wind volume lowers to about 50 to 60% of the maximum wind volume (obtained when the conditioned air is blown out in a frontward-downward direction as described above).

[0018] The smaller the wind volume sent out through the blowing port 6, the shorter the distance over which the warm air reaches, and thus the more likely the air stream flows off the side wall W1 and bounces back by its buoyant force. This makes it impossible to achieve air conditioning up to all corners of the room, and causes the temperature near the floor surface to rise. This not only makes the user feel uncomfortable but also locally lowers the user's body temperature, harming his health. One solution is to increase the rotation rate of the blowing fan 7 thereby to increase the wind volume of the conditioned air sent out, but doing so also increases noise.

[0019] Another solution is to design the blowing passage 6 to run downward to reduce the pressure loss occurring when the conditioned air is blown out in a straight downward or rearward-downward direction and thereby to reduce noise. Doing so, however, not only reduces the wind volume obtained when the conditioned air is blown out in a horizontal or frontward direction but also makes the horizontal louver elements 11a and 11b more likely to collect condensed moisture during cooling operation.

[0020] In the air conditioner disclosed in Patent Publication 1, a sharp change in the wind direction causes the air stream to flow off the wind direction plate, and this makes it difficult to set the wind direction in a desired direction. Moreover, also in this case, as in the case described above, a high static pressure part is produced near the wind direction plate, and the isobars cross the air stream. This increases the pressure loss, and thus reduces the wind volume.

[0021] An object of the present invention is to provide an air conditioner that permits the wind direction of the air sent out through the blowout port thereof to be switched, while permitting the conditioned air to reach all corners of a room and permitting reduction of noise.

Means for Solving the Problem

[0022] 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 includes a suction port through which air inside the room is taken in, a blowout port

through which the air taken in through the suction port and then conditioned is sent out into the room, a blowing passage through which the conditioned air is directed to the blowout port, and a wind deflector that permits the wind direction of the conditioned air sent out through the blowout port to be varied between a frontward-downward direction and a straight downward direction or a rearward-downward direction is characterized in that, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, the wind deflector is so arranged that the isobars of the static pressure distribution near the wind deflector run along the flow direction of the conditioned air facing the wind deflector.

[0023] With this configuration, the air conditioner is installed on a wall surface of a room, and, for example, when cooling operation is performed, the conditioned air is sent out through the blowout port in a frontward-downward direction; when heating operation is performed, the wind deflector so moves as to send out the conditioned air in a straight downward direction or a rearward-downward direction so that, by the Coanda effect, the conditioned air falls along the wall surface and then flows along the floor surface to circulate inside the room. Here, the static pressure distribution formed near the wind deflector is formed substantially parallel to the air stream flowing while facing the wind deflector. Thus, the air stream flows without crossing the isobars and is then sent out through the blowout port.

[0024] According to the present invention, the air conditioner configured as described above may be further characterized in that the blowing passage has a front guide that guides the conditioned air in a frontward-downward direction, and that, when the conditioned air is sent out through the blowout port in a frontward-downward direction, the wind deflector forms a stream passage along the air stream flowing through the front guide and, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, the wind deflector bends the air stream flowing through the front guide.

[0025] With this configuration, the conditioned air flowing through the front guide is guided by the wind deflector to flow through the stream passage along the front guide so as to be sent out in a frontward-downward direction. Moreover, the conditioned air flowing through the front guide is guided by the wind deflector to be bent so as to be sent out in a straight downward direction or a rearward-downward direction.

[0026] According to the present invention, the air conditioner configured as described above may be further characterized in that, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, the air stream flowing through the front guide is stopped from flowing further frontward by the wind deflector. With this configuration, the air stream flowing through the front guide is stopped from flowing further frontward by a layer of air near the wind deflector and is thereby bent so as to be directed in a straight downward direction or a rearward-downward direction.

[0027] According to the present invention, the air conditioner configured as described above may be further characterized in that, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, a high static pressure part where the static pressure is higher than in the front guide is formed in contact with the wind deflector in the frontward direction in which the air stream flowing through the front guide is directed. With this configuration, the air stream flowing through the front guide is stopped from flowing further frontward by the high static pressure part formed in a frontward direction in which the air stream is flowing, and is thereby bent so as to be directed in a straight downward direction or a rearward-downward direction.

[0028] Preferably, the high static pressure part has a substantially bow-like cross-sectional shape described by a two-pointed curve. More preferably, the high static pressure part has a maximum static pressure in a middle part of the arc forming the substantially bow-like shape.

[0029] According to the present invention, the air conditioner configured as described above may be further characterized in that, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, the high static pressure part narrows the stream passage of the conditioned air so as to make the stream passage area smaller than in the front guide. With this configuration, the air stream is so stopped by the high static pressure part that the width of the stream passage through which the conditioned air can flow is narrower than in the front guide. The stream passage area narrowed by the high static pressure part may be widened back on the downstream side.

[0030] According to the present invention, the air conditioner configured as described above may be further characterized in that the wind deflector is arranged on the extension line of the lower inner wall of the front guide so as to cross the extension line. With this configuration, the wind deflector directs the conditioned air to below the extension line of the front guide.

[0031] The wind deflector may be composed of a movable inner wall of the blowing passage. The wind deflector may extend the blowing passage. The wind deflector may be composed of a plurality of wind direction plates arranged in the blowout port which are rotatable to change the orientations thereof.

[0032] According to the present invention, the air conditioner configured as described above may be further characterized in that static pressure detecting means is provided for detecting the static pressure distribution in the blowing passage, and that, based on the result of detection by the static pressure detecting means, the wind deflector can be varied. With this configuration, the static pressure detecting means detects the static pressure distribution in the blowing

passage, and the orientation of the wind deflector can be varied so that the isobars near the wind deflector run along the stream passage.

[0033] According to the present invention, the air conditioner configured as described above may be further characterized in that, as a result of the conditioned air being sent out, heating operation is performed in the room.

[0034] According to the present invention, an air conditioner that includes a suction port through which air inside a room is taken in, a blowout port through which the air taken in through the suction port and then conditioned is sent out into the room, a blowing passage through which the conditioned air is directed to the blowout port, and a wind deflector that permits the wind direction of the conditioned air sent out through the blowout port to be varied is characterized in that the wall surface of the air stream passage bent by the wind deflector is formed by a static pressure difference in the blowing passage.

[0035] With this configuration, the conditioned air flowing through the blowing passage is, with the air stream bent by the wind deflector, sent out through the blowout port, and a static pressure distribution is formed in the blowing passage. The wall surface of the bent air stream passage is formed by a static pressure difference in the blowing passage, and the air stream flows along the wall surface.

[0036] According to the present invention, the air conditioner configured as described above may be further characterized in that the blowing passage has a front guide that guides the conditioned air in a frontward-downward direction, and that the conditioned air that flows through the front guide is sent out through the blowout port in a frontward-downward direction, and also the conditioned air that flows through the front guide is bent by the wind deflector so as to be sent out through the blowout port in a straight downward direction or in a rearward-downward direction.

[0037] With this configuration, the conditioned air flowing through the front guide is guided by the wind deflector to be bent so as to be sent out in a straight downward direction or a rearward-downward direction. By the Coanda effect, the conditioned air falls along the wall surface of the room and then flows along the floor surface to circulate inside the room. Preferably, the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction to perform heating operation.

[0038] According to the present invention, the air conditioner configured as described above may be further characterized in that the wall surface is formed as a result of the air stream that flows through the front guide being stopped from flowing further frontward by the wind deflector. With this configuration, the air stream flowing through the front guide is stopped from flowing further frontward by the wall surface formed by a static pressure difference near the wind deflector, and is thereby bent so as to be directed in a straight downward direction or a rearward-downward direction.

[0039] According to the present invention, the air conditioner configured as described above may be further characterized in that the wall surface is formed by a high static pressure part where the static pressure is higher than in the front guide which is formed in contact with the wind deflector in a frontward direction in which the air stream flowing through the front guide is directed. With this configuration, the air stream flowing through the front guide is stopped from flowing further frontward by the wall surface formed in a frontward direction in which the air stream is flowing, and is thereby bent so as to be directed in a straight downward direction or a rearward-downward direction.

[0040] According to the present invention, the air conditioner configured as described above may be further characterized in that the high static pressure part narrows the stream passage of the conditioned air so as to make the stream passage area smaller than in the front guide. With this configuration, the wall surface formed by the high static pressure part bends the air stream, and thereby makes the width of the stream passage through which the conditioned air can flow smaller than in the front guide. The stream passage area narrowed by the high static pressure part may be widened back on the downstream side.

[0041] According to the present invention, the air conditioner configured as described above may be further characterized in that the wind deflector is arranged on the extension line of the lower inner wall of the front guide so as to cross the extension line. With this configuration, the wall surface of the air stream passage formed near the wind deflector directs the conditioned air to below the extension line of the front guide.

[0042] The wind deflector may be composed of a movable inner wall of the blowing passage. The wind deflector may extend the blowing passage. The wind deflector may be composed of a plurality of wind direction plates arranged in the blowout port which are rotatable to change the orientations thereof.

[0043] According to the present invention, the air conditioner configured as described above may be further characterized in that positioning means is provided for positioning the wind deflector at a position where the wall surface is formed. With this configuration, the positioning means positions the wind deflector at a predetermined position so that the wall surface of the air stream passage is formed by a static pressure difference near the wind deflector.

[0044] According to the present invention, an air conditioner that is installed on a wall surface inside a room and that includes a suction port through which air inside the room is taken in, a blowout port through which the air taken in through the suction port and then conditioned is sent out into the room, a blowing passage through which the conditioned air is directed to the blowout port, and a wind deflector that has a first wind direction plate rotatably arranged in the blowout port and that permits the wind direction of the conditioned air sent out through the blowout port to be varied is characterized in that the first wind direction plate can take one of the following positions: a stopping position where the first wind

direction plate stops at least part of the blowout port, a position that the first wind direction plate reaches by rotating in one direction from the stopping position and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a straight downward direction or a rearward-downward direction, a position that the first wind direction plate reaches by rotating in the one direction from the stopping position and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a frontward-downward direction, a position that the first wind direction plate reaches by rotating in the opposite direction from the stopping position and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a frontward-downward direction, and a position that the first wind direction plate reaches by rotating in the opposite direction from the stopping position and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a frontward-upward direction.

[0045] With this configuration, the air conditioner is installed on a wall surface inside a room, and, for example, when it is not operating, the first wind direction plate is arranged in the stopping position to stop the blowout port. When the air conditioner starts to perform, for example, heating operation, the first wind direction plate rotates in one direction so that the conditioned air is sent out through the blowout port in a straight downward direction or a rearward-downward direction. By the Coanda effect, the conditioned air falls along the wall surface of the room and then flows along the floor surface to circulate inside the room. The first wind direction plate can rotate further in the one direction so that the conditioned air is sent out through the blowout port in a frontward-downward direction. When the air conditioner starts to perform, for example, cooling operation, the first wind direction plate rotates in the opposite direction so that the conditioned air is sent out through the blowout port in a frontward-upward direction. By the Coanda effect, the conditioned air flows along the ceiling surface and then falls along the wall surface opposite to the air conditioner to circulate inside the room. The first wind direction plate can rotate further in the opposite direction so that the conditioned air is sent out through the blowout port in a frontward-downward direction.

[0046] According to the present invention, an air conditioner that is installed on a wall surface inside a room and that includes a suction port through which air inside the room is taken in, a blowout port through which the air taken in through the suction port and then conditioned is sent out into the room, a blowing passage through which the conditioned air is directed to the blowout port, and a wind deflector that has a first wind direction plate rotatably arranged in the blowout port and that permits the wind direction of the conditioned air sent out through the blowout port to be varied is characterized in that the first wind direction plate can take one of the following positions: a stopping position where the first wind direction plate stops at least part of the blowout port, a position that the first wind direction plate reaches by rotating in one direction from the stopping position and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a straight downward direction, a position that the first wind direction plate reaches by rotating in the one direction from the stopping position and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a frontward-downward direction, a position that the first wind direction plate reaches by rotating in an opposite direction from the stopping position and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a frontward-downward direction, and a position that the first wind direction plate reaches by rotating in the opposite direction from the stopping position and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a horizontal direction.

[0047] With this configuration, the air conditioner is installed on a wall surface inside a room, and, for example, when it is not operating, the first wind direction plate is arranged in the stopping position to stop the blowout port. When the air conditioner starts to perform, for example, heating operation, the first wind direction plate rotates in one direction so that the conditioned air is sent out through the blowout port in a rearward-downward direction. By the Coanda effect, the conditioned air falls along the wall surface of the room and then flows along the floor surface to circulate inside the room. The first wind direction plate can rotate further in the one direction so that the conditioned air is sent out through the blowout port in a frontward-downward direction. When the air conditioner starts to perform, for example, cooling operation, the first wind direction plate rotates in the opposite direction so that the conditioned air is sent out through the blowout port in a horizontal direction. By the Coanda effect, the conditioned air flows along the ceiling surface and then falls along the wall surface opposite to the air conditioner to circulate inside the room. The first wind direction plate can rotate further in the opposite direction so that the conditioned air is sent out through the blowout port in a frontward-downward direction.

[0048] According to the present invention, the air conditioner configured as described above may be further characterized in that the blowing passage has a front guide that guides the conditioned air in a frontward-downward direction, and that, when the conditioned air is sent out through the blowout port in a frontward-downward direction, the first wind direction plate forms a stream passage along the air stream flowing through the front guide and, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, the first wind direction plate bends the air stream flowing through the front guide by stopping the air stream from flowing further frontward.

[0049] With this configuration, the conditioned air flowing through the front guide is guided by the first wind direction plate to flow through the stream passage along the front guide so as to be sent out in a frontward-downward direction.

Moreover, the conditioned air flowing through the front guide is stopped from flowing further frontward by the first wind direction plate and is thereby bent so as to be sent out in a straight downward direction or a rearward-downward direction.

[0050] According to the present invention, the air conditioner configured as described above may be further characterized in that, in the position that the first wind direction plate reaches by rotating in the one direction from the stopping position and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a frontward-downward direction, the first wind direction plate is arranged with a convex surface thereof facing upward and, in the position that the first wind direction plate reaches by rotating in the opposite direction from the stopping position and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a frontward-downward direction, the first wind direction plate is arranged with the convex surface thereof facing downward. With this configuration, when the first wind direction plate is arranged with the convex surface thereof up, the conditioned air is sent out more upward than the conditioned air sent out in a frontward-downward direction when the first wind direction plate is arranged with the convex surface thereof down.

[0051] According to the present invention, the air conditioner configured as described above may be further characterized in that, with the first wind direction plate in a position that the first wind direction plate reaches by rotating in one direction, heating operation is performed and, with the first wind direction plate in a position that the first wind direction plate reaches by rotating in the opposite direction, cooling operation or drying operation is performed.

[0052] According to the present invention, the air conditioner configured as described above may be further characterized in that the first wind direction plate is arranged in a lower part of the blowout port, and that the wind deflector further has a second wind direction plate rotatably arranged in an upper part of the blowout port. With this configuration, the first wind direction plate arranged in the lower part of the blowout port takes one of the positions described above, and the second wind direction plate arranged in the upper part of the blowout port is arranged in the desired position to send out the conditioned air in various directions.

[0053] According to the present invention, the air conditioner configured as described above may be further characterized in that the second wind direction plate can take one of the following positions: an upper part stopping position where the second wind direction plate stops the upper part of the blowout port, a position that is inclined relative to the upper part stopping position and where the second wind direction plate directs the air stream in a frontward-downward direction, and a position that is inclined relative to the upper part stopping position and where the second wind direction plate directs the air stream in a horizontal direction or a frontward-upward direction. With this configuration, when the first wind direction plate is arranged in the stopping position and the second wind direction plate is arranged in the upper part stopping position, the blowout port is stopped. When the first wind direction plate is rotated from the stopping position and the second wind direction plate is inclined relative to the upper part stopping position, the conditioned air is sent out in a frontward-downward direction. When the first wind direction plate is rotated in the opposite direction from the stopping position and the second wind direction plate is inclined relative to the upper part stopping position, the conditioned air is sent out in a horizontal direction or a frontward-upward direction.

[0054] According to the present invention, the air conditioner configured as described above may be further characterized in that, when the conditioned air is sent out in a straight downward direction or a rearward-downward direction, the second wind direction plate is arranged in the upper part stopping position. With this configuration, when the first wind direction plate is rotated in one direction from the stopping position and the second wind direction plate is arranged in the upper part stopping position, the conditioned air is sent out in a straight downward direction or a rearward-downward direction.

[0055] According to the present invention, the air conditioner configured as described above may be further characterized in that, when the conditioned air is sent out in a straight downward direction or a rearward-downward direction, the second wind direction plate is arranged in a position inclined relative to the upper part stopping position and reached by rotating in a substantially reverse direction so that the second wind direction plate extends the upper wall of the blowing passage. With this configuration, when the first wind direction plate is rotated in one direction from the stopping position and the second wind direction plate is arranged in the position inclined relative to the upper part stopping position and reached by rotating in the substantially reverse direction, the upper wall of the blowing passage is extended, and the conditioned air is sent out in a straight downward direction or a rearward-downward direction. Here, the second wind direction plate may be positioned in contact with the first wind direction plate. Alternatively, the second wind direction plate may be positioned in contact with an upper wall of the blowing passage.

Advantages of the Invention

[0056] According to the present invention, when the conditioned air is sent out through the blowout port in a straight downward direction or a rearward-downward direction, the isobars of the static pressure distribution near the wind deflector are formed along the stream passage, and thus the air stream flowing while facing the wind deflector does not cross the isobars. This reduces the pressure loss in the air stream, and thus helps increase the wind volume obtained with the rotation rate of the blowing fan kept equal. Thus, it is possible to reduce the rotation rate of the blowing fan

needed to send out the desired wind volume, and thereby reduce noise.

[0057] According to the present invention, when the conditioned air is sent out through the blowout port in a frontward-downward direction, the wind deflector forms a stream passage along the air stream flowing through the front guide and, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, the wind deflector bends the air stream flowing through the front guide. Thus, the wind direction can be varied easily.

[0058] According to the present invention, the air stream flowing through the front guide is stopped from flowing further forward by the wind deflector. Thus, the air stream can be bent easily with a layer of air near the wind deflector so that the isobars near the wind deflector are formed along the stream passage.

[0059] According to the present invention, the high static pressure part is formed in contact with the wind deflector in a forward direction in which the air stream flowing through the front guide flows. Thus, the air stream can be bent easily by the high static pressure part so that the isobars in the high static pressure part are formed along the stream passage.

[0060] According to the present invention, the high static pressure part has a substantially bow-like cross-sectional shape described by a two-pointed curve. Thus, the isobars can be formed easily so as not to cross the air stream. Moreover, the high static pressure part has a maximum static pressure in a middle part of the arc forming the substantially bow-like shape. Thus, the isobars on the upstream and downstream sides of the high static pressure part are formed substantially symmetrically. This permits the air stream to flow more smoothly along the isobars, and thus helps further reduce the pressure loss. Thus, the wind volume of the conditioned air sent out from the air conditioner can be further increased.

[0061] According to the present invention, the high static pressure part narrows the stream passage of the conditioned air so as to make the stream passage area smaller than in the front guide. Thus, the wind speed of the air stream adjacent to the high static pressure part does not vary greatly. This reduces the static pressure variation in the air stream, thus permits the air stream to flow more smoothly, and thus helps further reduce the pressure loss. Thus, the wind volume of the conditioned air sent out from the air conditioner can be further increased.

[0062] The stream passage area narrowed by the high static pressure part may be widened back on the downstream side. The widened stream passage then acts as a so-called diffuser, helping the blowing means increase the static pressure and thereby further increasing the wind volume.

[0063] According to the present invention, the wind deflector is arranged on the extension line of the lower inner wall of the front guide so as to cross the extension line. This ensures that the air stream is directed in a substantially straight downward direction or a rearward-downward direction.

[0064] According to the present invention, the wind deflector is composed of a movable inner wall of the blowing passage. Thus, the wind direction can be varied easily, and the air stream can be easily made to flow along the isobars near the wind deflector. Moreover, the wind deflector extends the blowing passage. Thus, the pressure loss that occurs when the conditioned air is blown out in a frontward-downward direction can be reduced. Moreover, the wind deflector is composed of rotatable wind direction plates. Thus, the configuration can be made simpler.

[0065] According to the present invention, based on the result of detection by the static pressure detecting means, the wind deflector can be varied. Thus, the air stream can be more surely made to flow along the isobars near the wind deflector.

[0066] According to the present invention, as a result of the conditioned air being sent out, heating operation is performed in the room. Thus, warm air can be sent out at a high wind volume in a straight downward direction or a rearward-downward direction so that efficient air conditioning is achieved inside the room.

[0067] According to the present invention, the wall surface of the air stream passage bent by the wind deflector is formed by a static pressure difference in the blowing passage. Thus, the air stream flowing while facing the wind deflector does not cross the isobars of the static pressure distribution. This reduces the pressure loss in the air stream, and thus helps increase the wind volume obtained with the rotation rate of the blowing fan kept equal. Thus, it is possible to reduce the rotation rate of the blowing fan needed to send out the desired wind volume, and thereby reduce noise.

[0068] According to the present invention, the wind deflector forms the stream passage along the air stream flowing through the front guide so that the conditioned air is sent out through the blowout port in a frontward-downward direction, and also the wind deflector bends the air stream flowing through the front guide so that the conditioned air is sent out through the blowout port in a straight downward direction or a rearward-downward direction. Thus, the pressure loss is reduced when the conditioned air is blown out in a frontward-downward direction and when it is blown out in a straight downward direction or a rearward-downward direction.

[0069] According to the present invention, the wall surface of the air stream passage is formed as a result of the air stream that flows through the front guide being stopped from flowing further frontward by the wind deflector. Thus, with the static pressure difference near the wind deflector, the wall surface can be easily formed, and the air stream can be bent along the wall surface.

[0070] According to the present invention, the wall surface of the air stream passage is formed by a high static pressure part that is formed in contact with the wind deflector in a frontward direction in which the air stream flowing through the

front guide is directed. Thus, with the high static pressure part, the wall surface can be easily formed, and the air stream can be bent along the wall surface.

[0071] According to the present invention, the high static pressure part narrows the stream passage of the conditioned air so as to make the stream passage area smaller than in the front guide. Thus, the wind speed of the air stream adjacent to the high static pressure part does not vary greatly. This reduces the static pressure variation in the air stream, thus permits the air stream to flow more smoothly, and thus helps further reduce the pressure loss. Thus, the wind volume of the conditioned air sent out from the air conditioner can be further increased.

[0072] According to the present invention, the wind deflector is arranged on the extension line of the lower inner wall of the front guide so as to cross the extension line. This ensures that the air stream is directed in a substantially straight downward direction or a rearward-downward direction.

[0073] According to the present invention, the wind deflector is composed of a movable inner wall of the blowing passage. Thus, the wind direction can be varied easily, and the wall surface formed by the static pressure difference can be formed near the wind deflector. Moreover, the wind deflector extends the blowing passage. Thus, the pressure loss that occurs when the conditioned air is blown out in a frontward-downward direction can be reduced. Moreover, the wind deflector is composed of rotatable wind direction plates. Thus, the configuration can be made simpler.

[0074] According to the present invention, the positioning means is provided for positioning the wind deflector at a position where the wall surface is formed. Thus, the arrangement of the wind deflector in the position where the wall surface of the air stream passage is formed can be managed to ensure that the wall surface is formed.

[0075] According to the present invention, the first wind direction plate is rotated in one direction from the stopping position so that the conditioned air is sent out in a straight downward direction or a rearward-downward direction, and is further rotated in the one direction so that the conditioned air is sent out in a frontward-downward direction. Thus, the orientation of the first wind direction plate can be varied quickly. Moreover, the first wind direction plate is rotated in the opposite direction from the stopping position so that the conditioned air is sent out in a horizontal direction or a frontward-upward direction, and is further rotated in the opposite direction so that the conditioned air is sent out in a frontward-downward direction. Thus, the orientation of the first wind direction plate can be varied quickly. Thus, air conditioning can be performed quickly and comfortably.

[0076] According to the present invention, when the conditioned air is sent out through the blowout port in a frontward-downward direction, the air stream flowing through the front guide is stopped from flowing further frontward by the first wind direction plate and is thereby bent. Thus, the isobars of the static pressure distribution in the blowing passage can be formed along the air stream passage so that the air stream is so formed as not to cross the isobars. This reduces the pressure loss in the air stream, and thus helps increase the wind volume obtained with the rotation rate of the blowing fan kept equal. Thus, it is possible to reduce the rotation rate of the blowing fan needed to send out the desired wind volume, and thereby reduce noise.

[0077] According to the present invention, the first wind direction plate is rotated in one direction from the stopping position so as to be arranged with the convex surface thereof up in a position where it directs the air stream in a frontward-downward direction, and is rotated in the opposite direction from the stopping position so as to be arranged with the convex surface thereof down in a position where it directs the air stream in a frontward-downward direction. Thus, for example between during heating operation and cooling operation, the direction in which the conditioned air is sent out in a frontward-downward direction can be varied so that air conditioning is performed with the optimum wind direction that suits the operating status.

[0078] According to the present invention, with the first wind direction plate in a position rotated in one direction from the stopping position, heating operation is performed and, with the first wind direction plate in a position rotated in the opposite direction from the stopping position, cooling operation or drying operation is performed. Thus, during heating operation, the conditioned air is sent out in a straight downward direction or a rearward-downward direction and, during cooling or drying operation, the conditioned air is sent out in a frontward-upward direction. Thus, air conditioning can be performed comfortably.

[0079] According to the present invention, the wind deflector further has a second wind direction plate rotatably arranged in an upper part of the blowout port. Thus, the wind direction can be easily varied with the first and second wind direction plates.

[0080] According to the present invention, the second wind direction plate can take one of the following positions: an upper part stopping position where the second wind direction plate stops the upper part of the blowout port, a position that is inclined relative to the upper part stopping position and where the second wind direction plate directs the air stream in a frontward-downward direction, and a position that is inclined relative to the upper part stopping position and where the second wind direction plate directs the air stream in a horizontal direction or a frontward-upward direction. Thus, the wind direction can be easily varied between a frontward-downward direction and a horizontal direction or a frontward-upward direction.

[0081] According to the present invention, when the conditioned air is sent out in a straight downward direction or a rearward-downward direction, the second wind direction plate is arranged in the upper part stopping position. Thus, the

blowing passage can be easily extended without spoiling the outward appearance so that the conditioned air is sent out in a straight downward direction or a rearward-downward direction.

[0082] According to the present invention, when the conditioned air is sent out in a straight downward direction or a rearward-downward direction, the second wind direction plate is arranged in a position inclined relative to the upper part stopping position and reached by rotating in a substantially reverse direction so that the second wind direction plate extends the upper wall of the blowing passage. Thus, the conditioned air can be easily sent out in a straight downward direction or a rearward-downward direction. Moreover, it is possible to suppress development of an eddy and thereby enhance blowing efficiency.

[0083] According to the present invention, the second wind direction plate is positioned in contact with the first wind direction plate or in contact with an upper wall of the blowing passage. Thus, the second wind direction plate can be easily positioned so that the air stream is formed along the isobars of the static pressure distribution.

Brief Description of Drawings

[0084] [FIG. 1] A side cross-sectional view of the indoor unit of the air conditioner of a first embodiment of the present invention, showing a state for blowing out in a frontward-downward direction.

[FIG. 2] A side cross-sectional view of the indoor unit of the air conditioner of the first embodiment of the present invention, showing a state for blowing out in a rearward-downward direction.

[FIG. 3] A diagram showing the static pressure distribution near the blowout port as observed when the indoor unit of the air conditioner of the first embodiment of the present invention is in the state for blowing out in a rearward-downward direction.

[FIG. 4] A diagram showing the relationship between the rotation rate of the blowing fan and the wind volume as observed with the indoor unit of the air conditioner of the first embodiment of the present invention.

[FIG. 5] A diagram showing the relationship between the wind volume of the blowing fan and the noise it produces as observed with the indoor unit of the air conditioner of the first embodiment of the present invention.

[FIG. 6] A see-through perspective view showing the behavior of air streams inside the room as observed when the indoor unit of the air conditioner of the first embodiment of the present invention is in the state for blowing out in a rearward-downward direction.

[FIG. 7] A side cross-sectional view of the indoor unit of the air conditioner of the first embodiment of the present invention, showing a state for blowing out in a horizontal direction.

[FIG. 8] A see-through perspective view showing the behavior of air streams inside the room as observed when the indoor unit of a modified example of the air conditioner of the first embodiment of the present invention is in the state for blowing out in a rearward-downward direction.

[FIG. 9] A side cross-sectional view of the indoor unit of the air conditioner of a second embodiment of the present invention, showing a state for blowing out in a frontward-downward direction.

[FIG. 10] A side cross-sectional view of the indoor unit of the air conditioner of the second embodiment of the present invention, showing a state for blowing out in a rearward-downward direction.

[FIG. 11 (a) to 11 (f)] Side cross-sectional views illustrating the operation of the wind deflector of the indoor unit of the air conditioner of the second embodiment of the present invention.

[FIG. 12] A side cross-sectional view of the indoor unit of the air conditioner of a third embodiment of the present invention, showing a state for blowing out in a frontward-downward direction during heating operation.

[FIG. 13] A side cross-sectional view of the indoor unit of the air conditioner of the third embodiment of the present invention, showing a state for blowing out in a rearward-downward direction during heating operation.

[FIG. 14] A side cross-sectional view of the indoor unit of the air conditioner of the third embodiment of the present invention, showing a state for blowing out in a frontward-downward direction during cooling operation.

[FIG. 15] A side cross-sectional view of the indoor unit of the air conditioner of the third embodiment of the present invention, showing a state for blowing out in a horizontal direction during cooling operation.

[FIG. 16] A side cross-sectional view of the indoor unit of the air conditioner of the third embodiment of the present invention, showing a non-operating state.

[FIG. 17] A side cross-sectional view of the indoor unit of the air conditioner of a fourth embodiment of the present invention, showing a state for blowing out in a frontward-downward direction during heating operation.

[FIG. 18] A side cross-sectional view of the indoor unit of the air conditioner of the fourth embodiment of the present invention, showing another state for blowing out in a frontward-downward direction during heating operation.

[FIG. 19] A side cross-sectional view of the indoor unit of the air conditioner of the third embodiment of the present invention, showing a state for blowing out in a rearward-downward direction during heating operation.

[FIG. 20] A side cross-sectional view of the indoor unit of the air conditioner of the third embodiment of the present invention, showing another state for blowing out in a rearward-downward direction during heating operation.

[FIG. 21] A side cross-sectional view of the indoor unit of the air conditioner of the third embodiment of the present invention, showing a state for blowing out in a straight downward direction during heating operation.

[FIG. 22] A side cross-sectional view of the indoor unit of the air conditioner of the third embodiment of the present invention, showing another state for blowing out in a straight downward direction during heating operation.

[FIG. 23] A side cross-sectional view of the indoor unit of the air conditioner of a fourth embodiment of the present invention, showing a state for blowing out in a frontward-downward direction during cooling operation.

[FIG. 24] A side cross-sectional view of the indoor unit of the air conditioner of the fourth embodiment of the present invention, showing a state for blowing out in a frontward-upward direction during cooling operation.

[FIG. 25] A see-through perspective view showing the behavior of air streams inside the room as observed when the indoor unit of the air conditioner of the fourth embodiment of the present invention is in the state for blowing out in a frontward-upward direction.

[FIG. 26] A side cross-sectional view of the indoor unit of the air conditioner of the fourth embodiment of the present invention, showing a state for blowing out in a horizontal direction during cooling operation.

[FIG. 27] A side cross-sectional view of the indoor unit of the air conditioner of the fourth embodiment of the present invention, showing a non-operating state.

[FIG. 28] A side cross-sectional view of the indoor unit of the air conditioner of a fifth embodiment of the present invention, showing a state for blowing out in a frontward-downward direction during heating operation.

[FIG. 29] A side cross-sectional view of the indoor unit of the air conditioner of the fifth embodiment of the present invention, showing a state for blowing out in a rearward-downward direction during heating operation.

[FIG. 30] A side cross-sectional view of the indoor unit of the air conditioner of the fifth embodiment of the present invention, showing another state for blowing out in a rearward-downward direction during heating operation.

[FIG. 31] A side cross-sectional view of the indoor unit of the air conditioner of the fifth embodiment of the present invention, showing a state for blowing out in a straight downward direction during heating operation.

[FIG. 32] A side cross-sectional view of the indoor unit of the air conditioner of the fifth embodiment of the present invention, showing another state for blowing out in a straight downward direction during heating operation.

[FIG. 33] A side cross-sectional view of the indoor unit of the air conditioner of the fifth embodiment of the present invention, showing another state for blowing out in a frontward-downward direction during heating operation.

[FIG. 34] A side cross-sectional view of the indoor unit of the air conditioner of the fifth embodiment of the present invention, showing a state for blowing out in a frontward-downward direction during cooling operation.

[FIG. 35] A side cross-sectional view of the indoor unit of the air conditioner of the fifth embodiment of the present invention, showing a state for blowing out in a frontward-upward direction during cooling operation.

[FIG. 36] A side cross-sectional view of the indoor unit of the air conditioner of the fifth embodiment of the present invention, showing a state for blowing out in a horizontal direction during cooling operation.

[FIG. 37] A side cross-sectional view of the indoor unit of the air conditioner of the fifth embodiment of the present invention, showing a non-operating state.

[FIG. 38] A side cross-sectional view of the indoor unit of the air conditioner of a sixth embodiment of the present invention, showing a state for blowing out in a frontward-downward direction during heating operation.

[FIG. 39] A side cross-sectional view of the indoor unit of the air conditioner of the sixth embodiment of the present invention, showing another state for blowing out in a frontward-downward direction during heating operation.

[FIG. 40] A side cross-sectional view of the indoor unit of the air conditioner of the sixth embodiment of the present invention, showing a state for blowing out in a rearward-downward direction during heating operation.

[FIG. 41] A side cross-sectional view of the indoor unit of the air conditioner of the sixth embodiment of the present invention, showing a state for blowing out in a straight downward direction during heating operation.

[FIG. 42] A side cross-sectional view of the indoor unit of the air conditioner of the sixth embodiment of the present invention, showing a state for blowing out in a frontward-upward direction during cooling operation.

[FIG. 43] A side cross-sectional view of the indoor unit of the air conditioner of the sixth embodiment of the present invention, showing a state for blowing out in a horizontal direction during cooling operation.

[FIG. 44] A side cross-sectional view of the indoor unit of the air conditioner of the sixth embodiment of the present invention, showing a non-operating state.

[FIG. 45] A side cross-sectional view showing the indoor unit of an air conditioner taken up as a comparative example in comparison with the air conditioner of the first embodiment.

[FIG. 46] A diagram showing the static pressure distribution near the blowout port of the indoor unit of the air conditioner taken up as a comparative example in comparison with the air conditioner of the first embodiment.

[FIG. 47] A side cross-sectional view of the indoor unit of a conventional air conditioner, showing a state for blowing out in a frontward-downward direction.

[FIG. 48] A side cross-sectional view of the indoor unit of the conventional air conditioner, showing a state for blowing out in a straight downward direction.

[FIG. 49] A side cross-sectional view of the indoor unit of the conventional air conditioner, showing a state for blowing

out in a rearward-downward direction.

[FIG. 50] A diagram showing the static pressure distribution near the blowout port as observed when the indoor unit of the conventional air conditioner is in the state for blowing out in a frontward-downward direction

[FIG.51] A diagram showing the static pressure distribution near the blowout port as observed when the indoor unit of the conventional air conditioner is in the state for blowing out in a straight downward direction

[FIG. 52] A diagram showing the static pressure distribution near the blowout port as observed when the indoor unit of the conventional air conditioner is in the state for blowing out in a rearward-downward direction

List of Reference Symbols

[0085]

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 pans
12	vertical louver elements
25	eddy
61	temperature sensor
90	high static pressure part
98	imaginary surface
110a, 110b, 111a, 111b, 112a, 112b, 113a, 13b, 113c, 114a, 114b, 115a, 115b	wind deflector

Best Mode for Carrying Out the Invention

[0086] Hereinafter, embodiments of the present invention will be described with reference to the accompanying drawings. For the sake of convenience, in the embodiments described hereinafter, such parts as are found also in the conventional example shown in FIGS. 47 to 52 described earlier are identified with common reference numerals and symbols.

<First Embodiment>

[0087] FIG. 1 is a side cross-sectional view showing the air conditioner of a first embodiment of the present invention (taken along plane D shown in FIG. 6, 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.

[0088] 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 the 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.

[0089] 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.

[0090] The blowing passage 6 has a front guide 6a that guides frontward-downward the air sent from the blowing fan 7. On the downstream side of the front guide 6a, wind deflectors 110a and 110b are provided that are formed of a flexible material. The wind deflectors 110a and 110b form the wall surface of the blowing passage 6 between the front guide 6a and the blowout port 5. The wind deflectors 110a and 110b can be flexibly deformed so as to be held in the desired position so that the blowout angle at the blowout port 5 can be varied between a frontward-upward direction and a rearward-downward direction.

[0091] Inside the blowing passage 6, a static pressure sensor (unillustrated) is provided that detects the static pressure near the wind deflector 110a in a frontward direction. Through the detection by the static pressure sensor, the wind

deflectors 110a and 110b can be arranged so that the static pressure near the wind deflector 110a is kept at a predetermined value.

[0092] Incidentally, it is also possible, by the use of a static pressure sensor, to vary the wind deflectors 110a and 110b so that the static pressure near the wind deflector 110a is kept at a predetermined value and the positions of the wind deflectors 110a and 110b are stored in a database. This makes it possible to retrieve data suitable for particular operating conditions from the database to arrange the wind deflectors 110a and 110b in predetermined positions. Thus, it is possible to omit the static pressure sensor.

[0093] 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 through 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 (unillustrated) that is arranged outdoor, and, when the compressor is driven, a refrigeration cycle is operated.

[0094] 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 (unillustrated) 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.

[0095] In the air conditioner configured as described above, when the operation of the air conditioner is started, the blowing fan 7 is driven to rotate, and the refrigerant from the outdoor unit (unillustrated) flows to the indoor heat exchanger 9 to operate the refrigeration cycle. Now, air is sucked through the suction port 4 into the indoor unit 1, and the dust contained in the air is removed by the air filter 8.

[0096] The air sucked into the indoor unit 1 exchanges heat with the indoor heat exchanger 9 and is thereby cooled or heated. The air cooled or heated by the indoor heat exchanger 9 then has its direction in the left/right and up/down directions restricted by the vertical louver elements 12 and the wind deflectors 110a and 110b so as to be sent out into the room in a frontward-downward direction as indicated by arrow A. Thus, the indoor unit 1 is now in a state in which it sends out the conditioned air in a frontward-downward direction, that is, a state for blowing out in a frontward-downward direction.

[0097] In this state, the wind deflectors 110a and 110b are so arranged as to extend the upper and lower walls, respectively, of the blowing passage 6 substantially straight. Thus, the wind deflectors 110a and 110b form a stream passage along the air stream flowing through the front guide 6a. Moreover, the wind deflectors 110a and 110b form the stream passage in such a way that the cross-sectional area thereof increases down the blowing passage 6. Thus, the wind deflectors 110a and 110b act as a so-called diffuser, converting the kinetic energy of the air stream flowing while facing the wind deflectors 110a and 110b into a static pressure. This increases the wind volume of the conditioned air sent out through the blowout port 5.

[0098] Immediately after the start of the operation of the air conditioner, the air inside the room needs to be circulated quickly. Accordingly, the rotation rate of the blowing fan 7 is increased so that the air that has exchanged heat in the indoor heat exchanger 9 is sent out vigorously through the blowout port 5. Thus, the conditioned air is sent out through the blowout port 5 in a frontward-downward direction as indicated by arrow A, for example, at a wind speed of about 6 to 7 m/sec so as to circulate inside the room.

[0099] During heating operation, when a predetermined period has elapsed after the start of the heating operation, or when the difference between the air taken in through the suction port 4 and the user-specified temperature is smaller than a predetermined value, the wind deflectors 110a and 110b are deformed as shown in FIG. 2. Thus, the conditioned air is sent out through the blowout port 5 in a rearward-downward direction (toward the wall) as indicated by arrow C, for example, at a wind speed of about 5 to 6 m/sec.

[0100] The wind deflector 110a, which forms the upper wall of the blowing passage 6, has the side thereof facing the blowing passage 6 made concave, and thus stops the air stream flowing through the front guide 6a from flowing further frontward. The wind deflector 110b, which forms the lower wall of the blowing passage 6, has the side thereof facing the blowing passage 6 made convex. Moreover, the downstream-side ends of the wind deflectors 110a and 110b are arranged to point rearward-downward. Thus, the air stream flowing through front guide 6a is bent by the wind deflectors 110a and 110b and is thereby directed in a rearward-downward direction.

[0101] FIG. 3 shows the static pressure distribution in the blowing passage 6. On the inner side of the wind deflector 110a, in contact therewith, a high static pressure part 90 is formed where the static pressure is higher than in the front guide 6a. Based on the result of detection by the static pressure sensor (unillustrated) that detects the static pressure in the blowing passage 6, the positions of the wind deflectors 110a and 110b are adjusted so that the isobars 90a of the high static pressure part 90 run along the air stream flowing while facing the wind deflector 110a. That is, the isobars 90a of the high static pressure part 90 are formed substantially parallel to the line connecting the terminal end of the front guide 6a and the terminal end of the wind deflector 110a, and, near the high static pressure part 90, the air stream

is substantially parallel to the isobars 90a.

[0102] Thus, the high static pressure part 90 acts as a wall surface in terms of fluid mechanics, and helps the wind deflectors 110a and 110b smoothly vary the blowout direction of the conditioned air, thereby minimizing the increase in the pressure loss. In this way, the conditioned air can be sent out in a rearward-downward direction without reducing the wind volume. Incidentally, also when the conditioned air is sent out in a substantially straight downward direction, in a manner similar to that described above, the orientations of the wind deflectors 110a and 110b are so adjusted that the isobars 90a of the high static pressure part 90 are formed along the air stream, so that the conditioned air can be sent out substantially straight downward direction without reducing the wind volume.

[0103] FIG. 4 shows the relationship between the rotation rate of the blowing fan 7 and the wind volume as observed with the indoor unit 1 of the air conditioner of this embodiment. The vertical axis represents the wind volume (in m^3/min), and the horizontal axis represents the rotation rate (in rpm) of the blowing fan 7. In the figure, line K1 indicates the case where the blowout wind direction is rearward-downward (toward the wall, see FIG. 2). For comparison, lines K2, K3, and K4 indicate the cases observed with conventional air conditioners when the blowout wind direction is frontward-downward (with the maximum wind volume, see FIG. 47), straight down (see FIG. 48), and rearward-downward (see FIG. 49), respectively.

[0104] This figure shows that, with the conventional air conditioners (K2, K3, and K4), the larger the angle at which the wind direction is changed near the blowout port 5, the lower the wind volume at an equal rotation rate. This is because of the pressure loss that occurs when the air stream passes through the high static pressure part 90; that is, the higher the static pressure in the high static pressure part 90 through which the air stream passes, the greater the pressure loss, and thus the lower the wind volume.

[0105] By contrast, in this embodiment (K1), although the blowout wind direction is rearward-downward (toward the wall), the wind volume obtained is substantially as high as when the wind direction is not changed, that is, when the wind direction is frontward-downward (K2). Thus, it is possible to greatly enhance blowing efficiency when the wind direction is rearward-downward.

[0106] FIG. 5 shows the relationship between the wind volume of the blowing fan 7 and the noise it produces as observed with the indoor unit 1 of the air conditioner of this embodiment. The vertical axis represents noise (in dB), and the horizontal axis represents the wind volume (in m^3/min). As with the figure described just above, line K1 indicates the case where the blowout wind direction is rearward-downward (toward the wall, see FIG. 2), and lines K2, K3, and K4 indicate the cases observed with conventional air conditioners when the blowout wind direction is frontward-downward (with the maximum wind volume, see FIG. 47), straight down (see FIG. 48), and rearward-downward (see FIG. 49), respectively.

[0107] This figure shows that, with the conventional air conditioners (K2, K3, and K4), the larger the angle at which the wind direction is changed near the blowout port 5, the higher the noise at an equal wind volume. This is because of a reduction in the wind volume resulting from the pressure loss occurring when the air stream passes through the high static pressure part 90; that is, the higher the static pressure in the high static pressure part 90 through which the air stream passes, the higher the pressure loss, and thus the larger the reduction in the wind volume. This requires that, to obtain the desired wind volume, the rotation rate of the blowing fan 7 be increased, and thus increases noise.

[0108] By contrast, in this embodiment (K1), although the blowout wind direction is rearward-downward (toward the wall), noise is substantially as low as when the wind direction is not changed, that is, when the wind direction is frontward-downward (K2). Thus, it is possible to greatly enhance quietness when the wind direction is rearward-downward.

[0109] FIG. 45 shows the indoor unit 1 of an air conditioner taken up as a comparative example in comparison with this embodiment. In this figure, instead of the wall surface formed in terms of fluid mechanics by the high static pressure part 90, a physical wall surface is formed by the wind deflector 110a. FIG. 46 shows the static pressure distribution near the wind deflectors 110a and 110b in this case. As shown in this figure, in the stream passage, a high static pressure part 90 is formed that has isobars crossing the stream line of the air stream. This increases the pressure loss, and greatly reduces the wind volume to as low as that obtained when the conventional air conditioners shown in FIGS. 4 and 5 are operated with the blowout wind direction rearward-downward (K4).

[0110] In FIG. 2, the high static pressure part 90 has a substantially bow-like shape described by a two-pointed curve, and has the maximum static pressure in a middle part of the arc forming the substantially bow-like shape. This permits the static pressure distribution to be symmetric between the upstream and downstream sides of the high static pressure part 90. Thus, the air stream flows smoothly along the isobars 90a, further reducing the pressure loss and further increasing the wind volume of the conditioned air sent out from the air conditioner.

[0111] The inner wall of the wind deflector 110a facing the front guide 6a is so formed as to point increasingly downward as one goes downstream, and is so arranged as to cross the imaginary surface 98 that extends the lower wall of the front guide 6a further outward across the blowout port 5. Thus, a lower end part of the wind deflector 110a is arranged below the imaginary surface 98, and this ensures that the air stream is directed in a substantially straight downward direction or a rearward-downward direction. This prevents the air stream from being sent out in an unintended direction, and thus helps realize a highly reliable air conditioner.

[0112] FIG. 6 shows the behavior of air streams inside the room R as observed when the blowout wind direction is rearward-downward. The conditioned air falls along the side wall W1, and then, as indicated by arrow C, flows along the floor surface F, then along the side wall W2 opposite to the side wall W1, and then the ceiling wall S to return to the suction port 4. This helps prevent the warm air sent out from bouncing back, prevent a lowering of heating efficiency due to a short circuit, and enhance comfort by sufficiently warming a lower part of the room R.

[0113] During heating operation, when the temperature sensor 61 detects that the difference between the temperature of the air taken in through the suction port 4 and the user-specified temperature has become small, the blowing fan 7 is so adjusted that the wind volume it sends is gradually reduced. Even when the wind volume is reduced, the Coanda effect prevents the conditioned air (warm air) sent out downward from the indoor unit 1 from bouncing back, and thus the conditioned air continues to fall along the side wall W1 to flow further along the floor surface F to reach a lower part of the user's body without pouring directly into the living space. This eliminates the discomfort of the user being directly hit by wind, and thus enhances comfort.

[0114] Furthermore, since there is no discomfort of the user being directly hit by wind, and simultaneously quiet operation is ensured, even when the difference between the temperature of the air taken in through the suction port 4 and the user-specified temperature becomes small, the wind volume does not need to be reduced. Thus, it is possible to continue to supply conditioned air into the room R at a high wind volume.

[0115] Incidentally, the shapes of the wind deflectors 110a and 110b can be set by the user through operation of a remote control (unillustrated). This permits the user to freely set the wind direction of the conditioned air.

[0116] In this embodiment, when the conditioned air is sent out through the blowout port in a straight downward direction or a rearward-downward direction, the air stream flowing while facing the wind deflectors 110a and 110b is bent relative to the air stream flowing through the front guide 6a. Here, the high static pressure part 90 in contact with the wind deflector 110a forms, with a static pressure distribution, the wall surface of the air stream passage. Thus, the isobars 90a of the high static pressure part 90 do not cross the stream line of the main stream of the air stream flowing through the blowing passage 6 while being bent. This greatly reduce the pressure loss in the air stream.

[0117] Thus, despite a large change in the wind direction, the conditioned air can be sent out at a high wind volume. Incidentally, in the high static pressure part 90, a low-speed, low-energy air stream branched off from the main stream flows along the wind deflector 110a, and thus the high static pressure part 90 has little effect on the pressure loss.

[0118] Moreover, the main stream of the conditioned air flowing while facing the wind deflectors 110a and 110b flows through the space surrounded by the high static pressure part 90 and the lower wall surface of the blowing passage 6. That is, the high static pressure part 90 forms the wall surface of the stream passage. Thus, the air stream remains out of contact with the wind deflector 110a, reducing the pressure loss due to viscosity and further increasing the wind volume.

[0119] Moreover, by stopping, with the wind deflector 110a, the air stream flowing through the front guide 6a from flowing further frontward, it is possible to easily form the high static pressure part 90 having the isobars 90a running along the air stream, and thereby form the wall surface of the air stream passage.

[0120] Moreover, the high static pressure part 90 forms the wall surface of the stream passage, and narrows the stream passage of the conditioned air to form a nozzle-like shape and thereby make the stream passage area smaller than in the front guide 6a. By the action of the nozzle, high-energy fluid is sent out through 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, and the variation of the static pressure in the air stream is reduced. This permits the air stream to flow more smoothly, and thus helps further reduce the pressure loss. In this way, the wind volume of the conditioned air sent out from the air conditioner can be further increased.

[0121] Moreover, the stream passage once narrowed by the high static pressure part 90 to have a smaller stream passage area is widened back on the downstream side of the wind deflectors 110a and 110b. Thus, the cross-sectional area of the stream passage first decreases as one goes downstream to form a minimum-cross-sectional-area part (hereinafter referred to as the "throat part"); then widening back, the stream passage forms a so-called diffuser, which helps the blowing fan 7 increase the static pressure and thereby helps further increase the wind volume. As shown in FIG. 3, in the throat part of the stream passage, no high static pressure part 90 is produced, and thus no pressure loss occurs. Thus, by bending the stream passage there, it is possible to form a bent part that does not produce a pressure loss.

[0122] Moreover, since the wind deflectors 110a and 110b provided in the blowout port 5 can be flexibly deformed, the wall surface of the blowing passage 6 can be easily varied. Thus, the static pressure distribution in the blowing passage can be easily changed.

[0123] Incidentally, during cooling operation, when a predetermined period has elapsed after the start of the cooling operation, or when the difference between the temperature of the air taken in through the suction port 4 and the user-specified temperature is smaller than a predetermined value, the wind deflectors 110a and 110b are arranged as shown in FIG. 7. Thus, the conditioned air is sent out through the blowout port 5 in a horizontal direction as indicated by arrow D, for example, at a wind speed of about 5 to 6 m/sec.

[0124] Specifically, the wind deflector 110a, which extends the upper wall of the front guide 6a, is arranged to point in a horizontal direction. The wind deflector 110b, which extends the lower wall of the front guide 6a, is arranged with

the downstream-side end thereof pointing in a horizontal direction and with the side thereof facing the blowing passage 6 concave. When the conditioned air flows along the wind deflectors 110a and 110b, in the concave part of the wind deflector 110b, a high static pressure part 90 is formed that has a substantially bow-like shape described by a two-pointed curve.

[0125] Thus, just as described previously, with the rotation rate of the blowing fan 7 equal, the conditioned air can be sent out through the blowout port 5 in a horizontal direction at a higher wind volume than is conventionally possible; with the wind volume equal, the conditioned air can be sent out through the blowout port 5 in a horizontal direction with lower noise than is conventionally possible.

[0126] As a modified example of this embodiment, the air conditioner may be configured as a so-called corner air conditioner. Specifically, as shown in FIG. 8, the indoor unit 1b may be installed in contact with the ceiling wall S in the corner L between two adjacent side walls W3 and W4 of the room R. Also in this case, when the conditioned air is blown out through the blowout port in a rearward-downward direction toward the corner L, the conditioned air falls along the corner L and the side walls W3 and W4, and then, as indicated by arrow C, flows along the floor surface F, then along the side walls W5 and W6 opposite to the side walls W3 and W4, and then along the ceiling wall S to return to the suction port 4. Thus, warm air circulates inside the room R and achieves heating operation. Thus, the effects described previously can be obtained.

<Second Embodiment>

[0127] FIG. 9 is a side cross-sectional view showing the indoor unit 1 of the air conditioner of a second embodiment of the present invention. Such parts as are found also in the first embodiment shown in FIGS. 1 to 8 described above are identified with common reference numerals and symbols. In this embodiment, instead of the wind deflectors 110a and 110b formed of a flexible material which are provided in the first embodiment, wind deflectors 111a and 111b are provided that rotate to extend the blowing passage 6. In other respects, the configuration here is similar to that of the first embodiment.

[0128] The wind deflector 111b is rotatably supported by a rotary shaft 111d; the wind deflector 111a is rotatably supported by a rotary shaft 111e via an arm 111c coupled to a rotary shaft 111d. The rotary shaft 111d rotates by being driven via a gear (unillustrated) by a drive motor 111f. At the tip end of the wind deflector 111a, a position restricter 111g is provided that restricts the position of the wind deflector 111a.

[0129] As shown in the figure, when the operation of the air conditioner is started, the wind deflectors 111a and 111b are retracted below the cabinet 2, and the conditioned air is sent out through the blowout port 5 in a frontward-downward direction as indicated by arrow A. During heating operation, when a predetermined period has elapsed after the start of the heating operation, or when the difference between the air taken in through the suction port 4 and the user-specified temperature is smaller than a predetermined value, the wind deflectors 111a and 111b are spread out as shown in FIG. 10. Thus, the conditioned air is sent out in a rearward-downward direction as indicated by arrow C. The conditioned air is sent out, for example, toward the side wall W1 at a wind speed of about 5 to 6 m/sec, and then, by the Coanda effect, flows along the side wall W1.

[0130] FIGS. 11(a) to 11(f) show the operation of the wind deflectors 111a and 111b. FIG. 11(a) shows the state in which the wind deflectors 111a and 111b are spread out (see FIG. 10). Specifically, the wind deflector 111a makes contact with the upper wall of the front guide 6a to extend the upper wall of the blowing passage 6 as in the first embodiment, and is arranged in a position where it stops the air stream through the front guide 6a from flowing further frontward. The wind deflector 111b is arranged in a position where it extends the lower wall of the blowing passage 6 as in the first embodiment.

[0131] FIG. 11(b) shows the state in which the drive motor 111f has just started to drive. By being driven by the drive motor 111f, the rotary shaft 111d rotates in direction J and thereby causes the wind deflectors 111a and 111b and the arm 111c to rotate in direction J about the rotary shaft 111d. As shown in FIGS. 11(c) and 11(d), by being further driven by the drive motor 111f, the rotary shaft 111d rotates until the wind deflector 111b makes contact with the bottom face of the cabinet 2.

[0132] As the rotary shaft 111d rotates further, the wind deflector 111a rotates until, as shown in FIG. 11(e), the position restricter 111g makes contact with the bottom face of the cabinet 2. As the arm 111c continues to rotate, the position restricter 111f slides on the cabinet 2 and makes the wind deflector 111b to rotate in direction K. Then, as shown in FIG. 11(f), the wind deflector 111a makes contact with the wind deflector 111b, bringing the wind deflectors 111a and 111b into the retracted state (see FIG. 9).

[0133] When the wind deflectors 111a and 111b are spread out, they operate backward through the sequence described above. Meanwhile, the wind deflector 111a is positioned by making contact with the upper wall of the blowing passage 6. Thus, the upper wall of the blowing passage 6 acts as positioning means for positioning the wind deflector 111a so that the wind deflector 111a is arranged in the position where a static pressure distribution forms the wall surface of the air stream passage.

[0134] In this way, the arrangement of the wind deflector 111a can be managed to ensure that the wall surface of the air stream passage is formed. Moreover, the wind deflector 111b is prevented by a stopper (unillustrated) from moving counter-clockwise past the position shown in FIG. 11 (a). Thus, this stopper acts as positioning means for positioning the wind deflector 111b in a predetermined position.

[0135] In FIG. 10, the wind deflector 111a is concave on the side thereof facing the blowing passage 6, and the downstream-side end of the wind deflector 111a points rearward-downward. As in the first embodiment, the wind deflector 111b is arranged to extend the lower wall of the blowing passage 6. The wind deflector 111b is convex in the side thereof facing the blowing passage 6, and is arranged in a position where it smoothly extends a lower wall part of the blowout port 5, with the downstream-side end of the wind deflector 111b pointing rearward-downward. As in the first embodiment, when the conditioned air flows while facing the wind deflectors 111a and 111b, a high static pressure part 90 is formed in contact with the wind deflector 111a which has a substantially bow-like shape described by a two-pointed curve.

[0136] Thus, the isobars 90a (see FIG. 3) of the high static pressure part 90 are formed along the air stream facing the wind deflectors 111a and 111b. Thus, the high static pressure part 90 forms, with a static pressure difference inside the blowing passage 6, a wall surface in terms of fluid mechanics. This permits the blowout direction of the conditioned air to be smoothly varied so that the conditioned air is sent out through blowout port 5 in a rearward-downward direction without producing a pressure loss. The tip ends of the wind deflectors 111a and 111b may be arranged to point in a substantially straight downward direction so that the conditioned air is sent out through the blowout port 5 in a substantially straight downward direction.

[0137] Moreover, the stream passage is narrowed by the high static pressure part 90, and is then widened back on the down stream side. Furthermore, the wind deflector 111a is so arranged as to cross the imaginary surface 98 that extends the lower wall of the front guide 6a further outward across the blowout port 5. Thus, effects similar to those obtained in the first embodiment can be obtained. Incidentally, the arrangement of the vertical louver elements 12 and the wind deflectors 111a and 111b can be varied through operation of a remote control by the user.

<Third Embodiment>

[0138] FIG. 12 is a side cross-sectional view showing the indoor unit 1 of the air conditioner of a third embodiment of the present invention. Such parts as are found also in the second embodiment shown in FIGS. 9, 10, and 11(a) to 11(f) described above are identified with common reference numerals and symbols. In this embodiment, instead of the wind deflectors 111a and 111b provided in the second embodiment, wind deflectors 112a and 112b are provided that are rotatably supported. In other respects, the configuration here is similar to that of the second embodiment.

[0139] The wind deflector 112b extends the lower wall of the front guide 6a, and is supported on the cabinet 2 by a rotary shaft 112f that rotates by being driven by a drive motor (unillustrated). To the rotary shaft 112f, an upper arm 112c is rotatably coupled, and, to the upper arm 112c, a lower arm 112d is rotatably coupled via an elbow joint 112e. The wind deflector 112a (first wind direction plate) is composed of a wind direction plate that is arranged in the blowout port 5 and that is rotatably supported on the lower arm 112d by a rotary shaft 112g that rotates by being driven by a drive motor (unillustrated), the wind direction plate thus varying the orientation thereof by being driven by the drive motor to vary the wind direction.

[0140] When heating operation is started, as shown in the figure, the upper arm 112c and the lower arm 112d are spread out. Thus, the wind deflector 112a, which has a curved cross-sectional shape, is arranged, with the tip end thereof pointing downward and the concave side thereof down, along the air stream flowing through the front guide 6a. The wind deflector 112b, which likewise has a curved cross-sectional shape, is arranged, with the tip end thereof pointing downward and the convex side thereof facing the blowing passage 6, so as to extend substantially rectilinearly the upper wall of the blowout port 5. Thus, the wind deflectors 112a and 112b form a stream passage along the air stream flowing through the front guide 6a, and sends the conditioned air out in a frontward-downward direction as indicated by arrow A.

[0141] Moreover, since the wind deflector 112b is convex toward the blowing passage 6, the cross-sectional area of the stream passage of the conditioned air increases as one goes downstream. Hence, this part, when the air stream passes therethrough, converts the kinetic energy into a static pressure, acting as a so-called diffuser. Thus, the kinetic energy of the air stream flowing while facing the wind deflectors 112a and 112b is converted into a static pressure. This increases the wind volume of the conditioned air sent out through the blowout port 5.

[0142] When a predetermined period has elapsed after the start of the heating operation, or when the difference between the air taken in through the suction port 4 and the user-specified temperature is smaller than a predetermined value, the wind deflectors 112a and 112b are arranged as shown in FIG. 13. Specifically, by being driven by the drive motor, the wind deflector 112a is arranged in a position where one end part thereof makes contact with the upper wall of the blowing passage 6 so that the wind deflector 112a extends the upper wall of the blowing passage 6. The other end part of the of the wind deflector 112a is arranged to point rearward-downward. The wind deflector 112b is arranged with the tip end thereof pointing rearward-downward so as to be convex toward the blowing passage 6.

[0143] Here, the wind deflector 112a is positioned by making contact with the upper wall of the blowing passage 6.

Thus, the upper wall of the blowing passage 6 acts as means for positioning the wind deflector 112a, and serves to arrange the wind deflector 112a in a position where a static pressure difference forms a wall surface of the air stream passage. In this way, the arrangement of the wind deflector 112a can be managed to ensure that the wall surface of the air stream passage is formed. The wind deflector 112b is prevented by a stopper (unillustrated) from moving clockwise past the position shown in the figure. Thus, this stopper acts as positioning means for positioning the wind deflector 112b in a predetermined position.

[0144] The wind deflector 112a prevents the air stream flowing through the front guide 6a from flowing further frontward, and thereby forms a high static pressure part 90 located in contact with the wind deflector 112a and having a substantially bow-like shape described by a two-pointed curve. The high static pressure part 90 has isobars 90a (see FIG. 3) formed along the direction in which the conditioned air flows while facing the wind deflectors 112a and 112b. Thus, the high static pressure part 90, with the static pressure difference in the blowing passage 6, forms a wall surface of the air stream passage in terms of fluid mechanics. This permits the blowout direction of the conditioned air to be smoothly varied so that the conditioned air is sent out through blowout port 5 in a rearward-downward direction.

[0145] Here, the part where the upper wall of the front guide 6a makes contact with the wind deflector 112a does not form a smoothly curved surface, and thus an eddy 25 is produced in the high static pressure part 90. This makes blowing efficiency slightly lower than in the first and second embodiment. Even then, it is possible to make the increase in the pressure loss smaller than is conventionally possible, and to obtain blowing efficiency substantially equal to that obtained in the first and second embodiments. The tip ends of the wind deflectors 112a and 112b may be arranged to point substantially straight downward so that the conditioned air is sent out through the blowout port 5 in a substantially straight downward direction.

[0146] Moreover, the stream passage is narrowed by the high static pressure part 90, and is then widened back on the downstream side. Furthermore, the wind deflector 112a is arranged so as to cross the imaginary surface 98 that extends the lower wall of the front guide 6a further outward across the blowout port 5. Thus, effects similar to those obtained in the first and second embodiments can be obtained.

[0147] Incidentally, characteristics similar to those shown in FIGS. 3 and 4 described previously in connection with the first embodiment are obtained; that is, although the blowout direction is rearward-downward, the wind volume and quietness obtained are comparable with those obtained when the wind direction is not changed.

[0148] In the air conditioner configured as described above, when cooling operation is started, the wind deflectors 112a and 112b are arranged as shown in FIG. 14. Specifically, the wind deflector 112a is arranged, with the upper arm 112c and the lower arm 112d spread out, so that the tip end of the wind deflector 112a points frontward-rearward along the front guide 6a and the convex side of the wind deflector 112a faces downward.

[0149] The wind deflector 112b is retracted out of the air stream sent out through the blowout port 5 to below the cabinet 2. Thus, the conditioned air is sent out in a frontward-downward direction as indicated by arrow A. In this way, the conditioned air is sent out in a direction more upward than when it is sent out in a frontward-downward direction during heating operation, so that the conditioned air having a lower temperature falls by its own weight so as to spread inside the room. Moreover, retracting the wind deflector 112b below the cabinet 2 helps prevent condensation of moisture on the wind deflector 112b during cooling operation.

[0150] When a predetermined period has elapsed after the start of the cooling operation, or when the difference between the temperature of the air taken in through the suction port 4 and the user-specified temperature is smaller than a predetermined value, the wind deflectors 112a and 112b are arranged as shown in FIG. 15. Specifically, the wind deflector 112a is arranged, with the upper arm 112c and the lower arm 112d spread out, so that the convex side of the wind deflector 112a faces downward, that an upstream-side end part of the wind deflector 112a is substantially parallel to and divides in two the air stream flowing through the blowing passage 6, and that a downstream-side end part of the wind deflector 112a points horizontally frontward.

[0151] The wind deflector 112b is retracted out of the air stream sent out through the blowout port 5 to below the cabinet 2. Thus, the conditioned air is sent out through the blowout port 5 in a horizontal direction as indicated by arrow D, for example, at a wind speed of about 5 to 6 m/sec.

[0152] FIG. 16 shows the state of the air conditioner when it is not operating. When the operation of the air conditioner is stopped, the upper arm 112c and the lower arm 112d are folded; thus, the wind deflector 112b is arranged inside the blowing passage 6, and the wind deflector 112a completely stops the blowout port 5. This prevents a view into the interior of the indoor unit 1. Incidentally, through operation of a remote control, the user can vary the positions of the vertical louver elements 12 and the wind deflectors 112a and 112b.

[0153] In this embodiment, during heating operation, the wind deflector 112a (first wind direction plate) rotates from the stopping position shown in FIG. 16 clockwise as seen in the figures so as to be arranged in the states shown in FIGS. 12 and 13. This permits quick variation of the wind direction between a frontward-downward direction and a rearward-downward direction during heating operation. During cooling operation, the wind deflector 112a rotates, as opposed to during heating operation, counter-clockwise as seen in the figures so as to be arranged in the states shown in FIGS. 14 and 15. This permits quick variation of the wind direction between a frontward-downward direction and a

horizontal direction during cooling operation. In this way, comfortable air conditioning can be performed quickly. Incidentally, during drying operation, the wind deflectors 112a and 112b are advisably arranged in a manner similar to that during cooling operation.

<Fourth Embodiment>

[0154] FIG. 17 is a side cross-sectional view showing the indoor unit 1 of the air conditioner of a fourth embodiment of the present invention. Such parts as are found also in the third embodiment shown in FIGS. 12 to 16 described above are identified with common reference numerals and symbols. In this embodiment, instead of the wind deflectors 112a and 112b provided in the third embodiment, wind deflectors 113a, 113b, and 113c are provided that are rotatably supported. Moreover, the upper wall of the blowing passage 6 is inclined upward near the blowout port 5. In other respects, the configuration here is similar to that of the third embodiment.

[0155] 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 by being driven by a drive motor (unillustrated). The wind deflector 113a (second wind direction plate) and the wind deflector 113b (first wind direction plate) are respectively composed of wind direction plates that are arranged in the blowout port 5 and that are rotatably supported by rotary shafts 113d and 113e that rotate by being driven by drive motors (unillustrated), the wind direction plates thus varying the orientations thereof by being driven by the drive motors to vary the wind direction.

[0156] The wind deflectors 113b and 113c each have a curved cross-sectional shape, having a convex curved-surface on one side and a concave curved-surface on the other side. The wind deflector 113a has a substantially flat surface on one side (the lower side in the figure), and has a gently convex curved-surface on the other side (the upper side in the figure). The wind deflector 113a is, in a substantially middle part thereof, supported by a rotary shaft 113d.

[0157] In the air conditioner configured as described above, when heating operation is started, the wind deflectors 113a, 113b, and 113c are arranged as shown in the figure. Specifically, as the rotary shaft 113d is driven, the wind deflector 113a is arranged with the flat-surface side thereof facing rearward-downward and the curved-surface side thereof facing frontward-upward. As the rotary shaft 113e is driven, the wind deflector 113b is arranged so that an upstream-side end part thereof is substantially parallel to and divides in two the air stream flowing through the blowing passage 6. The wind deflector 113b is arranged so that the convex side thereof faces frontward-upward and that a downstream-side end part thereof points upward-downward.

[0158] The wind deflector 113c is arranged so that the tip end thereof points downward and that the convex surface thereof faces the blowing passage 6. Thus, the conditioned air is sent out in a frontward-downward direction as indicated by arrow A. This brings the indoor unit 1 into a state in which it sends out the conditioned air in a frontward-downward direction, that is, a state for blowing out in a frontward-downward direction.

[0159] Moreover, since the wind deflector 113c is convex toward the blowing passage 6, the cross-sectional area of the stream passage of the conditioned air increases as one goes downstream. Hence, this part, when the air stream passes therethrough, converts the kinetic energy into a static pressure, acting as a so-called diffuser. This helps increase the wind volume of the blowing fan 7.

[0160] The blowout port 5 may be narrowed with the wind deflectors 113a and 113c as shown in FIG. 18. Specifically, the wind deflector 113a is arranged with the flat-surface side thereof facing frontward-upward and the curved-surface side facing rearward-downward. The wind deflector 113c is arranged to face more upward than in FIG. 17 to reduce the stream passage area of the conditioned air formed between it and the wind deflector 113a. The wind deflector 113b is arranged along the air stream flowing between the wind deflectors 113a and 113c.

[0161] Thus, when the air stream flows between the wind deflectors 113a and 113c, the static pressure is converted into a kinetic energy. This reduces the wind volume of the blowing fan, increases the blowout wind speed, and thereby increases the distance over which the air stream can reach.

[0162] When a predetermined period has elapsed after the start of the heating operation, or when the difference between the air taken in through the suction port 4 and the user-specified temperature is smaller than a predetermined value, the wind deflectors 113a, 113b, and 113c are arranged as shown in FIG. 19. By being driven by the drive motor, the wind deflector 113a is positioned, with the flat-surface side thereof facing frontward, so that one end part thereof makes contact with the wind deflector 113b. Thus, the wind deflector 113b is arranged in a position in which it extends the upper wall of the blowing passage 6.

[0163] The other end part of the wind deflector 113a is arranged to point downward so as to make 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 toward the blowing passage 6. The wind deflector 113c is arranged, with the tip end thereof pointing rearward-downward, so as to be convex toward the blowing passage 6.

[0164] Here, the wind deflector 113a is positioned by making contact with the wind deflector 113b. Thus, the wind deflector 113b acts as positioning means for positioning the wind deflector 113a, and serves to arrange the wind deflector 113a in a position where a static pressure difference forms a wall surface of the air stream passage. In this way, the

arrangement of the wind deflector 113a can be managed to ensure that the wall surface of the air stream passage is formed. The wind deflector 113c is prevented by a stopper (unillustrated) from moving clockwise past the position shown in the figure. Thus, this stopper acts as positioning means for positioning the wind deflector 113c in a predetermined position. Incidentally, the wind deflector 113b is arranged in the position shown in the figure through control of the amount of rotation of the drive motor.

[0165] Thus, the wind deflectors 113a and 113b prevent the air stream flowing through the front guide 6a from flowing further frontward, and thereby form a high static pressure part 90 located in contact with the wind deflectors 113a and 113b and having a substantially bow-like shape described by a two-pointed curve. As in the first to third embodiments, the high static pressure part 90 has isobars 90a (see FIG. 3) formed along the direction in which the conditioned air flows while facing the wind deflectors 113a, 113b, and 113c. Thus, the high static pressure part 90 forms a wall surface in terms of fluid mechanics. This permits the blowout direction of the conditioned air to be smoothly varied so that the conditioned air is sent out through blowout port 5 in a rearward-downward direction.

[0166] Here, the part where the upper wall of the front guide 6a makes contact with the wind deflector 113a does not form a smoothly curved surface, and thus an eddy 25 is produced in the high static pressure part 90. This makes blowing efficiency slightly lower than in the first and second embodiment. Even then, it is possible to make the increase in the pressure loss smaller than is conventionally possible, and to obtain blowing efficiency substantially equal to that obtained in the first and second embodiments.

[0167] Moreover, the stream passage is narrowed by the high static pressure part 90, and is then widened back on the downstream side. Furthermore, the wind deflector 113b is arranged so as to cross the imaginary surface 98 that extends the lower wall of the front guide 6a further outward across the blowout port 5. Thus, effects similar to those obtained in the first and second embodiments can be obtained.

[0168] Incidentally, the wind deflector 113a may be arranged with the flat-surface side thereof facing the blowing passage 6 as shown in FIG. 20. This permits the wind deflectors 113a and 113b to be arranged along the front panel 3, and thus helps improve the outward appearance. In this case, the high static pressure part 90 is formed by being enclosed by the upper wall of the blowing passage 6, which is inclined frontward-upward, and the wind deflectors 113a and 113b. This causes a larger eddy 25 to develop in the high static pressure part 90. This makes blowing efficiency slightly lower than in the case shown in FIG. 19, but it is still possible to make the increase in the pressure loss smaller than is conventionally possible.

[0169] The wind deflectors 113b and 113c may be arranged with their tip ends pointing substantially straight downward as shown in FIG. 21 so that the conditioned air is sent out through the blowout port 5 in a substantially straight downward direction. In this case, by arranging the wind deflector 113a in the upper part stopping position where it stops the blowout port 5 along the front panel 3, it is possible to improve the outward appearance of the indoor unit 1.

[0170] In the air conditioner configured as described above, when cooling operation is started, the wind deflectors 113a, 113b, and 113c are arranged as shown in FIG. 23. Specifically, the wind deflector 113a is arranged with the flat-surface side thereof facing frontward-upward along the air stream flowing through the front guide 6a. The wind deflector 113b is arranged so as to be substantially parallel to and divide in two the air stream flowing through the front guide 6a and to be convex downward. Thus, the wind deflector 113b is arranged in a position about 180° inverted from the position shown in FIG. 17. The wind deflector 113c is retracted out of the air stream sent out through the blowout port 5, and is arranged below the cabinet 2.

[0171] Thus, the conditioned air is sent out in a frontward-downward direction as indicated by arrow A. In this way, the conditioned air is sent out in a direction more upward than when it is sent out in a frontward-downward direction during heating operation, so that the conditioned air having a lower temperature falls by its own weight so as to spread inside the room.

[0172] Incidentally, if the wind deflector 113a is arranged with the flat-surface side thereof facing rearward-downward, the air stream does not flow upward, and thus moisture condenses on the wind deflector 113a. To prevent this, the wind deflector 113a is arranged with the flat-surface side up so as to be arranged below the rotary shaft 113d. This permits the low-temperature conditioned air to flow along both sides of the wind deflector 113a, preventing condensation of moisture on the wind deflector 113a.

[0173] When a predetermined period has elapsed after the start of the cooling operation, or when the difference between the temperature of the air taken in through the suction port 4 and the user-specified temperature is smaller than a predetermined value, the wind deflectors 113a, 113b, and 113c are arranged as shown in FIG. 24. Specifically, the wind deflector 113a is arranged with the flat-surface side thereof facing rearward-upward along the air stream flowing through the front guide 6a. The wind deflector 113b is arranged so as to be parallel to and divide in two the air stream flowing through the front guide 6a and to be convex downward. The wind deflector 113c is retracted out of the air stream sent out through the blowout port 5 so as to be arranged below the cabinet 2.

[0174] Thus, the conditioned air is sent out through the blowout port 5 in a frontward-upward direction as indicated by arrow E, for example, at a wind speed of about 5 to 6 m/sec. The conditioned air sent out into the room then reaches the ceiling of the room R as shown in FIG. 25. The conditioned air then flows, by the Coanda effect, along the ceiling

wall S, then along the wall surface W2 opposite to the indoor unit 1, then along the floor surface F, then along the side wall W1 on which the indoor unit 1 is installed, so as to be eventually sucked through the suction port 4 into the indoor unit 1 at both sides thereof.

[0175] Thus, it is possible to prevent the user from being continuously hit by cold or warm wind, and thus to prevent discomfort to and instead enhance comfort to the user. Moreover, it is possible to prevent the user's body temperature from being locally lowered during cooling operation, and thus to enhance safety in terms of health. Moreover, here, the air stream widely agitates the air all over the room R, and makes the temperature distribution inside the room R even, around the user-specified temperature. That is, it is possible to obtain a comfortable space where, except for an upper part of the room R, the temperature is substantially equal to the user-specified temperature all over the user's living region, with little variation in temperature and almost no wind directly hitting the user. Moreover, by retracting the wind deflector 113c below the cabinet 2, it is possible to prevent condensation of moisture on the wind deflector 113c.

[0176] Furthermore, when the wind deflector 113a is set at a horizontal orientation as shown in FIG. 26, the conditioned air can be sent out through the blowout port 5 in a horizontal direction as indicated by arrow D. Incidentally, by arranging the wind deflector 113b convex downward in the state for blowing out in a frontward-downward direction shown in FIG. 23 described previously, it is possible to arrange the wind deflector 113b smoothly in the state for blowing out in a frontward-upward direction (see FIG. 24) and in the state for blowing out in a horizontal direction (see FIG. 26).

[0177] FIG. 27 shows the state of the air conditioner when it is not operating. When the operation of the air conditioner is stopped, the wind deflector 113c is arranged inside the blowing passage 6, and the wind deflectors 113a and 113b stop the blowout port 5 by being arranged in the upper stopping position and the stopping position, respectively. This prevents a view into the interior of the indoor unit 1.

[0178] Alternatively, the wind deflector 113a is arranged along the front panel 3, and the wind deflector 113b is arranged with the lower end thereof connected to the bottom face of the cabinet 2. This helps enhance the outward appearance of the indoor unit 1. Incidentally, through operation of a remote control, the user can vary the positions of the vertical louver elements 12 and the wind deflectors 113a, 113b, and 113c.

[0179] In this embodiment, during heating operation, the wind deflector 113b (first wind direction plate) rotates from the stopping position shown in FIG. 27 clockwise as seen in the figures so as to be arranged in the states shown in FIGS. 17 to 22. This permits quick variation of the wind direction among a frontward-downward direction, a rearward-downward direction, and a straight downward direction during heating operation. During cooling operation, the wind deflector 113b rotates, as opposed to during heating operation, counter-clockwise as seen in the figures so as to be arranged in the states shown in FIGS. 23, 24, and 26. This permits quick variation of the wind direction among a frontward-downward direction, a horizontal direction, and a frontward-upward direction during cooling operation. In this way, comfortable air conditioning can be performed quickly. Incidentally, during drying operation, the wind deflectors 113a, 113b, and 113c are advisably arranged in a manner similar to that during cooling operation.

[0180] On the other hand, the wind deflector 113a (second wind direction plate) rotates from the upper part stopping position shown in FIG. 27 counter-clockwise as seen in the figures so that the conditioned air can be easily sent out in a frontward-downward direction (see FIGS. 17, 18, and 23), a rearward-downward direction (see FIG. 19), a straight downward direction (see FIG. 21), a frontward-upward direction (see FIG. 24), and a horizontal direction (see FIG. 26). Furthermore, with the wind deflector 113a arranged in the upper part stopping position, it is possible to send out the conditioned air in a rearward-downward direction (see FIG. 20) and a straight downward direction (see FIG. 22) without spoiling the outward appearance.

<Fifth Embodiment>

[0181] FIG. 28 is a side cross-sectional view showing the indoor unit 1 of the air conditioner of a fifth embodiment of the present invention. Such parts as are found also in the fourth embodiment shown in FIGS. 17 to 27 described above are identified with common reference numerals and symbols. In this embodiment, instead of the wind deflectors 113a, 113b, and 113c provided in the fourth embodiment, wind deflectors 114a and 114b are provided. In other respects, the configuration here is similar to that of the fourth embodiment.

[0182] The wind deflector 114a (second wind direction plate) and the wind deflector 114b (first wind direction plate) 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 composed of 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.

[0183] In the air conditioner configured as described above, when heating operation is started, the wind deflectors 114a and 114b are arranged as shown in the figure. Specifically, the wind deflectors 114a and 114b are arranged along the air stream flowing through the front guide 6a. Here, the wind deflector 114b is arranged with a rotary shaft 114d side end part thereof pointing rearward. Thus, the conditioned air is sent out in a frontward-downward direction as indicated

by arrow A. This brings the indoor unit 1 into a state in which it sends out the conditioned air in a frontward-downward direction, that is, a state for blowing out in a frontward-downward direction.

[0184] When a predetermined period has elapsed after the start of the heating operation, or when the difference between the air taken in through the suction port 4 and the user-specified temperature is smaller than a predetermined value, the wind deflectors 114a and 114b are arranged as shown in FIG. 29. Specifically, by being driven by the drive motor, the wind deflector 114a is arranged with one end thereof close to the upper wall of the blowing passage 6 so as to extend the upper wall downward. The other 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.

[0185] Here, by a stopper (unillustrated) of the drive motor, the wind deflector 114a is prevented from rotating counter-clockwise as seen in the figure. Thus, this stopper acts as positioning means for positioning the wind deflector 114a in a predetermined position, and serves to arrange the wind deflector 114a in a position where a static pressure difference forms a wall surface of the air stream passage. In this way, the arrangement of the wind deflector 114a can be managed to ensure that the wall surface of the air stream passage is formed. Incidentally, the wind deflector 114b is arranged in the position shown in the figure through control of the amount of rotation of the drive motor.

[0186] Thus, the wind deflectors 114a and 114b prevent the air stream flowing through the front guide 6a from flowing further frontward, and thereby form a high static pressure part 90 located in contact with the wind deflectors 114a and 114b. As in the first to fourth embodiments, the high static pressure part 90 has isobars 90a (see FIG. 3) formed along the direction in which the conditioned air flows while facing the wind deflectors 114a and 114b. Thus, the high static pressure part 90 forms a wall surface in terms of fluid mechanics. This permits the blowout direction of the conditioned air to be smoothly varied so that the conditioned air is sent out through blowout port 5 in a rearward-downward direction.

[0187] Moreover, the stream passage is narrowed by the high static pressure part 90, and is then widened back on the downstream side. Furthermore, the wind deflector 114b is arranged so as to cross the imaginary surface 98 that extends the lower wall of the front guide 6a further outward across the blowout port 5. Thus, effects similar to those obtained in the first to fourth embodiments can be obtained. Incidentally, here, the high static pressure part 90 does not have a substantially bow-like shape as in the first to fourth embodiments. This makes blowing efficiency slightly lower, but it is still possible to make the increase in the pressure loss smaller and thereby make blowing efficiency higher than is conventionally possible.

[0188] Arranging the wind deflector 114a along the front panel 3 as shown in FIG. 30 helps enhance the outward appearance of the indoor unit 1. In this case, by a stopper (unillustrated) of the drive motor, the wind deflector 114a is prevented from rotating clockwise as seen in the figure. Thus, this stopper acts as positioning means for positioning the wind deflector 114a in a predetermined position.

[0189] Here, the part where the upper wall of the front guide 6a makes contact with the wind deflector 114a does not form a smoothly curved surface, and thus an eddy 25 is produced in the high static pressure part 90. This makes blowing efficiency slightly lower than in the first and second embodiment. Even then, it is possible to make the increase in the pressure loss smaller than is conventionally possible, and to obtain blowing efficiency substantially equal to that obtained in the first and second embodiments.

[0190] The wind deflector 114b may be arranged with the tip end thereof pointing substantially straight downward as shown in FIG. 31 so that the conditioned air is sent out through the blowout port 5 in a substantially straight downward direction. In this case, arranging the wind deflector 114a along the front panel 3 as shown in FIG. 32 helps enhance the outward appearance of the indoor unit 1.

[0191] The wind deflector 114b may be arranged with a shaft-side end part thereof pointing frontward as shown in FIG. 33 so that the blowout direction is frontward. Preferably, however, the wind deflector 114b is arranged with a shaft-side end part thereof pointing rearward as shown in FIG. 28 described previously when the blowout direction is frontward-downward, because doing so permits smooth movement of the wind deflector 114b when the blowout direction is changed to rearward-downward (see FIGS. 29 and 30) and to substantially straight downward (see FIGS. 31 and 32).

[0192] In the air conditioner configured as described above, when cooling operation is started, the wind deflectors 114a and 114b are arranged as shown in FIG. 34. Specifically, the wind deflectors 114a and 114b are arranged inclined frontward-downward along the air stream flowing through the front guide 6a. Here, the wind deflector 114a is arranged with the front end thereof more upward than when heating operation is performed with the blowout direction frontward-downward as shown in FIGS. 28 and 33. This permits the air stream to pass along both sides of the wind deflector 114a, and thus helps prevent moisture from being condensed on the surface of the wind deflector 114a by the low-temperature conditioned air.

[0193] The wind deflector 114b is arranged with a rotary shaft 114d side end part thereof pointing frontward. Thus, the conditioned air is sent out in a frontward-downward direction as indicated by arrow A. This brings the indoor unit 1 into a state in which it sends out the conditioned air in a frontward-downward direction, that is, a state for blowing out in a frontward-downward direction.

[0194] When a predetermined period has elapsed after the start of the cooling operation, or when the difference between the temperature of the air taken in through the suction port 4 and the user-specified temperature is smaller

than a predetermined value, the wind deflectors 114a and 114b are arranged as shown in FIG. 35. Specifically, 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 arranged with a shaft-side end part thereof located in front of and below an open-side end part thereof.

[0195] Thus, the conditioned air is sent out through the blowout port 5 in a frontward-upward direction as indicated by arrow E, for example, at a wind speed of about 5 to 6 m/sec. The conditioned air sent out into the room then reaches the ceiling of the room R as shown in FIG. 25 described previously. The conditioned air then flows, by the Coanda effect, along the ceiling wall S, then along the wall surface W2 opposite to the indoor unit 1, then along the floor surface F, then along the side wall W1 on which the indoor unit 1 is installed, so as to be eventually sucked through the suction port 4 into the indoor unit 1 at both sides thereof. Thus, as in the fourth embodiment, it is possible to enhance comfort and safety.

[0196] Furthermore, when the wind deflector 114a is set at a horizontal orientation as shown in FIG. 36, the conditioned air can be sent out through the blowout port 5 in a horizontal direction as indicated by arrow D. Incidentally, by arranging the wind deflector 114b with the shaft-side end thereof pointing frontward in the state for blowing out in a frontward-downward direction shown in FIG. 34 described previously, it is possible to arrange the wind deflector 114b smoothly in the state for blowing out in a frontward-upward direction (see FIG. 35) and in the state for blowing out in a horizontal direction (see FIG. 36).

[0197] FIG. 37 shows the state of the air conditioner when it is not operating. When the operation of the air conditioner is stopped, the wind deflectors 114a and 114b are arranged in the upper stopping position and the stopping position, respectively, to stop the blowout port 5. This prevents a view into the interior of the indoor unit 1. Arranging the wind deflector 114a along the front panel 3 and arranging the wind deflector 114b so that the lower end thereof is connected to the bottom face of the cabinet 2 helps enhance the outward appearance of the indoor unit 1. Incidentally, through operation of a remote control, the user can vary the positions of the vertical louver elements 12 and the wind deflectors 114a and 114b.

[0198] In this embodiment, during heating operation, the wind deflector 114b (first wind direction plate) rotates from the stopping position shown in FIG. 37 clockwise as seen in the figures so as to be arranged in the states shown in FIGS. 28 to 32. This permits quick variation of the wind direction among a frontward-downward direction, a rearward-downward direction, and a straight downward direction during heating operation. During cooling operation, the wind deflector 114b rotates, as opposed to during heating operation, counter-clockwise as seen in the figures so as to be arranged in the states shown in FIGS. 34, 35, and 36. This permits quick variation of the wind direction among a frontward-downward direction, a horizontal direction, and a frontward-upward direction during cooling operation. In this way, comfortable air conditioning can be performed quickly. Incidentally, during drying operation, the wind deflectors 114a and 114b are advisably arranged in a manner similar to that during cooling operation.

[0199] On the other hand, the wind deflector 114a (second wind direction plate) rotates from the upper part stopping position shown in FIG. 37 counter-clockwise as seen in the figures so that the conditioned air can be easily sent out in a frontward-downward direction (see FIGS. 28, 33, and 34), a rearward-downward direction (see FIG. 29), a straight downward direction (see FIG. 31), a frontward-upward direction (see FIG. 35), and a horizontal direction (see FIG. 36). Furthermore, with the wind deflector 114a arranged in the upper part stopping position, it is possible to send out the conditioned air in a rearward-downward direction (see FIG. 30) and a straight downward direction (see FIG. 32) without spoiling the outward appearance.

<Sixth Embodiment>

[0200] FIG. 38 is a side cross-sectional view showing the indoor unit 1 of the air conditioner of a sixth embodiment of the present invention. Such parts as are found also in the fifth embodiment shown in FIGS. 28 to 37 described above are identified with common reference numerals and symbols. In this embodiment, instead of the wind deflectors 114a and 114b provided in the fifth embodiment, wind deflectors 115a and 115b are provided. In other respects, the configuration here is similar to that of the fifth embodiment.

[0201] The wind deflector 115a (second wind direction plate) and the wind deflector 115b (first wind direction plate) 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 composed of 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.

[0202] In the air conditioner configured as described above, when heating operation is started, the wind deflectors 115a and 115b are arranged as shown in the figure. Specifically, the wind deflectors 115a and 115b are arranged along the air stream flowing through the front guide 6a. Here, the rotary shaft 115d of the wind deflector 115b is arranged above the wind deflector 115b. Thus, the conditioned air is sent out in a frontward-downward direction as indicated by

arrow A. This brings the indoor unit 1 into a state in which it sends out the conditioned air in a frontward-downward direction, that is, a state for blowing out in a frontward-downward direction.

[0203] In the state for blowing out in a frontward-downward direction, the rotary shaft 115d of the wind deflector 115b may be arranged below the wind deflector 115b as shown in FIG. 39. Arranging the rotary shaft 115d above the wind deflector 115b as shown in FIG. 38 permits the conditioned air to reach far. This is therefore suitable in cases where the room is comparatively large.

[0204] By contrast, arranging the rotary shaft 115d below the wind deflector 115b as shown in FIG. 39 permits finer control of the air stream in the space nearby during heating operation. This is therefore suitable in cases where the room is comparatively small. Which arrangement to adopt may be determined according to the size of the room.

[0205] When a predetermined period has elapsed after the start of the heating operation, or when the difference between the air taken in through the suction port 4 and the user-specified temperature is smaller than a predetermined value, the wind deflectors 115a and 115b are arranged as shown in FIG. 40. Specifically, by being driven by the drive motor, the wind deflector 115a is arranged, with one end thereof making contact with the upper wall of the blowing passage 6, so as to extend the upper wall of the front guide 6a. The wind deflector 115b is arranged with one end thereof close to the wind deflector 115a and the other end pointing substantially straight downward. Incidentally, the gap between the wind deflectors 115a and 115b is so small that only a very small portion of the conditioned air leaks therethrough.

[0206] Here, the wind deflector 115a is positioned by making contact with the upper wall of the blowing passage 6. Thus, the upper wall of the blowing passage 6 acts as positioning means for positioning the wind deflector 115a in a predetermined position, and serves to arrange the wind deflector 115a in a position where a static pressure difference forms a wall surface of the air stream passage. In this way, the arrangement of the wind deflector 115a can be managed to ensure that the wall surface of the air stream passage is formed. Incidentally, the wind deflector 115b is arranged in the position shown in the figure through control of the amount of rotation of the drive motor.

[0207] Thus, the wind deflectors 115a and 115b prevent the air stream flowing through the front guide 6a from flowing further frontward, and thereby form a high static pressure part 90 located in contact with the wind deflectors 115a and 115b. As in the first to fifth embodiments, the high static pressure part 90 has isobars 90a (see FIG. 3) formed along the direction in which the conditioned air flows while facing the wind deflectors 115a and 115b. Thus, the high static pressure part 90 forms a wall surface in terms of fluid mechanics. This permits the blowout direction of the conditioned air to be smoothly varied so that the conditioned air is sent out through blowout port 5 in a rearward-downward direction.

[0208] Moreover, the stream passage is narrowed by the high static pressure part 90, and is then widened back on the downstream side. Furthermore, the wind deflector 115b is arranged so as to cross the imaginary surface 98 that extends the lower wall of the front guide 6a further outward across the blowout port 5. Thus, effects similar to those obtained in the first to fifth embodiments can be obtained. Incidentally, here, the high static pressure part 90 does not have a substantially bow-like shape as in the first to fourth embodiments. This makes blowing efficiency slightly lower, but it is still possible to make the increase in the pressure loss smaller and thereby make blowing efficiency higher than is conventionally possible.

[0209] The wind deflector 115b has the rotary shaft 115d provided not in an end part thereof but in a substantially middle part thereof. This permits the wind deflector 115b to be rotated with a lower torque than in the fifth embodiment. This helps save the power consumed by the drive motor and lower the required output of the drive motor, and thus helps reduce cost.

[0210] Incidentally, the wind deflector 115b may be arranged with the tip end thereof pointing in a direction slightly more frontward than straight downward as shown in FIG. 41 so that the conditioned air is sent out through the blowout port 5 in a substantially straight downward direction as indicated by arrow B. By arranging the wind deflector 115b with the rotary shaft 115d up in the state for blowing out in a frontward-downward direction shown in FIG. 39 described previously, it is possible to move the wind deflector 115b smoothly in the state for blowing out in a rearward-downward direction (see FIG. 40) and in the state for blowing out in a substantially straight downward direction (see FIG. 41).

[0211] In the air conditioner configured as described above, when cooling operation is started, the wind deflectors 115a and 115b are arranged as shown in FIG. 38. Here, the wind deflector 115a is arranged with an outer end part thereof more upward than when heating operation is performed. This permits the air stream to pass along both sides of the wind deflector 115a, and thus helps prevent condensation of moisture on the wind deflector 115a. Thus, the conditioned air is sent out in a frontward-downward direction as indicated by arrow A. This brings the indoor unit 1 into a state in which it sends out the conditioned air in a frontward-downward direction, that is, a state for blowing out in a frontward-downward direction.

[0212] When a predetermined period has elapsed after the start of the cooling operation, or when the difference between the temperature of the air taken in through the suction port 4 and the user-specified temperature is smaller than a predetermined value, the wind deflectors 115a and 115b are arranged as shown in FIG. 42. Specifically, 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, which is inclined upward near the blowout port 5. The wind deflector 115b is arranged with an outer end part thereof located in front of and below an inner end part thereof.

[0213] Thus, the conditioned air is sent out through the blowout port 5 in a frontward-upward direction as indicated by arrow E, for example, at a wind speed of about 5 to 6 m/sec. The conditioned air sent out into the room then reaches the ceiling of the room R as shown in FIG. 25 described previously. The conditioned air then flows, by the Coanda effect, along the ceiling wall S, then along the wall surface W2 opposite to the indoor unit 1, then along the floor surface F, then along the side wall W1 on which the indoor unit 1 is installed, so as to be eventually sucked through the suction port 4 into the indoor unit 1 at both sides thereof. Thus, as in the fourth and fifth embodiments, it is possible to enhance comfort and safety.

[0214] Furthermore, when the wind deflector 115a is set at a horizontal orientation as shown in FIG. 43, the conditioned air can be sent out through the blowout port 5 in a horizontal direction as indicated by arrow D. Incidentally, by arranging the wind deflector 115b with the rotary shaft 115d above the wind deflector 115b in the state for blowing out in a frontward-downward direction shown in FIG. 38 described previously, it is possible to arrange the wind deflector 115b smoothly in the state for blowing out in a frontward-upward direction (see FIG. 42) and in the state for blowing out in a horizontal direction (see FIG. 43).

[0215] FIG. 44 shows the state of the air conditioner when it is not operating. When the operation of the air conditioner is stopped, the wind deflectors 115a and 115b stop the blowout port. This prevents a view into the interior of the indoor unit 1. Arranging the wind deflector 115a along the front panel 3 and arranging the wind deflector 115b so that the lower end of the wind deflector 115a is connected to the bottom face of the cabinet 2 helps enhance the outward appearance of the indoor unit 1. Incidentally, through operation of a remote control, the user can vary the positions of the vertical louver elements 12 and the wind deflectors 115a and 115b.

[0216] In this embodiment, during heating operation, the wind deflector 115b (first wind direction plate) rotates from the stopping position shown in FIG. 44 clockwise as seen in the figures so as to be arranged in the states shown in FIGS. 39 to 41. This permits quick variation of the wind direction among a frontward-downward direction, a rearward-downward direction, and a straight downward direction during heating operation. During cooling operation, the wind deflector 115b rotates, as opposed to during heating operation, counter-clockwise as seen in the figures so as to be arranged in the states shown in FIGS. 38, 42, and 43. This permits quick variation of the wind direction among a frontward-downward direction, a horizontal direction, and a frontward-upward direction during cooling operation. In this way, comfortable air conditioning can be performed quickly. Incidentally, during drying operation, the wind deflectors 115a and 115b are advisably arranged in a manner similar to that during cooling operation.

[0217] On the other hand, the wind deflector 115a (second wind direction plate) rotates from the upper part stopping position shown in FIG. 44 counter-clockwise as seen in the figures so that the conditioned air can be easily sent out in a frontward-downward direction (see FIGS. 38 and 39), a rearward-downward direction (see FIG. 40), a straight downward direction (see FIG. 41), a frontward-upward direction (see FIG. 42), and a horizontal direction (see FIG. 43).

[0218] It should be understood that the present invention may be carried out in any manners other than specifically described above as embodiments; that is, many modifications and variations are possible within the scope and spirits of the present invention.

Industrial Applicability

[0219] 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 installed on a wall surface inside a room, the air conditioner including a suction port through which air inside the room is taken in, a blowout port through which the air taken in through the suction port and then conditioned is sent out into the room, a blowing passage through which the conditioned air is directed to the blowout port, and a wind deflector that permits a wind direction of the conditioned air sent out through the blowout port to be varied between a frontward-downward direction and a straight downward direction or a rearward-downward direction, **characterized in that**, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, the wind deflector is so arranged that isobars of a static pressure distribution near the wind deflector run along a flow direction of the conditioned air facing the wind deflector.
2. The air conditioner of claim 1, **further characterized in that** the blowing passage has a front guide that guides the conditioned air in a frontward-downward direction, and

that, when the conditioned air is sent out through the blowout port in a frontward-downward direction, the wind deflector forms a stream passage along an air stream flowing through the front guide and, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, the wind deflector bends the air stream flowing through the front guide.

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3. The air conditioner of claim 2,
further **characterized in**
that, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, the air stream flowing through the front guide is stopped from flowing further frontward by the
10 wind deflector.
- 15
4. The air conditioner of claim 2,
further **characterized in**
that, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, a high static pressure part where a static pressure is higher than in the front guide is formed in contact with the wind deflector in a frontward direction in which the air stream flowing through the front guide is directed.
- 20
5. The air conditioner of claim 4,
further **characterized in**
that the high static pressure part has a substantially bow-like cross-sectional shape described by a two-pointed curve.
- 25
6. The air conditioner of claim 5,
further **characterized in**
that the high static pressure part has a maximum static pressure in a middle part of an arc forming the substantially bow-like shape.
- 30
7. The air conditioner of claim 4,
further **characterized in**
that, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, the high static pressure part narrows a stream passage of the conditioned air so as to make a stream passage area smaller than in the front guide.
- 35
8. The air conditioner of claim 7,
further **characterized in**
that the stream passage narrowed by the high static pressure part widens back on a downstream side.
- 40
9. The air conditioner of claim 2,
further **characterized in**
that the wind deflector is arranged on an extension line of a lower inner wall of the front guide so as to cross the extension line.
- 45
10. The air conditioner of one of claims 1 to 9,
further **characterized in**
that the wind deflector is composed of a movable inner wall of the blowing passage.
- 50
11. The air conditioner of claim 10,
further **characterized in**
that, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, the wind deflector extends the blowing passage.
- 55
12. The air conditioner of one of claims 1 to 9,
further **characterized in**
that the wind deflector is composed of a plurality of wind direction plates arranged in the blowout port, the wind direction plates being rotatable to change orientations thereof.
13. The air conditioner of one of claims 1 to 9,
further **characterized in**

that static pressure detecting means is provided for detecting a static pressure distribution in the blowing passage, and
that, based on a result of detection by the static pressure detecting means, the wind deflector can be varied.

- 5 **14.** The air conditioner of claim 1,
further **characterized in**
that, as a result of the conditioned air being sent out, heating operation is performed in the room.
- 10 **15.** An air conditioner including
a suction port through which air inside a room is taken in,
a blowout port through which the air taken in through the suction port and then conditioned is sent out into the room,
a blowing passage through which the conditioned air is directed to the blowout port, and
a wind deflector that permits a wind direction of the conditioned air sent out through the blowout port to be varied,
characterized in
15 **that** a wall surface of a stream passage bent by the wind deflector is formed by a static pressure difference in the blowing passage.
- 20 **16.** The air conditioner of claim 15,
further **characterized in**
that the blowing passage has a front guide that guides the conditioned air in a frontward-downward direction, and
that the conditioned air that flows through the front guide is sent out through the blowout port in a frontward-downward
direction, and also the conditioned air that flows through the front guide is bent by the wind deflector so as to be
sent out through the blowout port in a straight downward direction or in a rearward-downward direction.
- 25 **17.** The air conditioner of claim 16,
further **characterized in**
that the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-
downward direction to achieve heating.
- 30 **18.** The air conditioner of claim 16,
further **characterized in**
that the wall surface is formed as a result of the air stream that flows through the front guide being stopped from
flowing further frontward by the wind deflector.
- 35 **19.** The air conditioner of claim 16,
further **characterized in**
that the wall surface is formed by a high static pressure part where a static pressure is higher than in the front guide
which is formed in contact with the wind deflector in a frontward direction in which the air stream flowing through
the front guide is directed.
- 40 **20.** The air conditioner of claim 19,
further **characterized in**
that the high static pressure part narrows a stream passage of the conditioned air so as to make a stream passage
area smaller than in the front guide.
- 45 **21.** The air conditioner of claim 19,
further **characterized in**
that the wind deflector is arranged on an extension line of a lower inner wall of the
front guide so as to cross the extension line.
- 50 **22.** The air conditioner of one of claims 15 to 21,
further **characterized in**
that the wind deflector is composed of a movable inner wall of the blowing passage.
- 55 **23.** The air conditioner of claim 22,
further **characterized in**
that, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-
downward direction, the wind deflector extends the blowing passage.

24. The air conditioner of one of claims 15 to 21,
further **characterized in**
that the wind deflector is composed of a plurality of wind direction plates arranged in the blowout port, the wind
direction plates being rotatable to change orientations thereof.

25. The air conditioner of one of claims 15 to 21,
further **characterized in**
that positioning means is provided for positioning the wind deflector at a position where the wall surface is formed.

26. An air conditioner installed on a wall surface inside a room, the air conditioner including
a suction port through which air inside the room is taken in,
a blowout port through which the air taken in through the suction port and then conditioned is sent out into the room,
a blowing passage through which the conditioned air is directed to the blowout port, and
a wind deflector that has a first wind direction plate rotatably arranged in the blowout port and that permits a wind
direction of the conditioned air sent out through the blowout port to be varied,
characterized in
that the first wind direction plate can take one of the following positions:

a stopping position where the first wind direction plate stops at least part of the blowout port,
a position that the first wind direction plate reaches by rotating in one direction from the stopping position and
where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a straight
downward direction or a rearward-downward direction,
a position that the first wind direction plate reaches by rotating in the one direction from the stopping position
and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a
frontward-downward direction,
a position that the first wind direction plate reaches by rotating in an opposite direction from the stopping position
and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a
frontward-downward direction, and
a position that the first wind direction plate reaches by rotating in the opposite direction from the stopping position
and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a
frontward-upward direction.

27. An air conditioner installed on a wall surface inside a room, the air conditioner including
a suction port through which air inside the room is taken in,
a blowout port through which the air taken in through the suction port and then conditioned is sent out into the room,
a blowing passage through which the conditioned air is directed to the blowout port, and
a wind deflector that has a first wind direction plate rotatably arranged in the blowout port and that permits a wind
direction of the conditioned air sent out through the blowout port to be varied,
characterized in
that the first wind direction plate can take one of the following positions:

a stopping position where the first wind direction plate stops at least part of the blowout port,
a position that the first wind direction plate reaches by rotating in one direction from the stopping position and
where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a straight
downward direction,
a position that the first wind direction plate reaches by rotating in the one direction from the stopping position
and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a
frontward-downward direction,
a position that the first wind direction plate reaches by rotating in an opposite direction from the stopping position
and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a
frontward-downward direction, and
a position that the first wind direction plate reaches by rotating in the opposite direction from the stopping position
and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a
horizontal direction.

28. The air conditioner of claim 26 or 27,
further **characterized in**
that the blowing passage has a front guide that guides the conditioned air in a frontward-downward direction, and

that, when the conditioned air is sent out through the blowout port in a frontward-downward direction, the first wind direction plate forms a stream passage along an air stream flowing through the front guide and, when the conditioned air is sent out through the blowout port in a straight downward direction or in a rearward-downward direction, the first wind direction plate bends the air stream flowing through the front guide by stopping the air stream from flowing further frontward.

29. The air conditioner of claim 26 or 27,
further **characterized in**

that, in the position that the first wind direction plate reaches by rotating in the one direction from the stopping position and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a frontward-downward direction, the first wind direction plate is arranged with a convex surface thereof facing upward and, in the position that the first wind direction plate reaches by rotating in the opposite direction from the stopping position and where the first wind direction plate permits the conditioned air to be sent out through the blowout port in a frontward-downward direction, the first wind direction plate is arranged with the convex surface thereof facing downward.

30. The air conditioner of claim 26 or 27,
further **characterized in**

that, with the first wind direction plate in a position that the first wind direction plate reaches by rotating in one direction, heating operation is performed and, with the first wind direction plate in a position that the first wind direction plate reaches by rotating in an opposite direction, cooling operation or drying operation is performed.

31. The air conditioner of claim 26 or 27,
further **characterized in**

that the first wind direction plate is arranged in a lower part of the blowout port, and that the wind deflector further has a second wind direction plate rotatably arranged in an upper part of the blowout port.

32. The air conditioner of claim 31,
further **characterized in**

that the second wind direction plate can take one of the following positions:

an upper part stopping position where the second wind direction plate stops the upper part of the blowout port, a position that is inclined relative to the upper part stopping position and where the second wind direction plate directs the air stream in a frontward-downward direction, and a position that is inclined relative to the upper part stopping position and where the second wind direction plate directs the air stream in a horizontal direction or a frontward-upward direction.

33. The air conditioner of claim 32,
further **characterized in**

that, when the conditioned air is sent out in a straight downward direction or a rearward-downward direction, the second wind direction plate is arranged in the upper part stopping position.

34. The air conditioner of claim 32,
further **characterized in**

that, when the conditioned air is sent out in a straight downward direction or a rearward-downward direction, the second wind direction plate is arranged in a position inclined relative to the upper part stopping position and reached by rotating in a reverse direction so that the second wind direction plate extends an upper wall of the blowing passage.

35. The air conditioner of claim 34,
further **characterized in**

that, when the conditioned air is sent out in a straight downward direction or a rearward-downward direction, the second wind direction plate is positioned in contact with the first wind direction plate.

36. The air conditioner of claim 34,
further **characterized in**

that, when the conditioned air is sent out in a straight downward direction or a rearward-downward direction, the second wind direction plate is positioned in contact with an upper wall of the blowing passage.

FIG.1

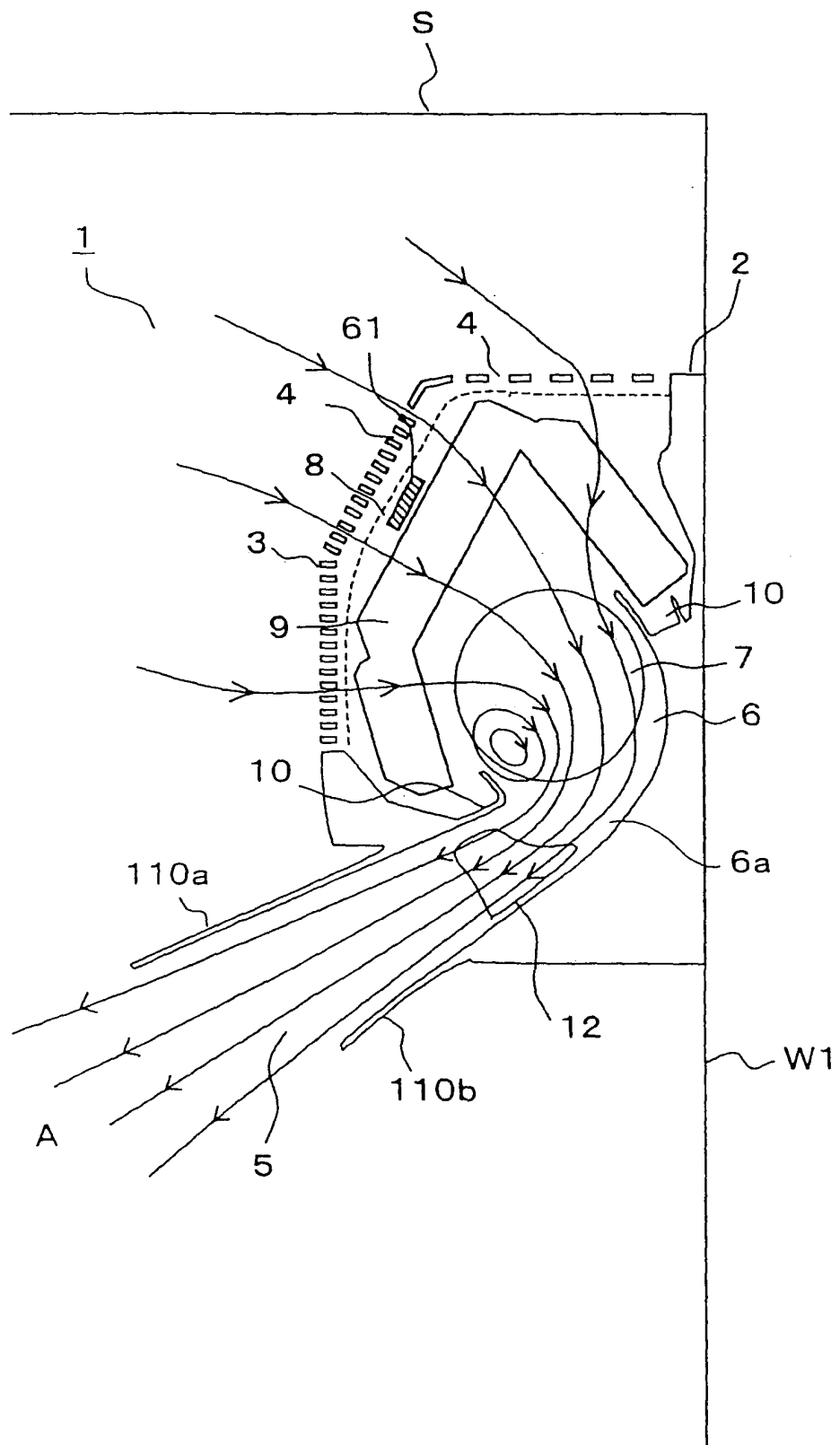
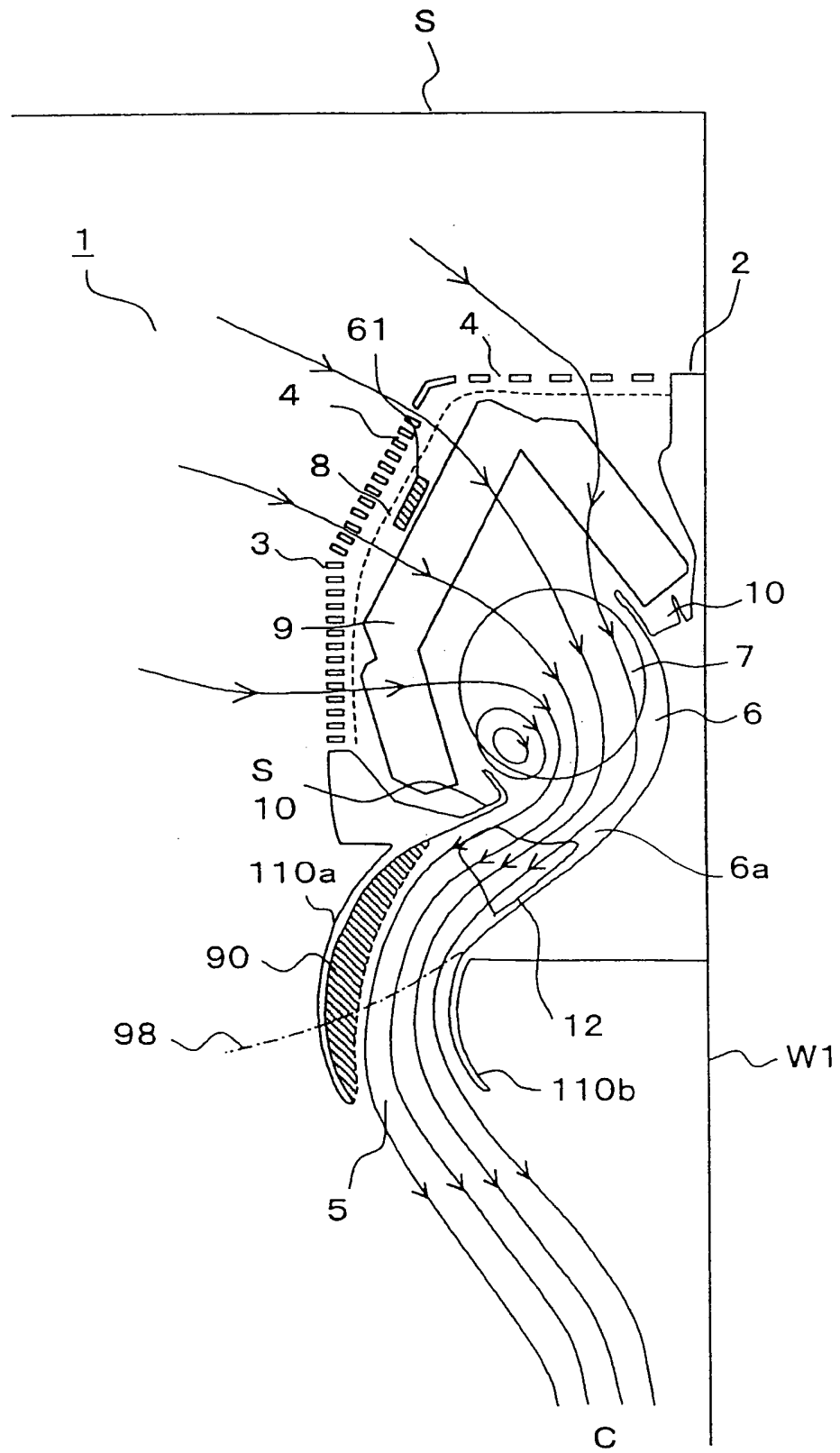


FIG.2



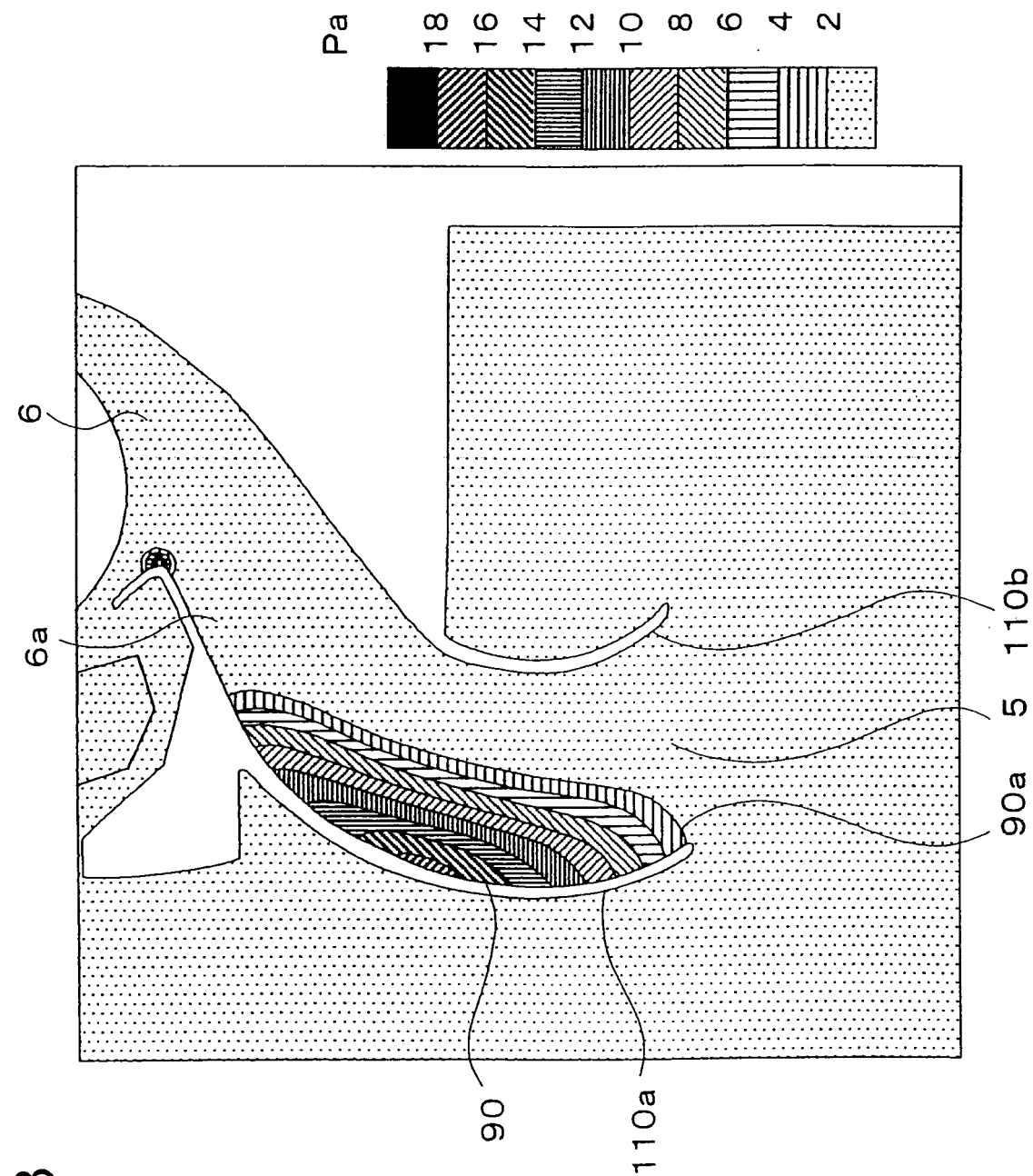
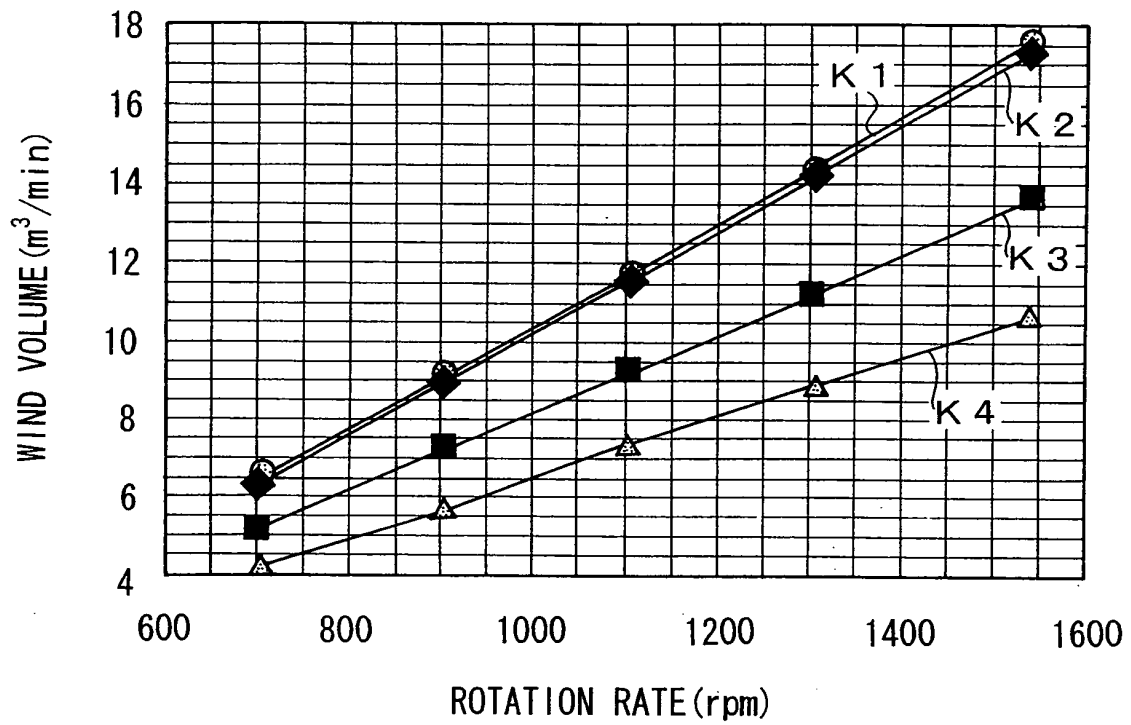
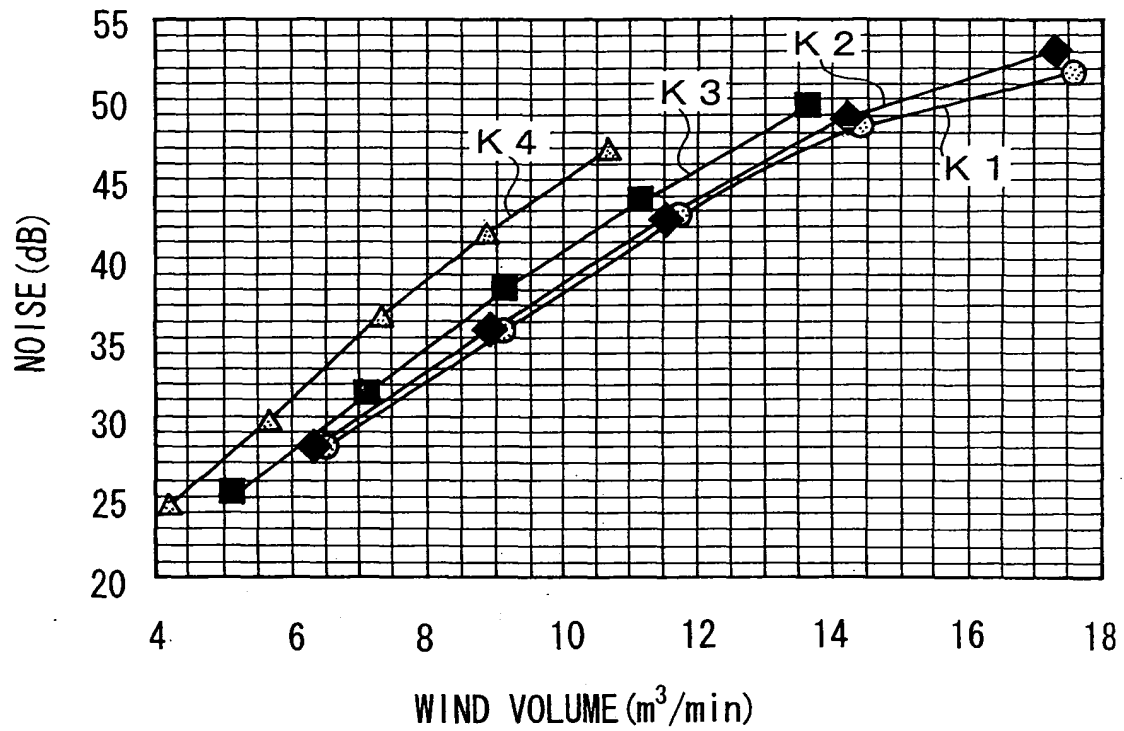


FIG.4



—○—	EMBODIMENT 1	REAR-DOWN BLOWOUT
—◆—	CONVENTIONAL EXAMPLE 1	FRONT-DOWN BLOWOUT
—■—	CONVENTIONAL EXAMPLE 1	STRAIGHT-DOWN BLOWOUT
—△—	CONVENTIONAL EXAMPLE 2	REAR-DOWN BLOWOUT

FIG.5



—○—	EMBODIMENT 1	REAR-DOWN BLOWOUT
—◆—	CONVENTIONAL EXAMPLE 1	FRONT-DOWN BLOWOUT
—■—	CONVENTIONAL EXAMPLE 1	STRAIGHT-DOWN BLOWOUT
—△—	CONVENTIONAL EXAMPLE 2	REAR-DOWN BLOWOUT

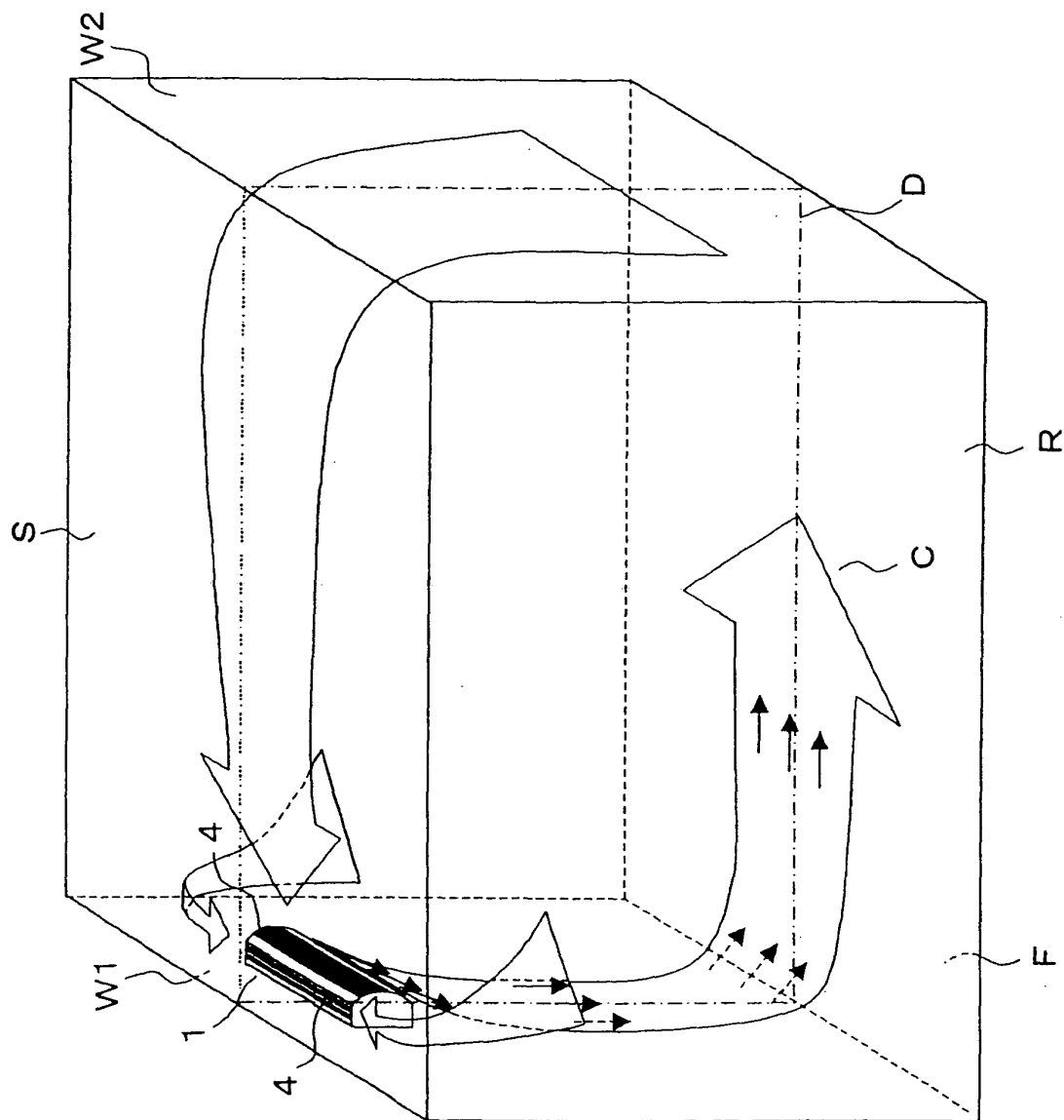


FIG. 6

FIG.7

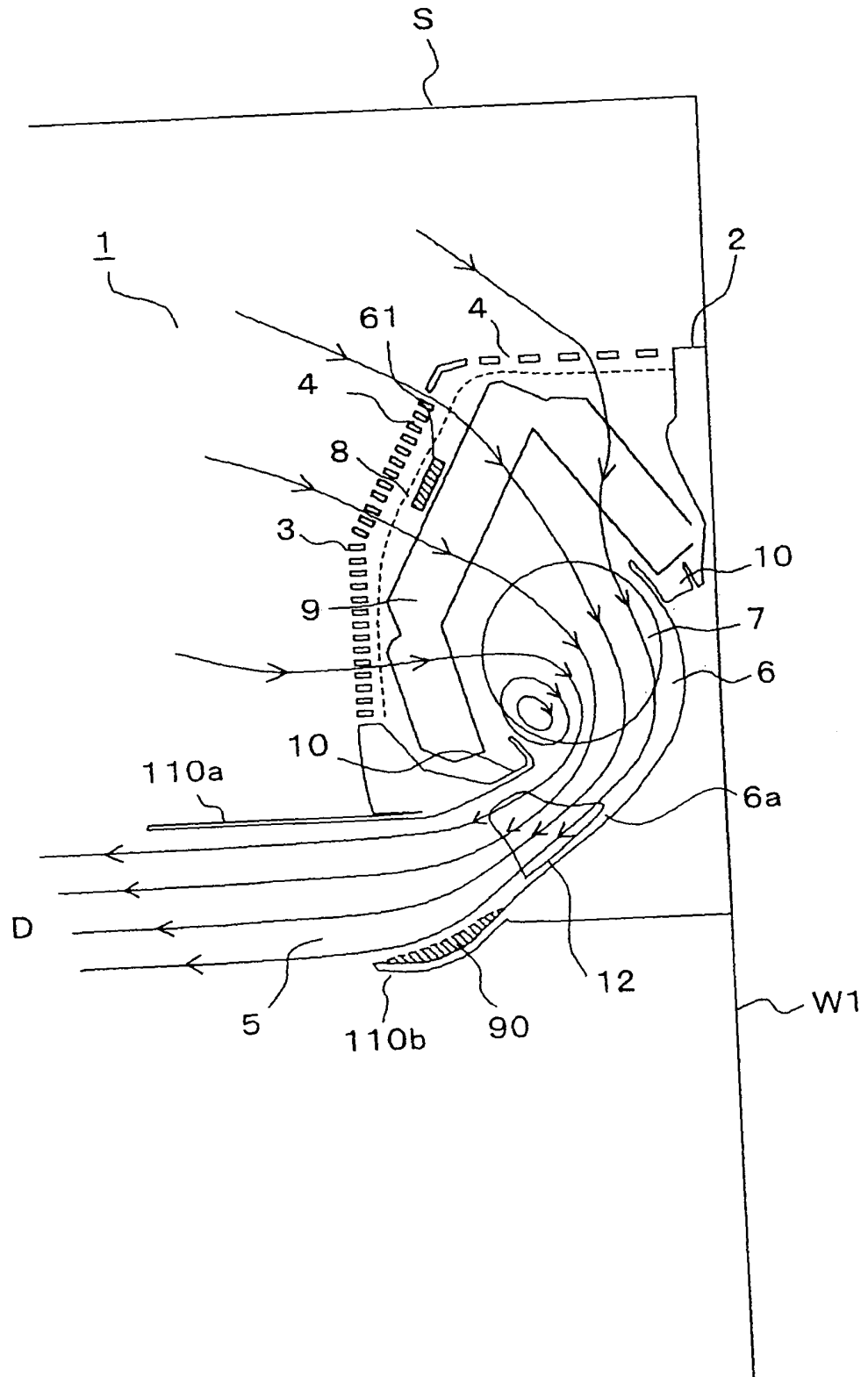


FIG.8

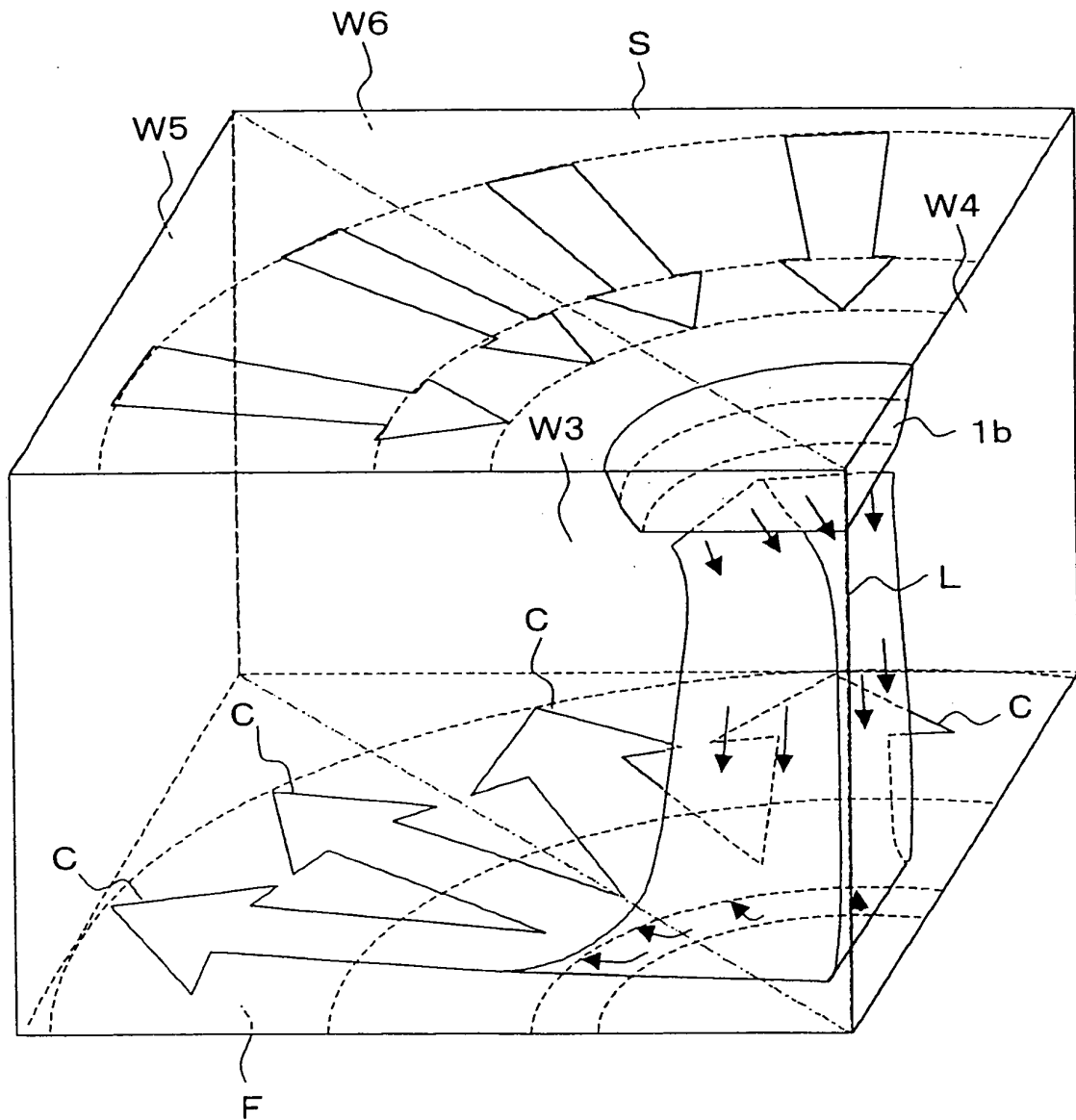


FIG.9

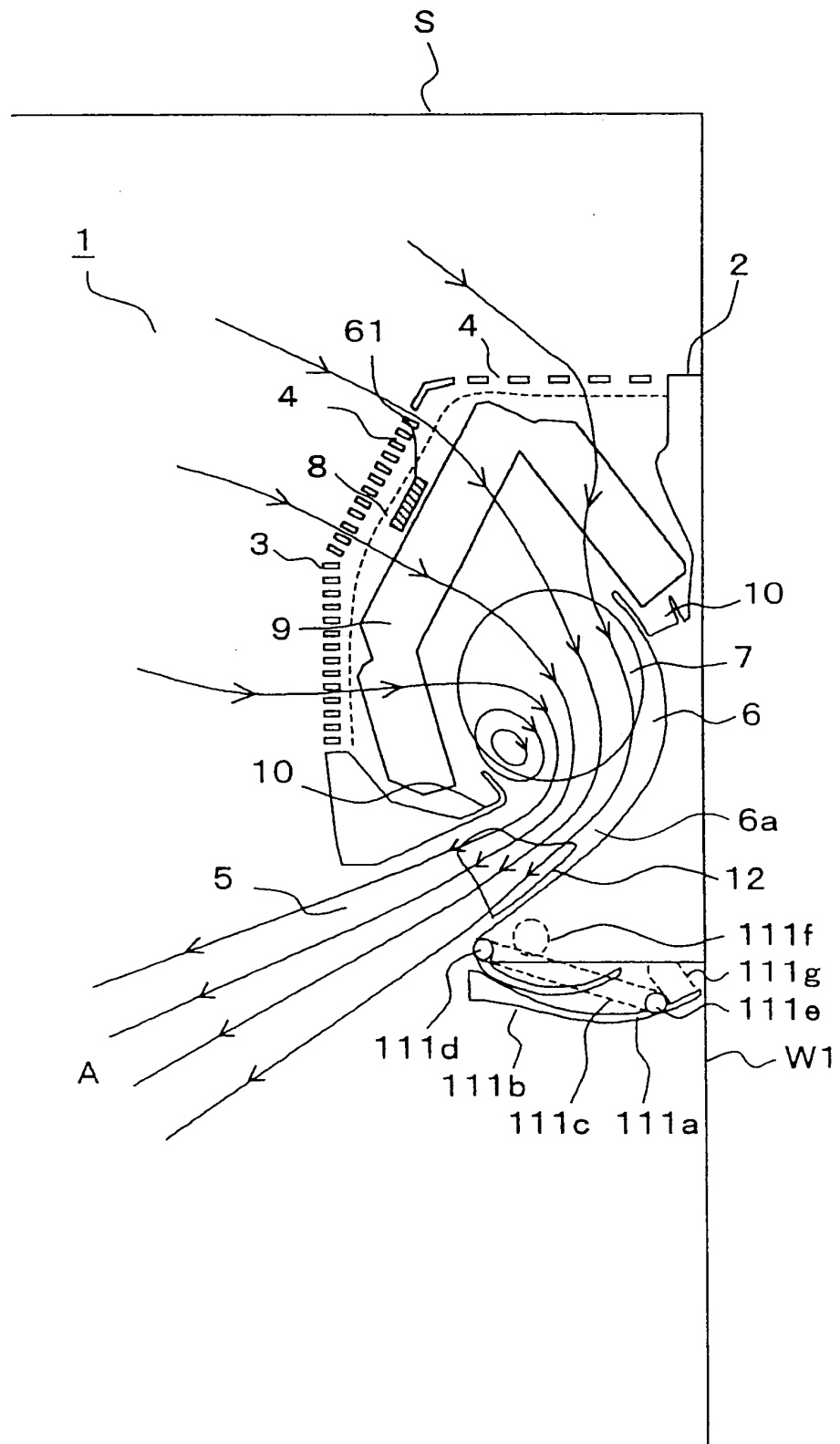


FIG.10

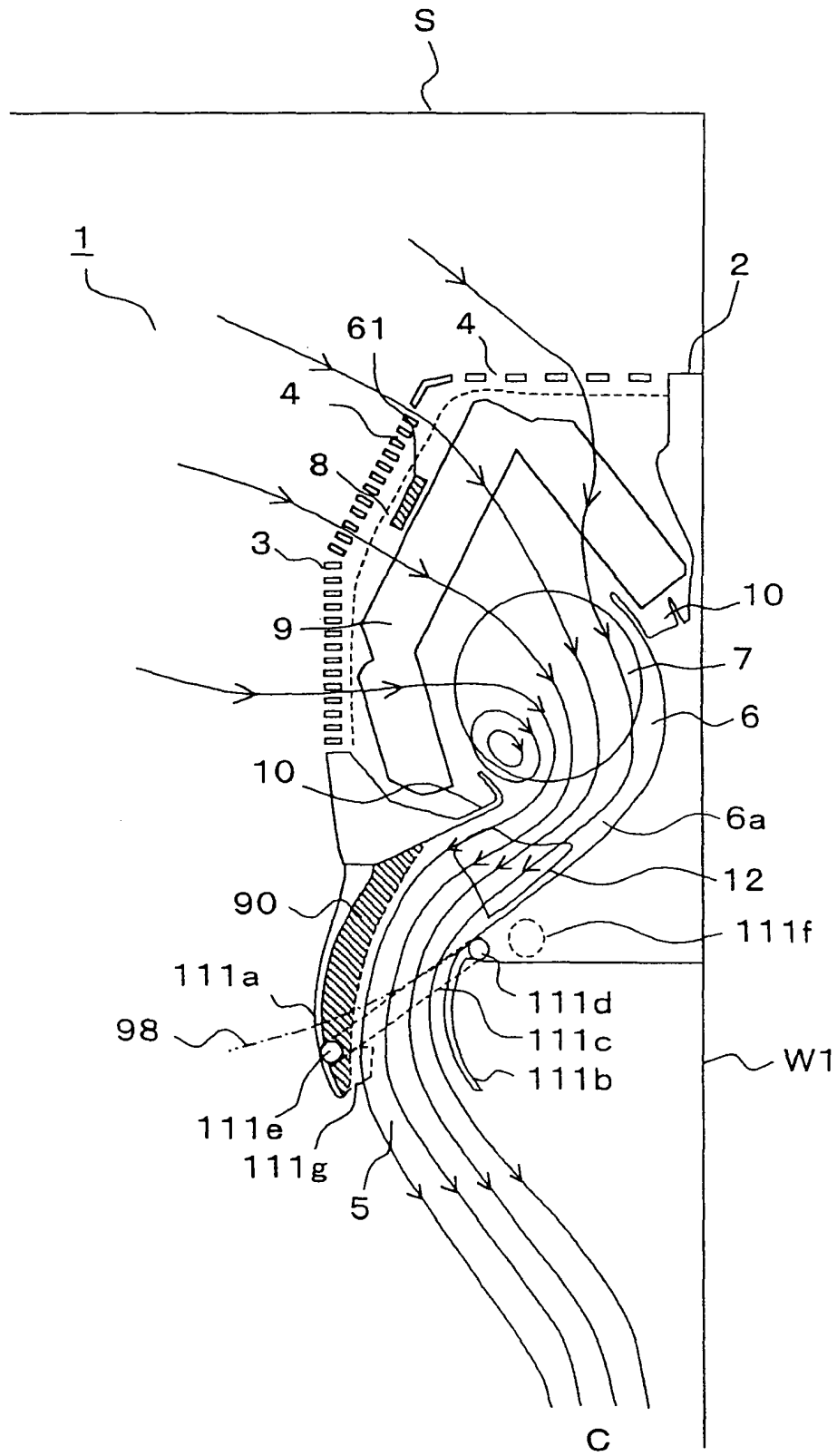


FIG.11

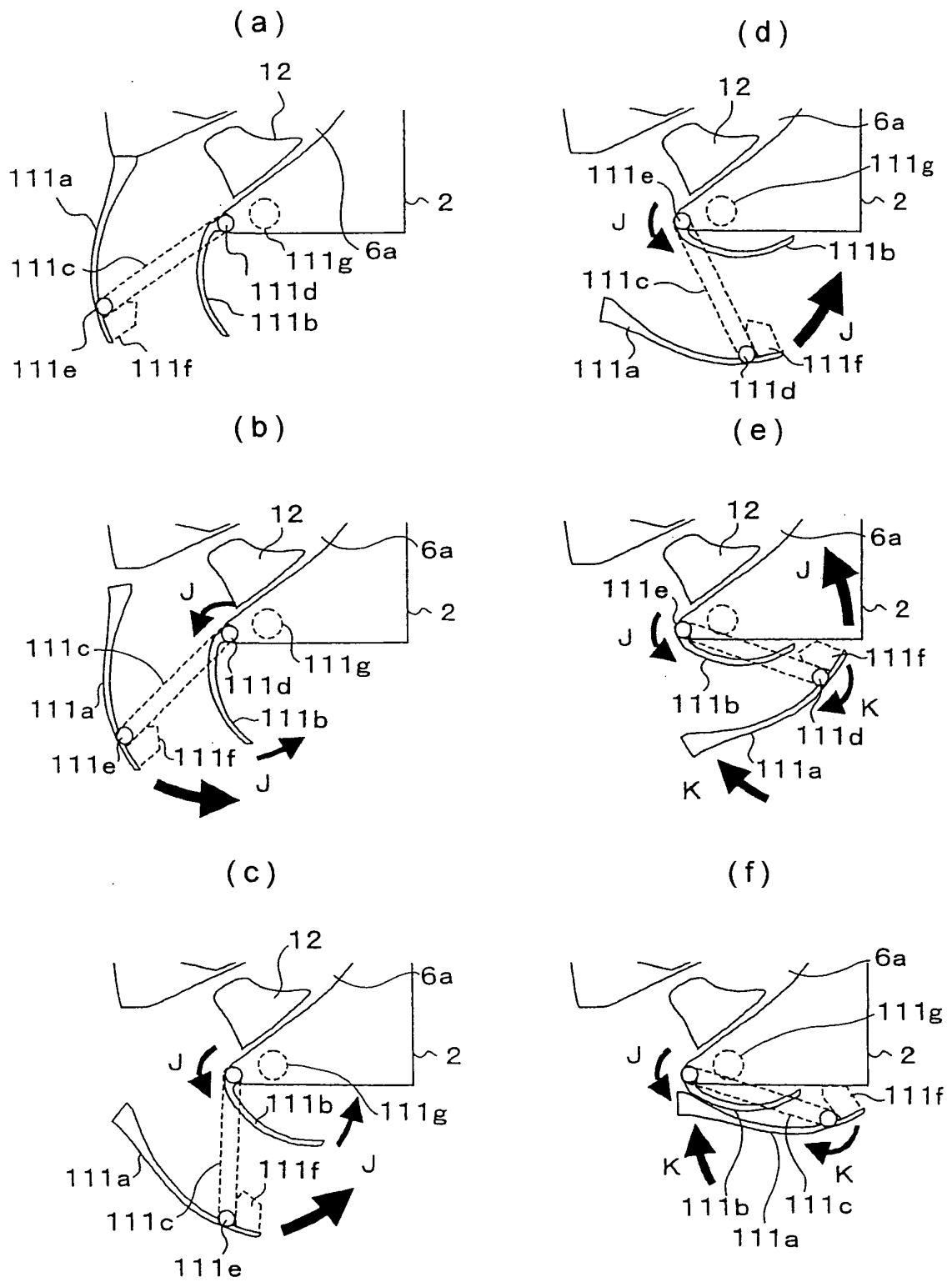


FIG.12

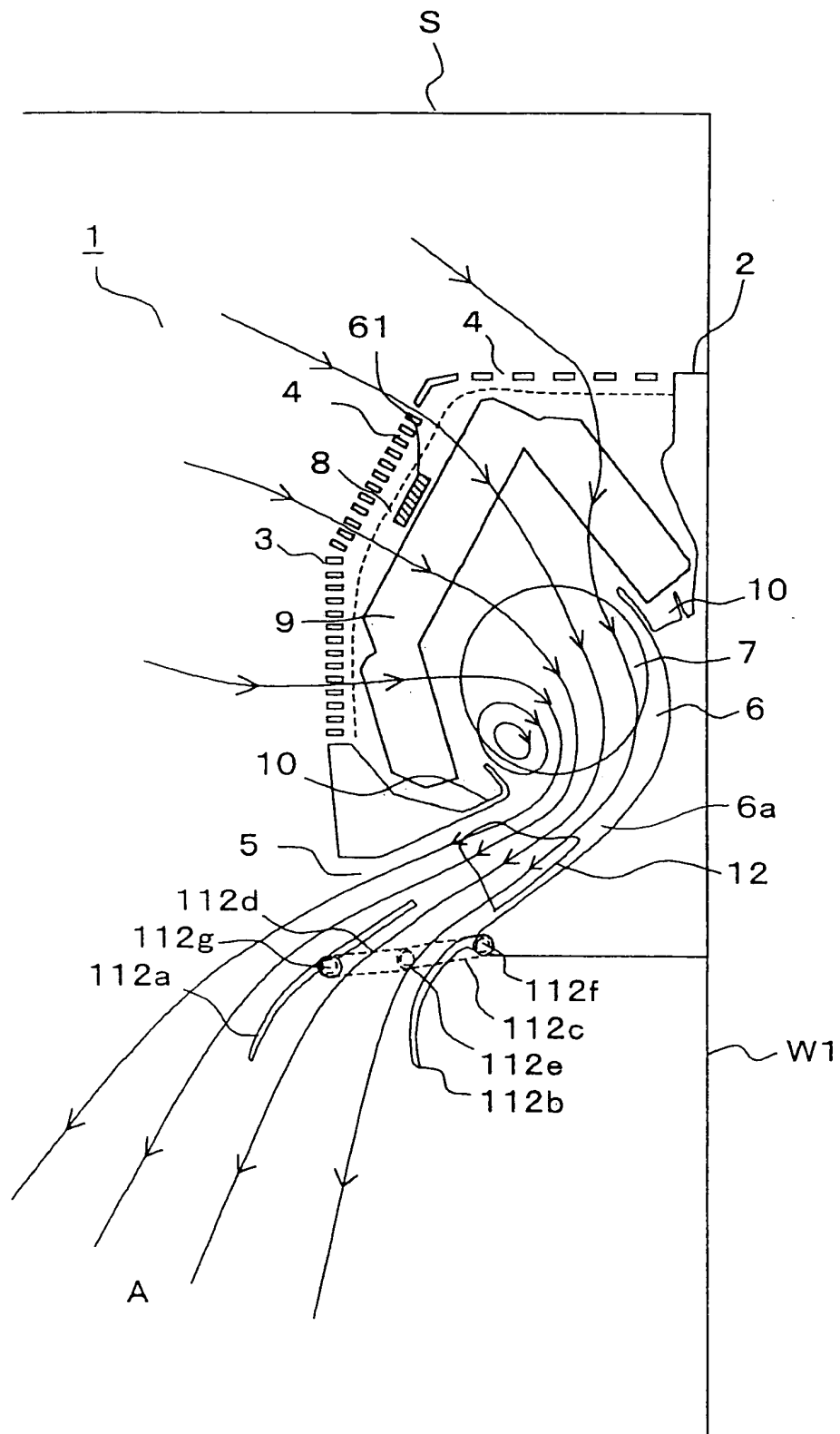


FIG.13

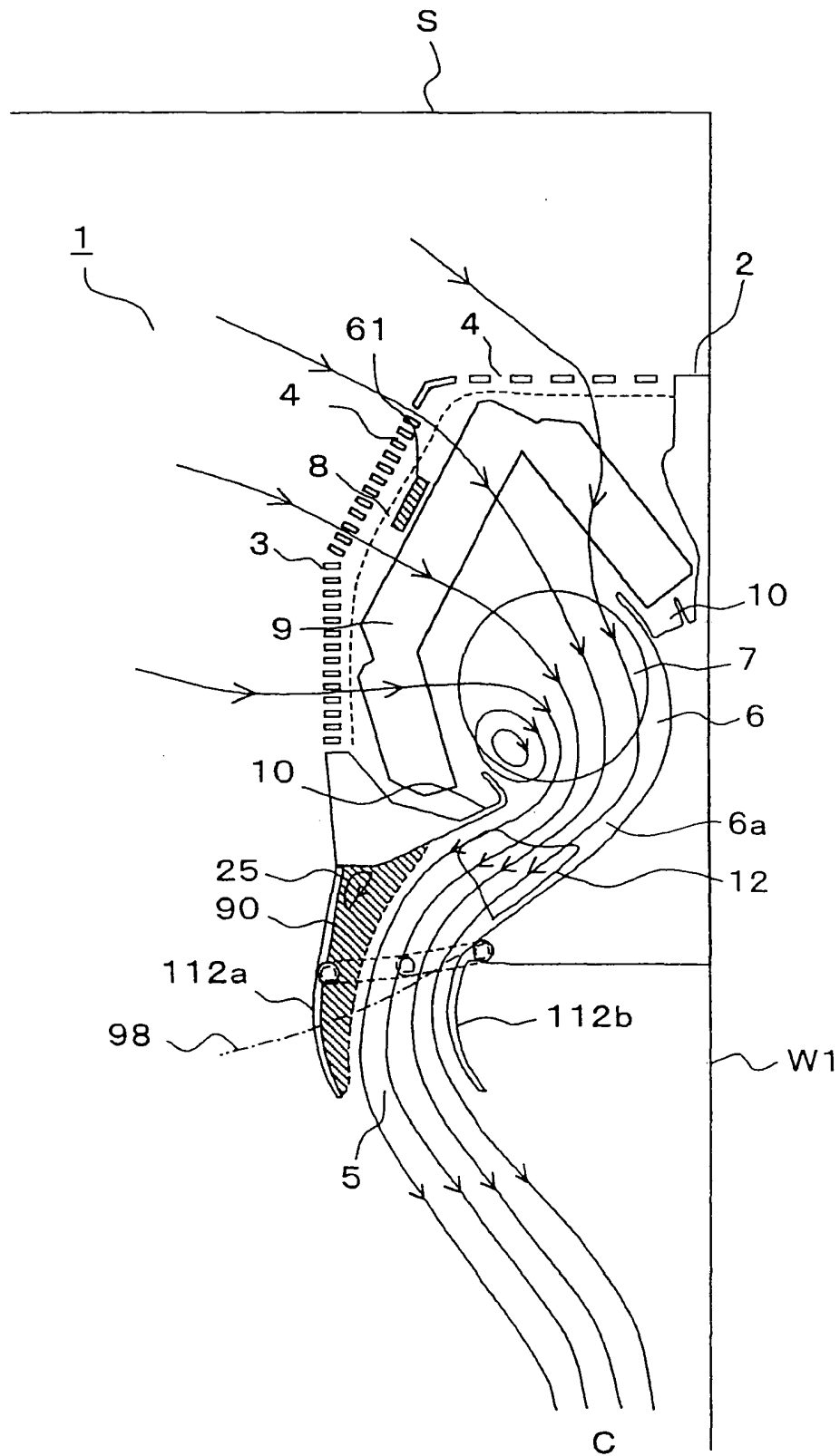


FIG.14

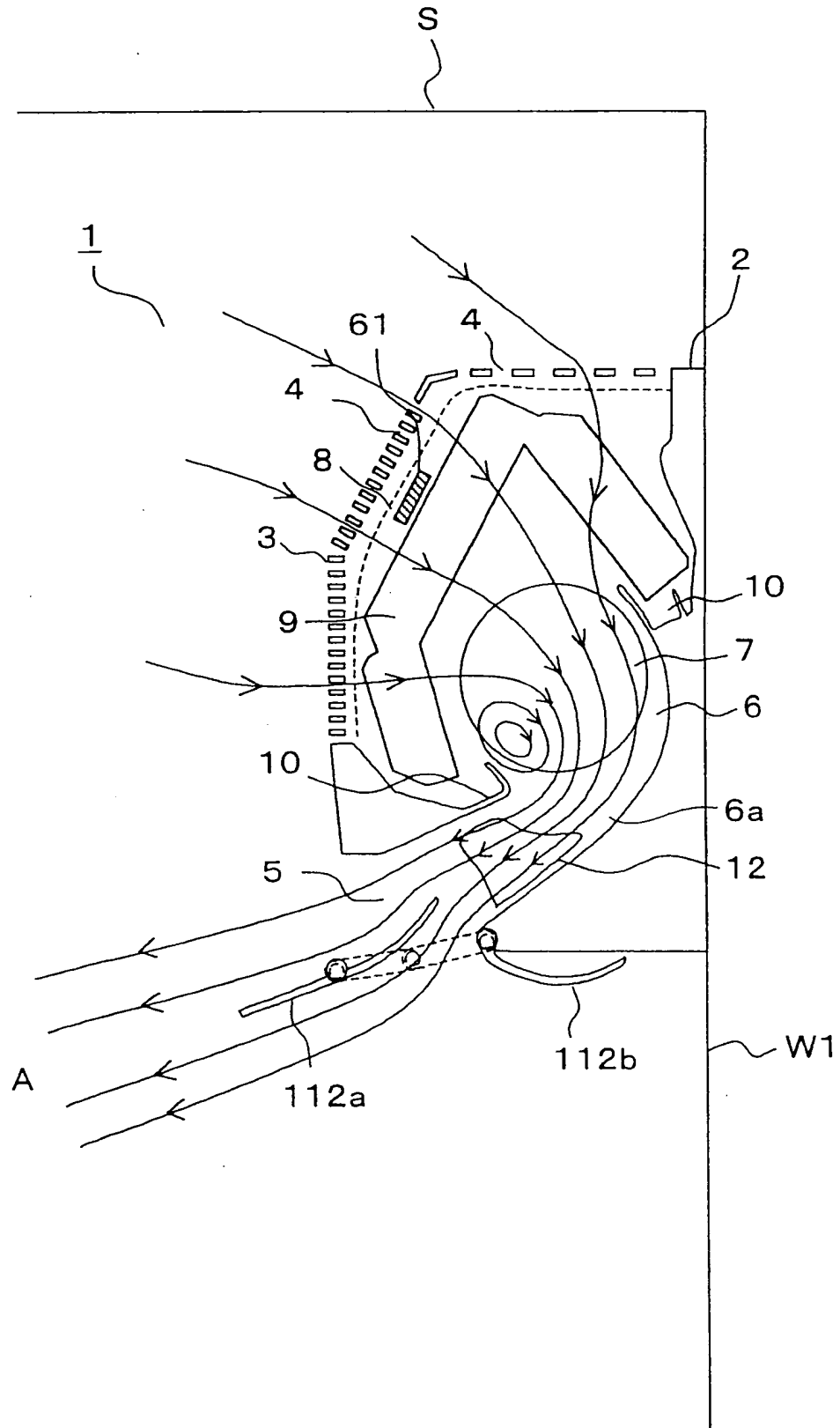


FIG.15

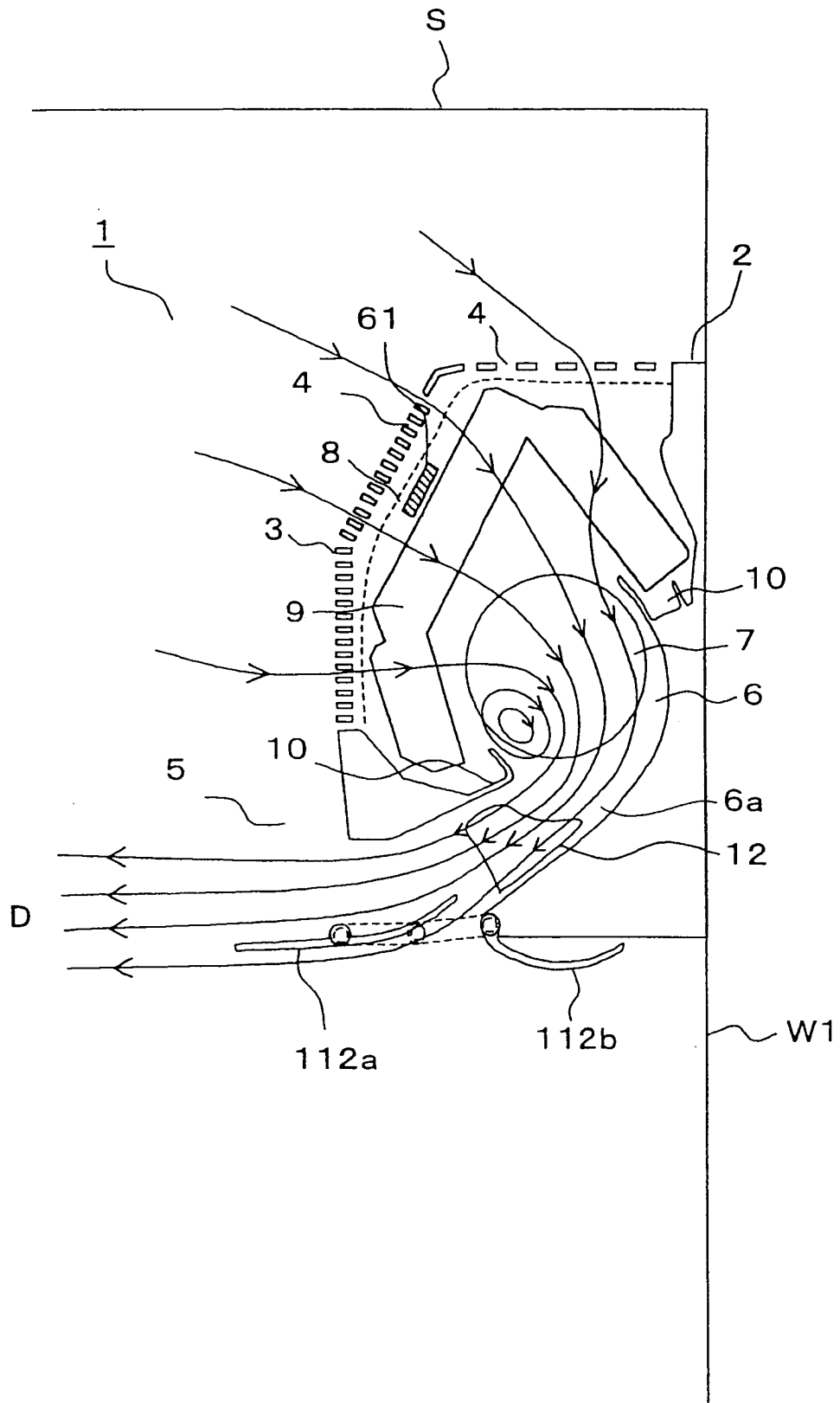


FIG.16

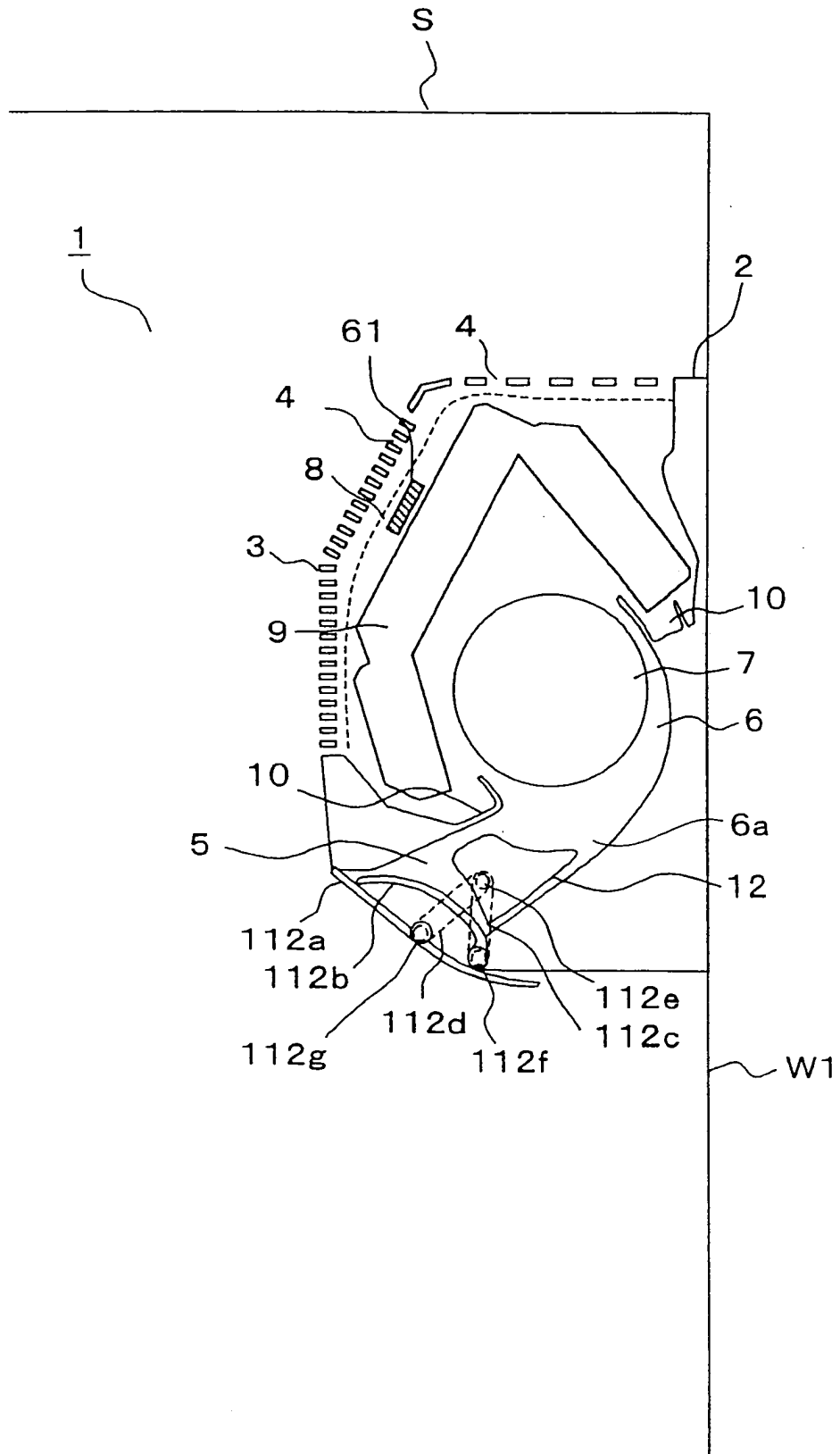


FIG.17

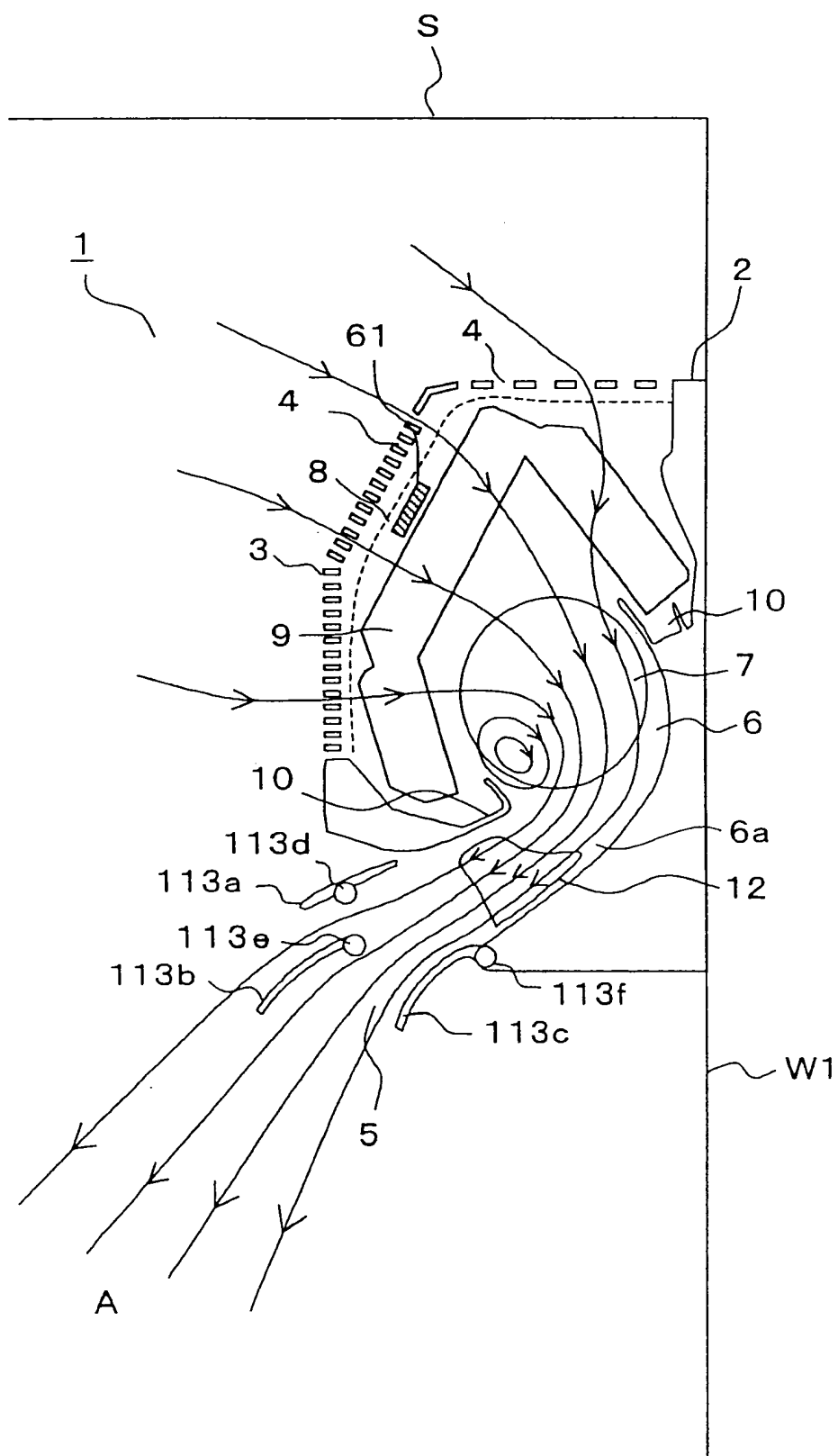


FIG.18

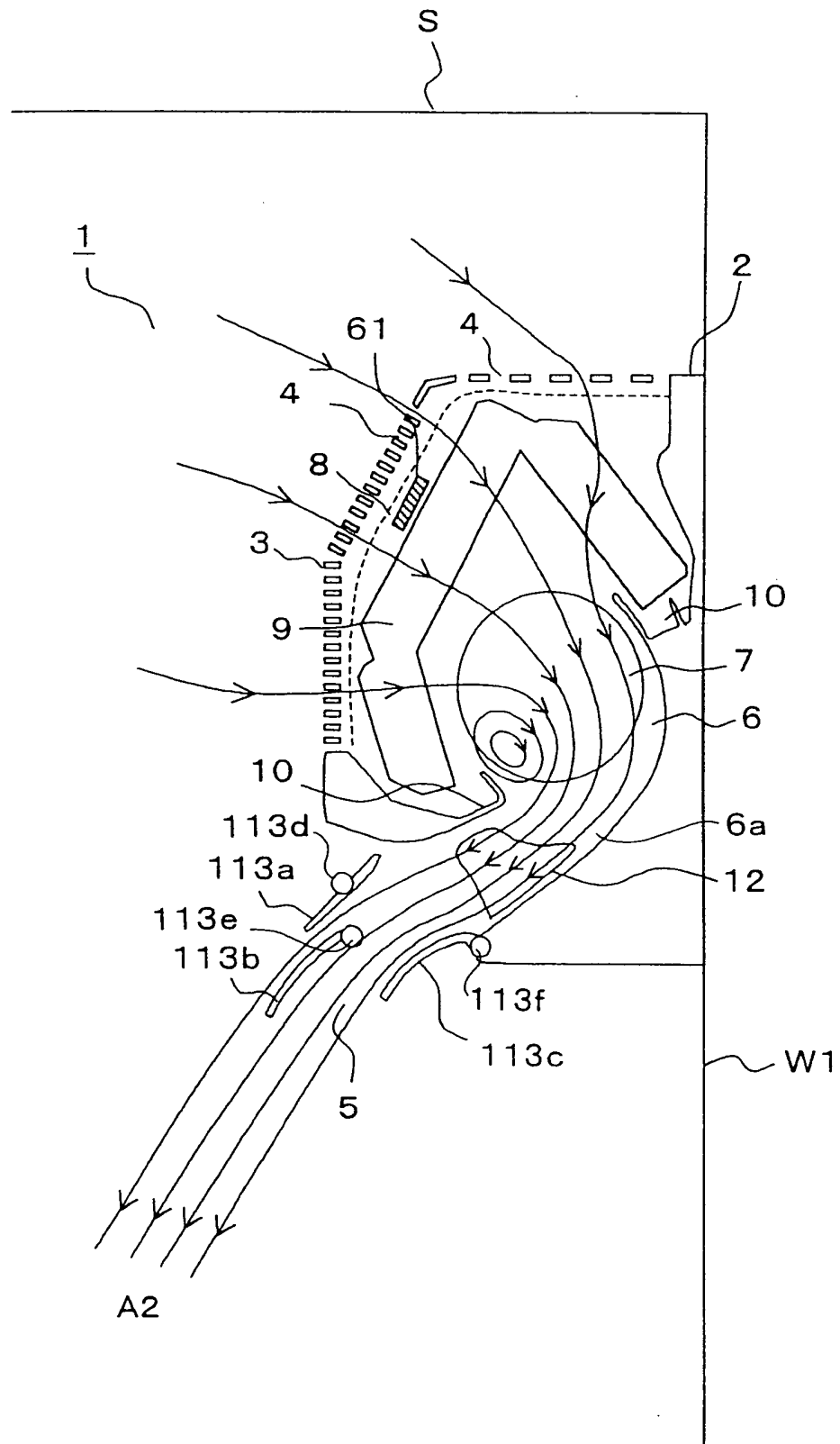


FIG.19

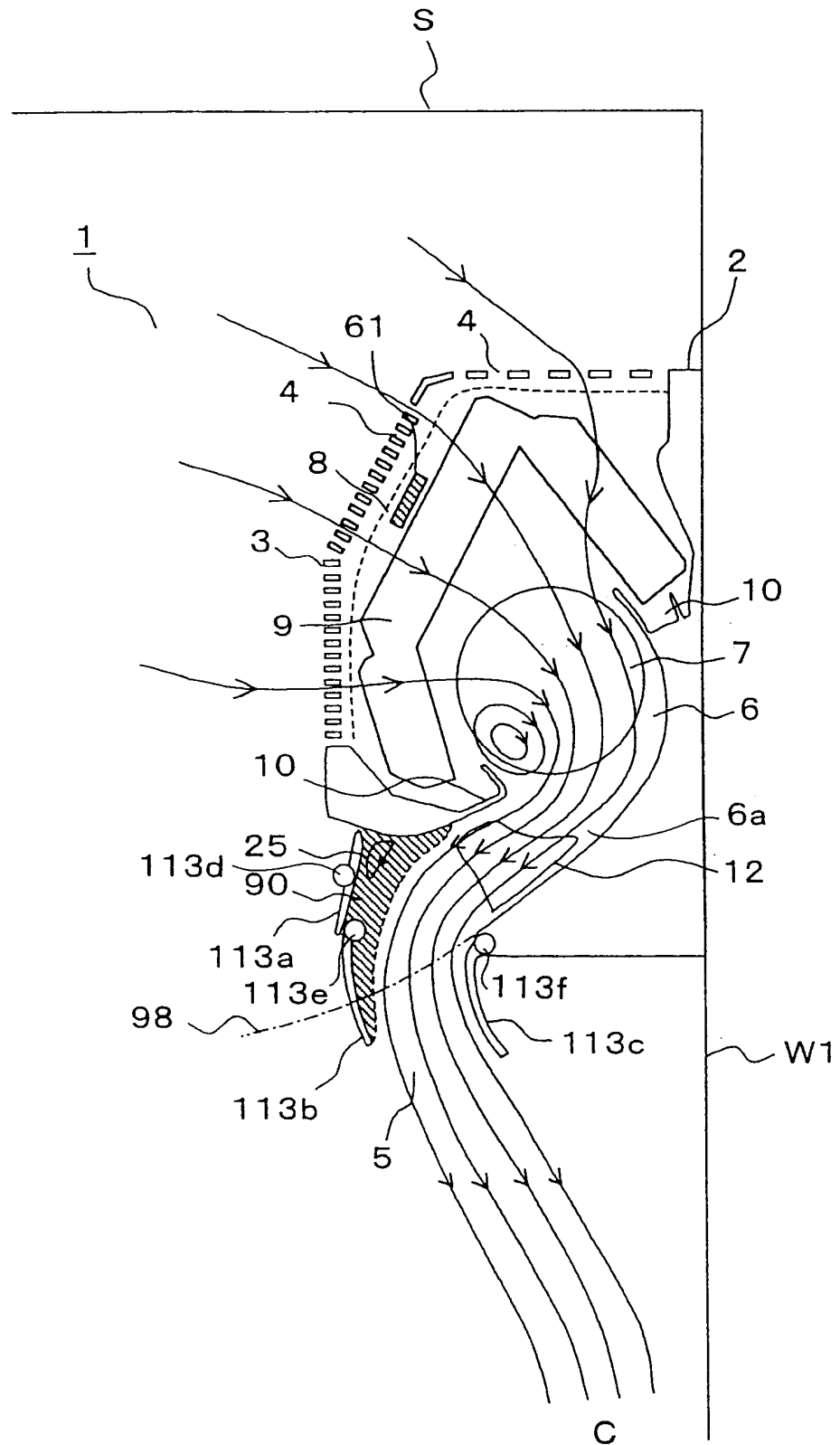


FIG.20

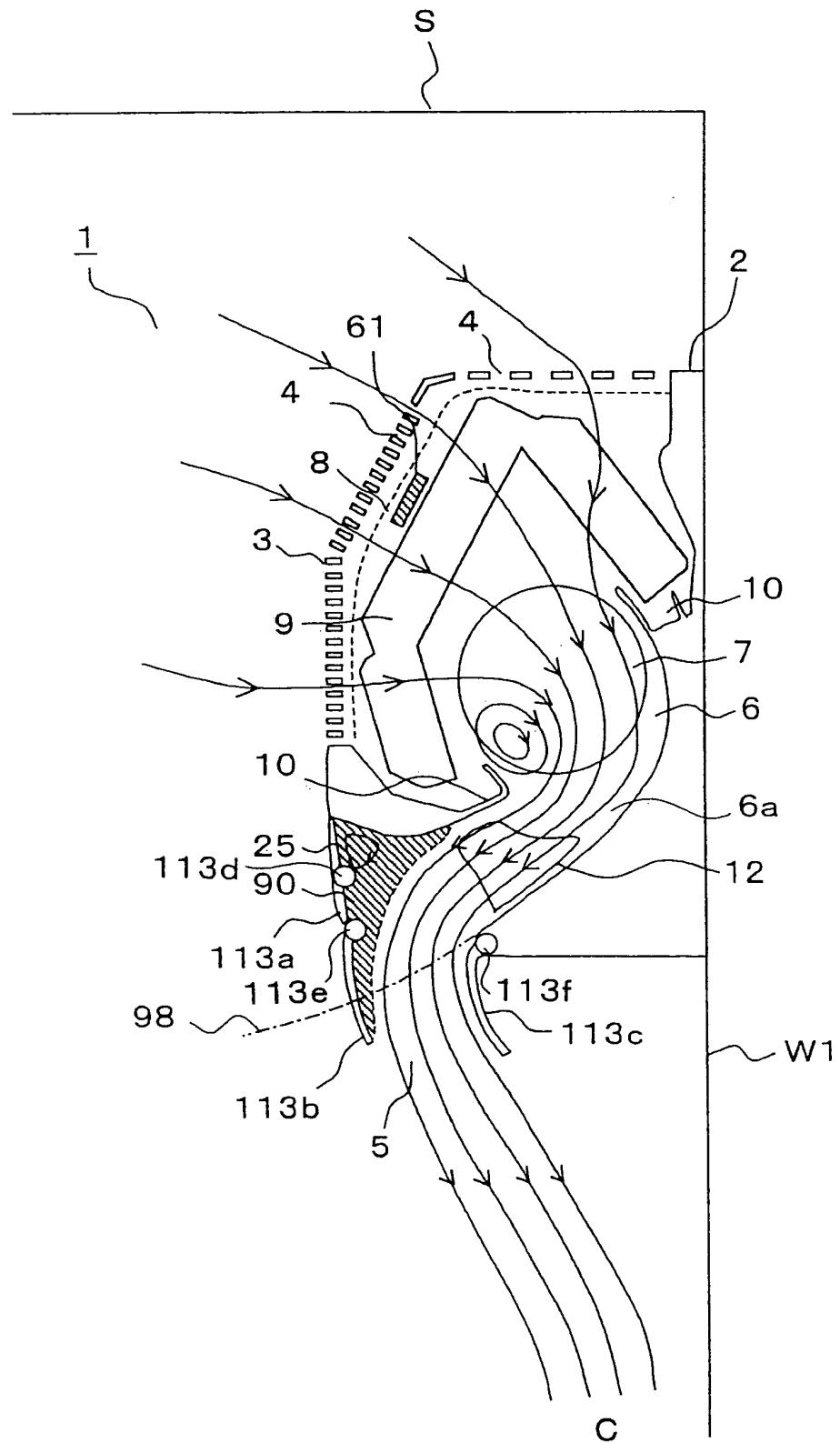


FIG.21

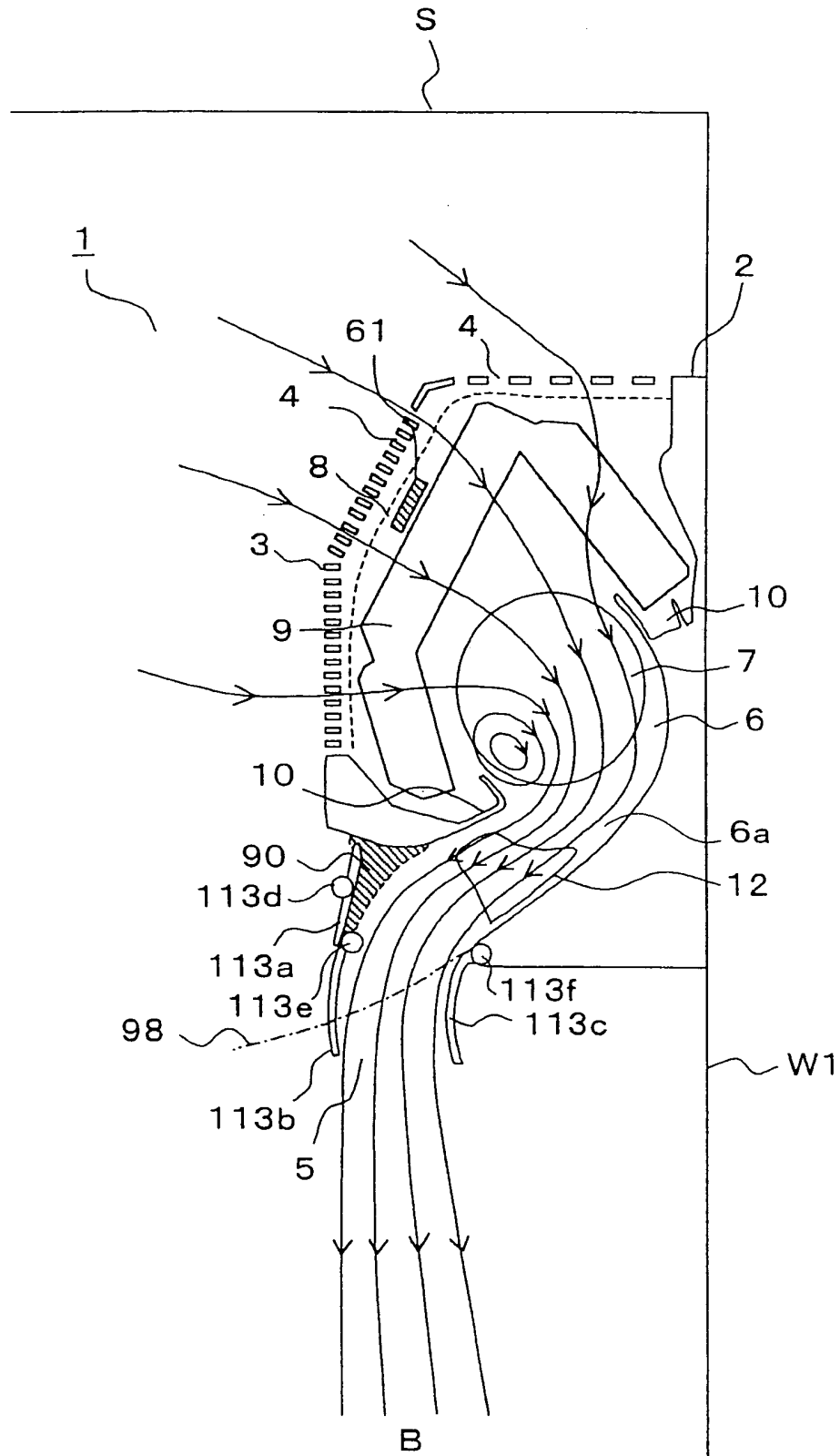


FIG.22

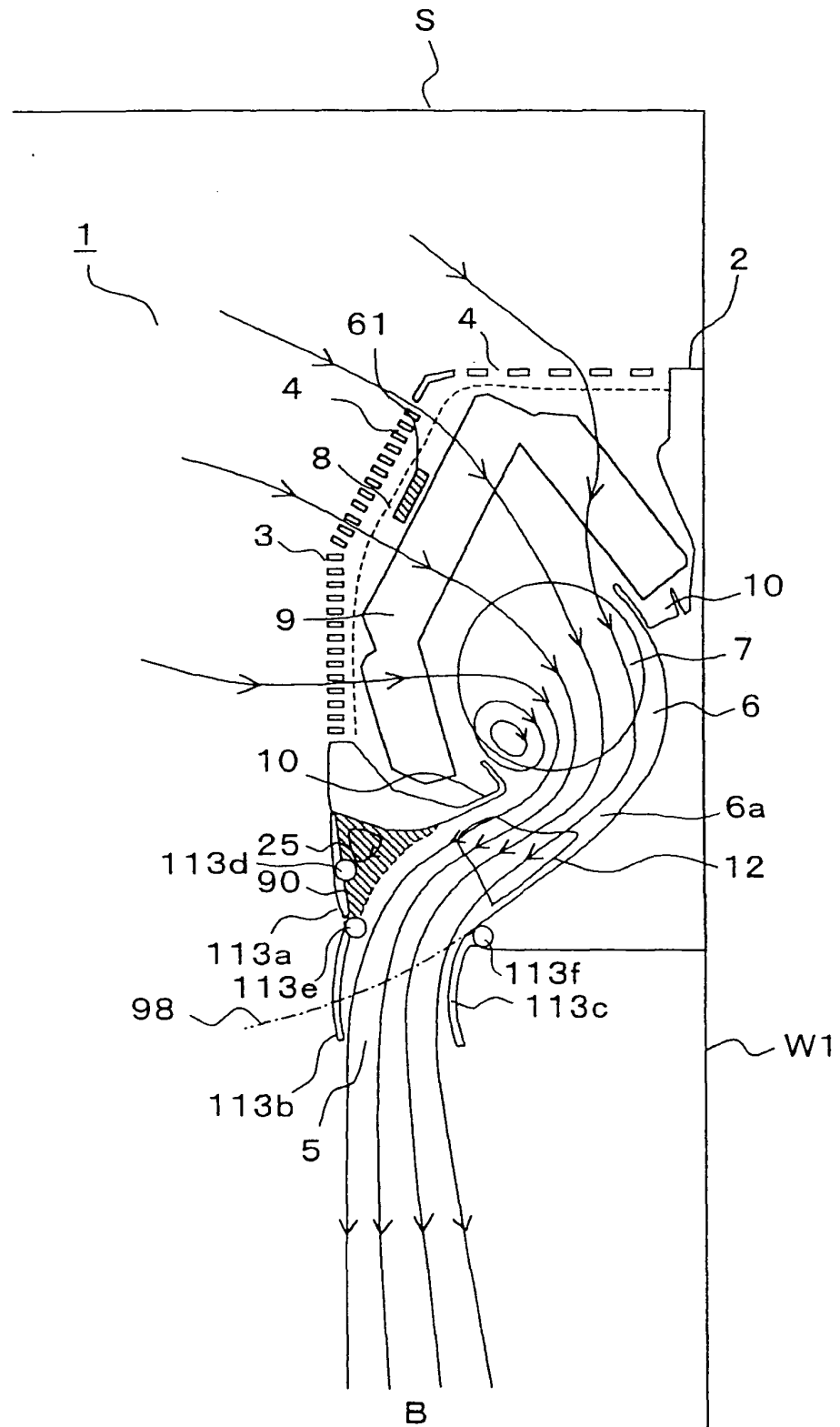


FIG.23

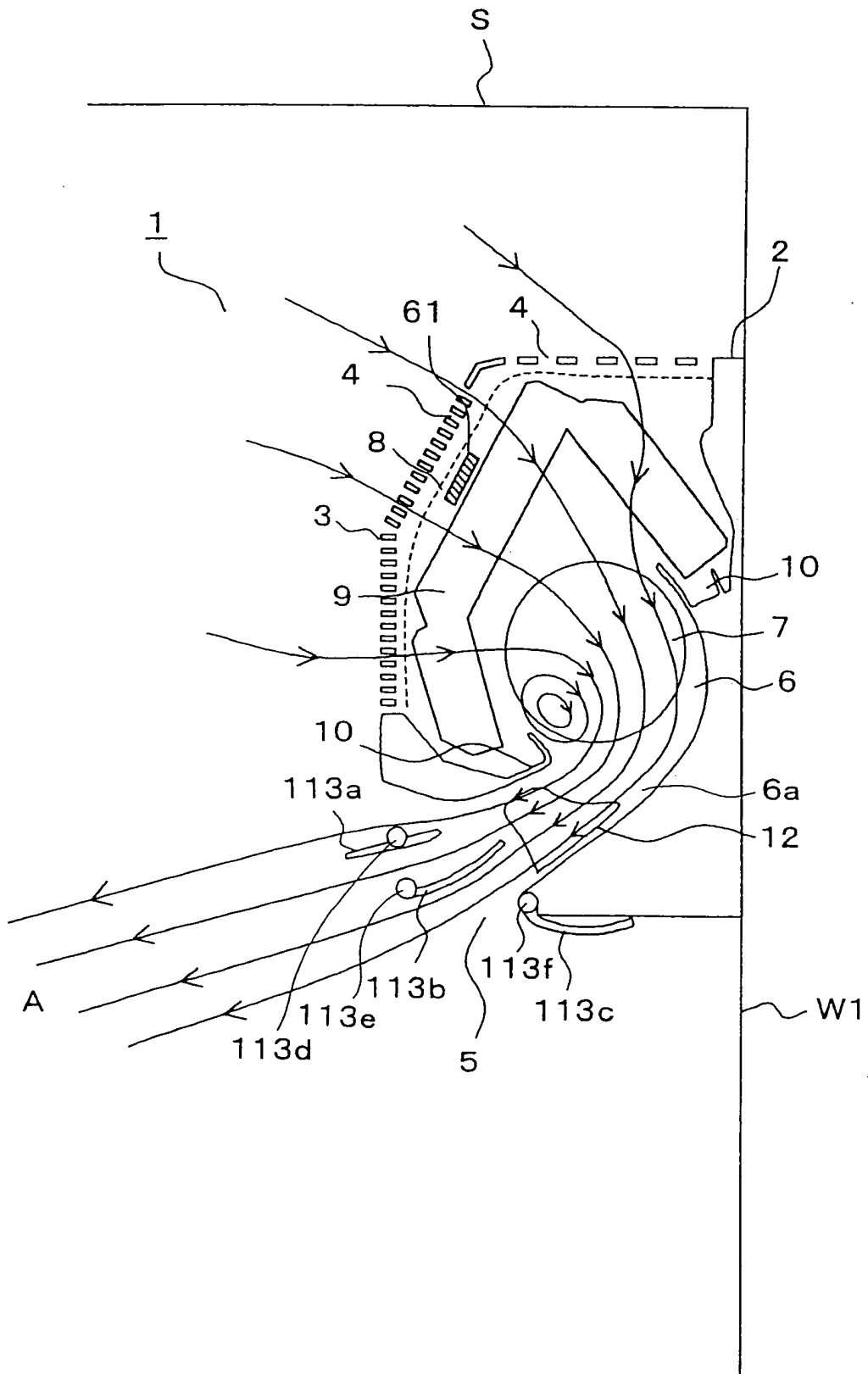


FIG.24

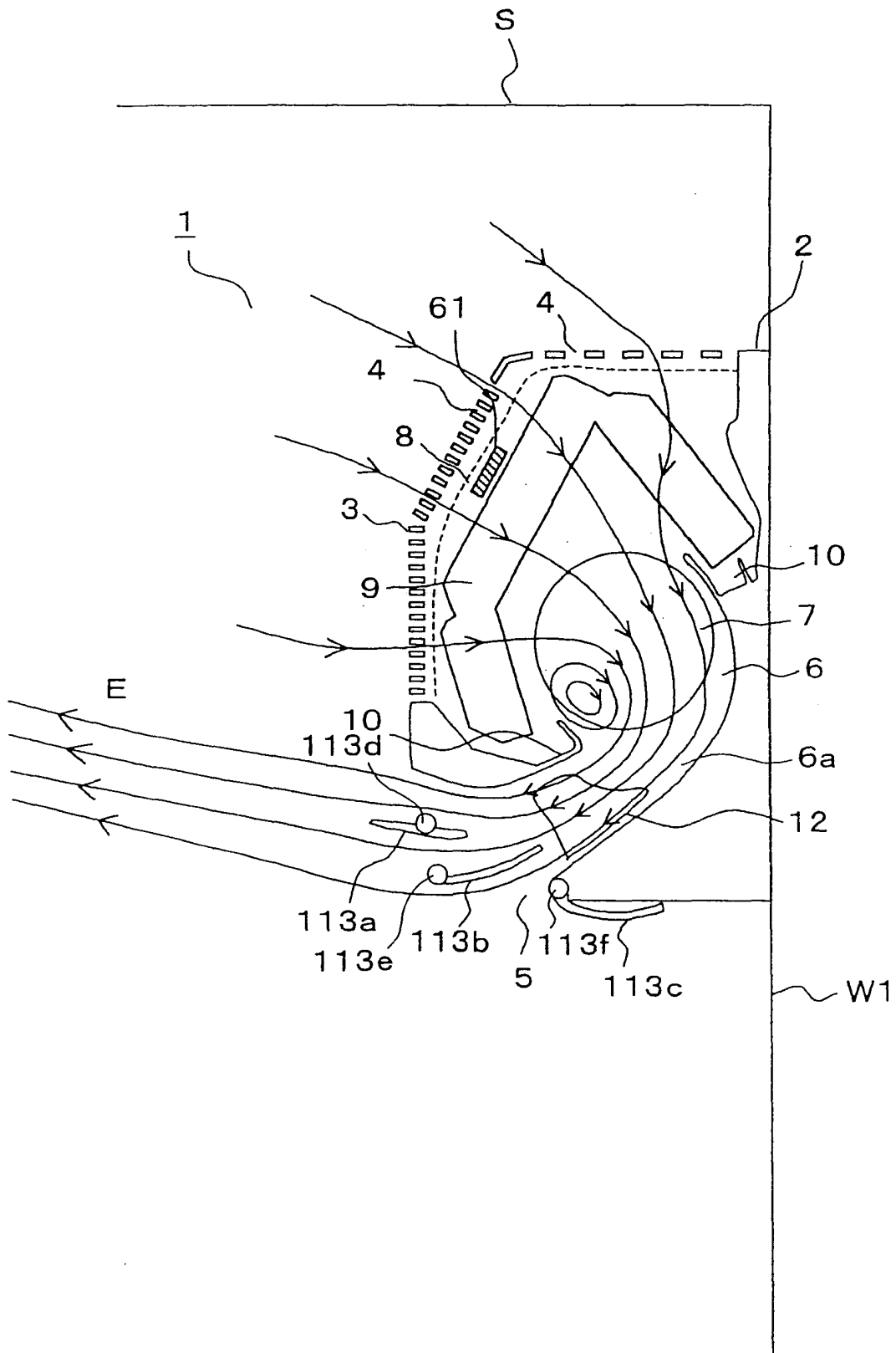


FIG.25

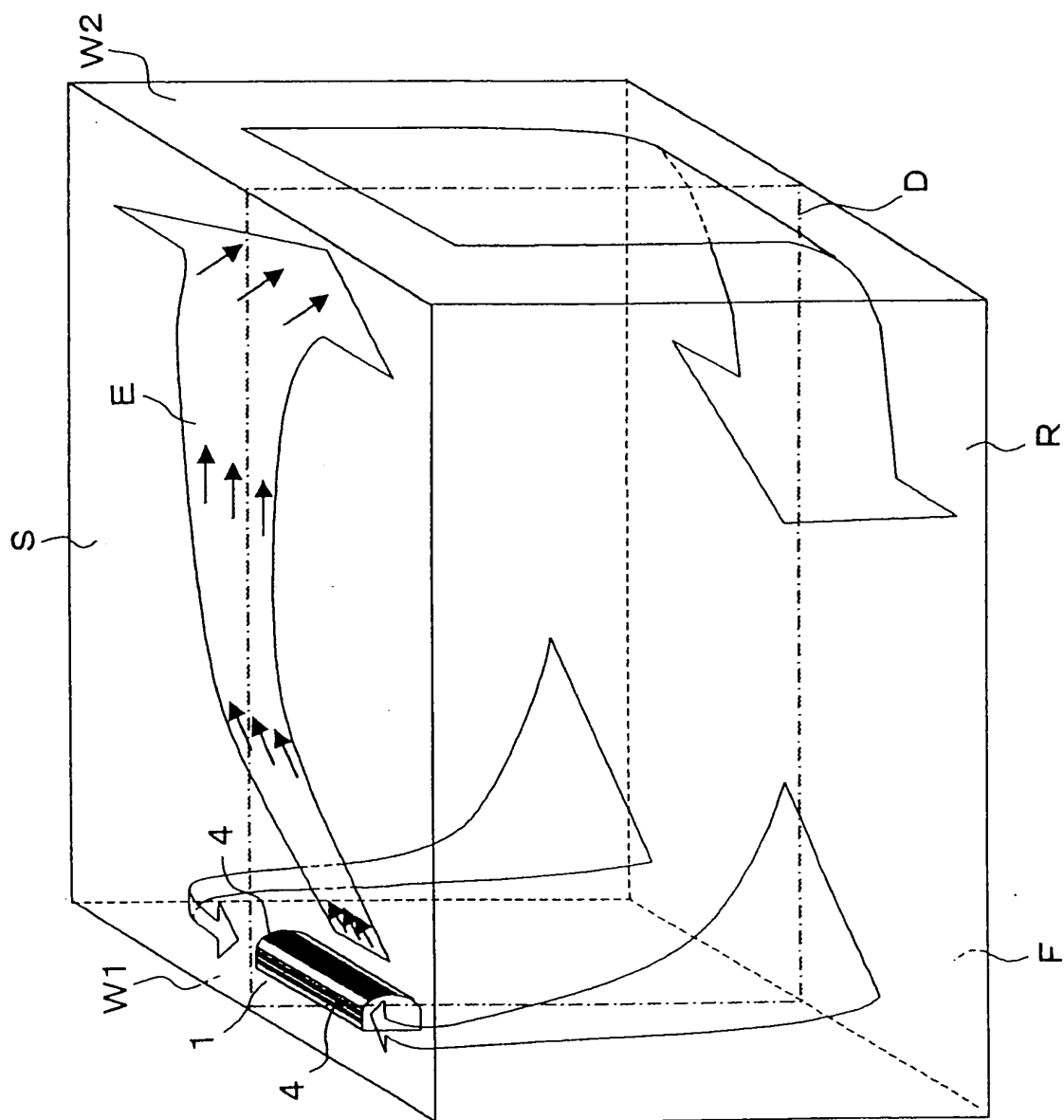


FIG.26

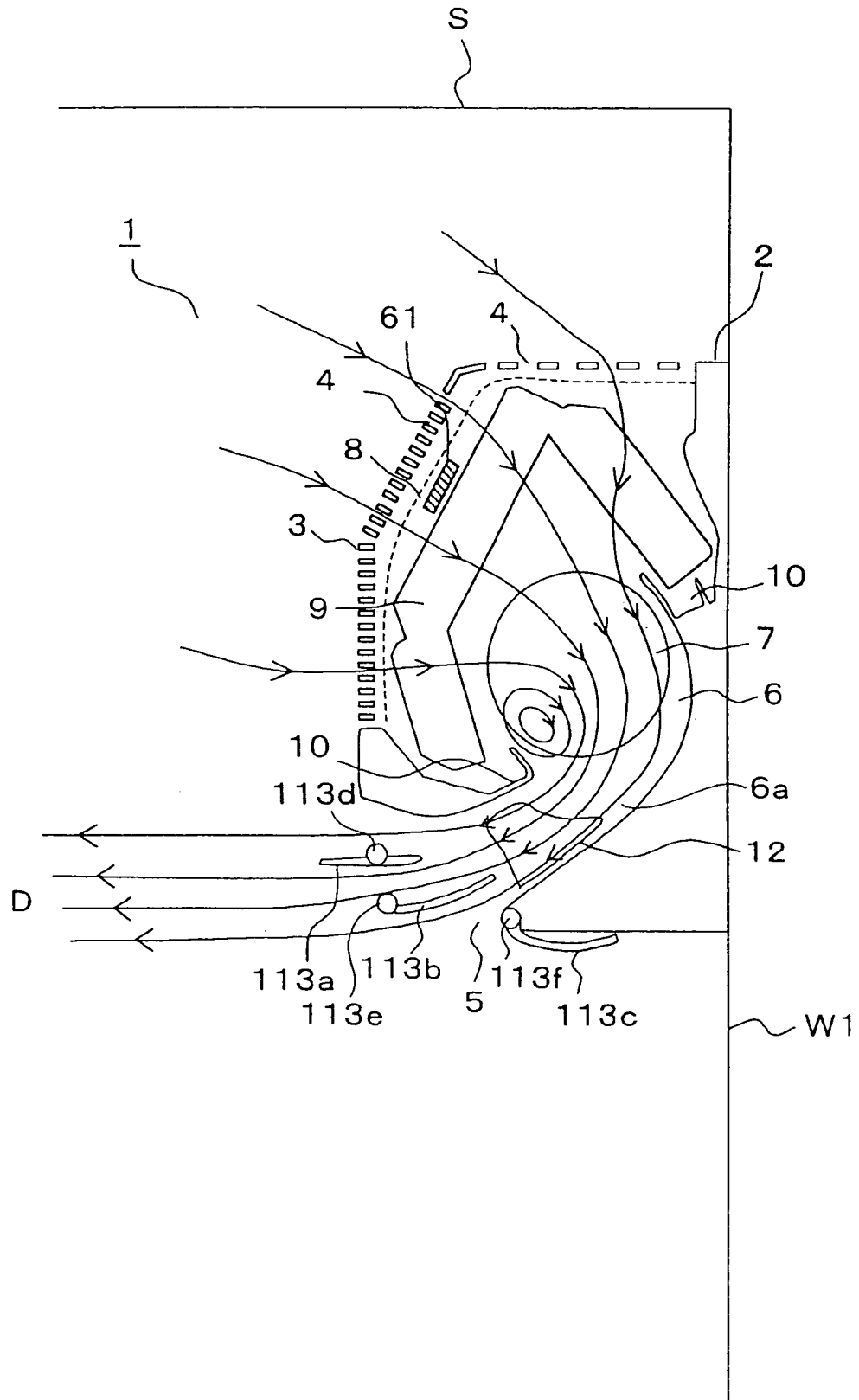


FIG.27

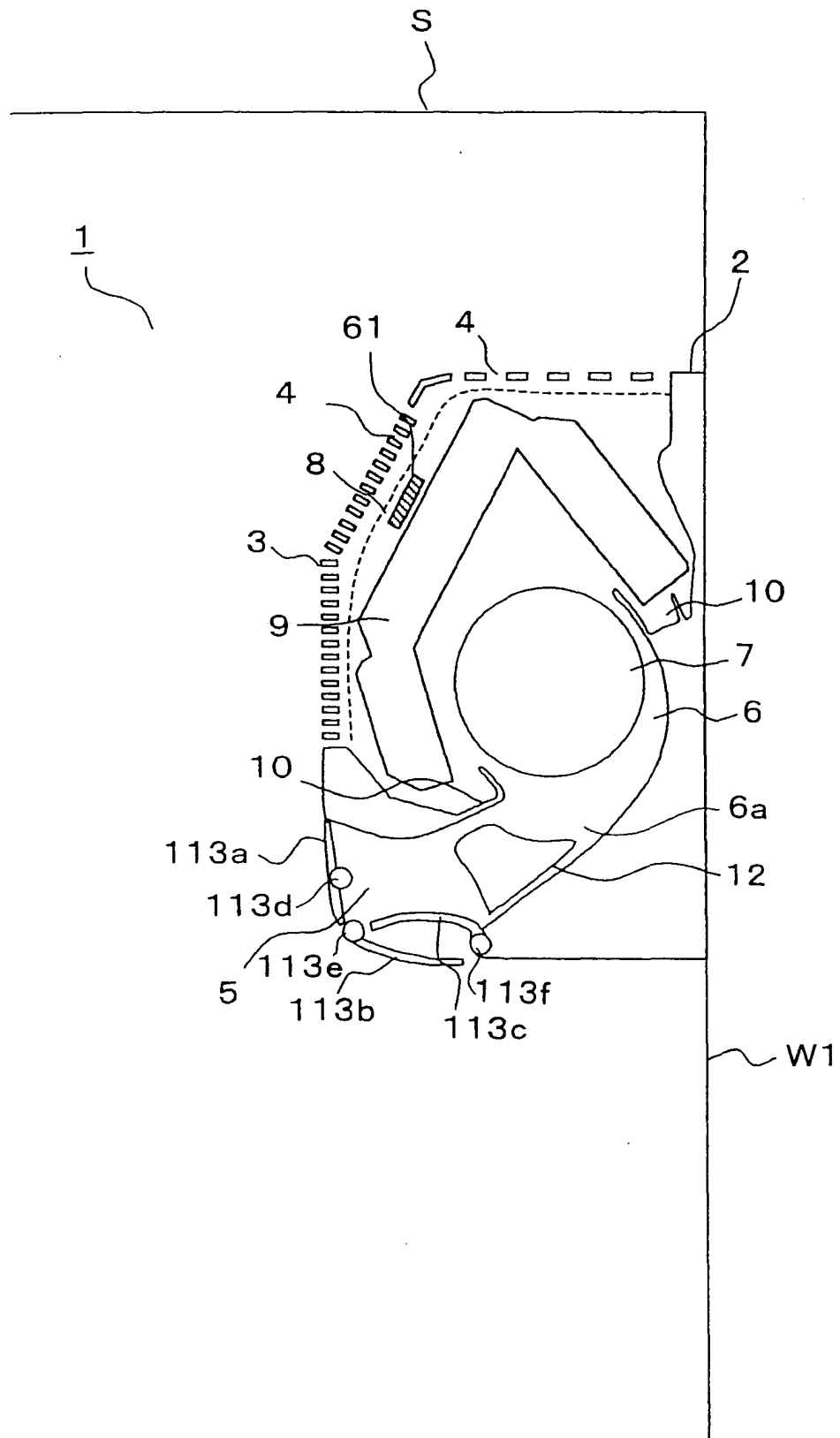


FIG.28

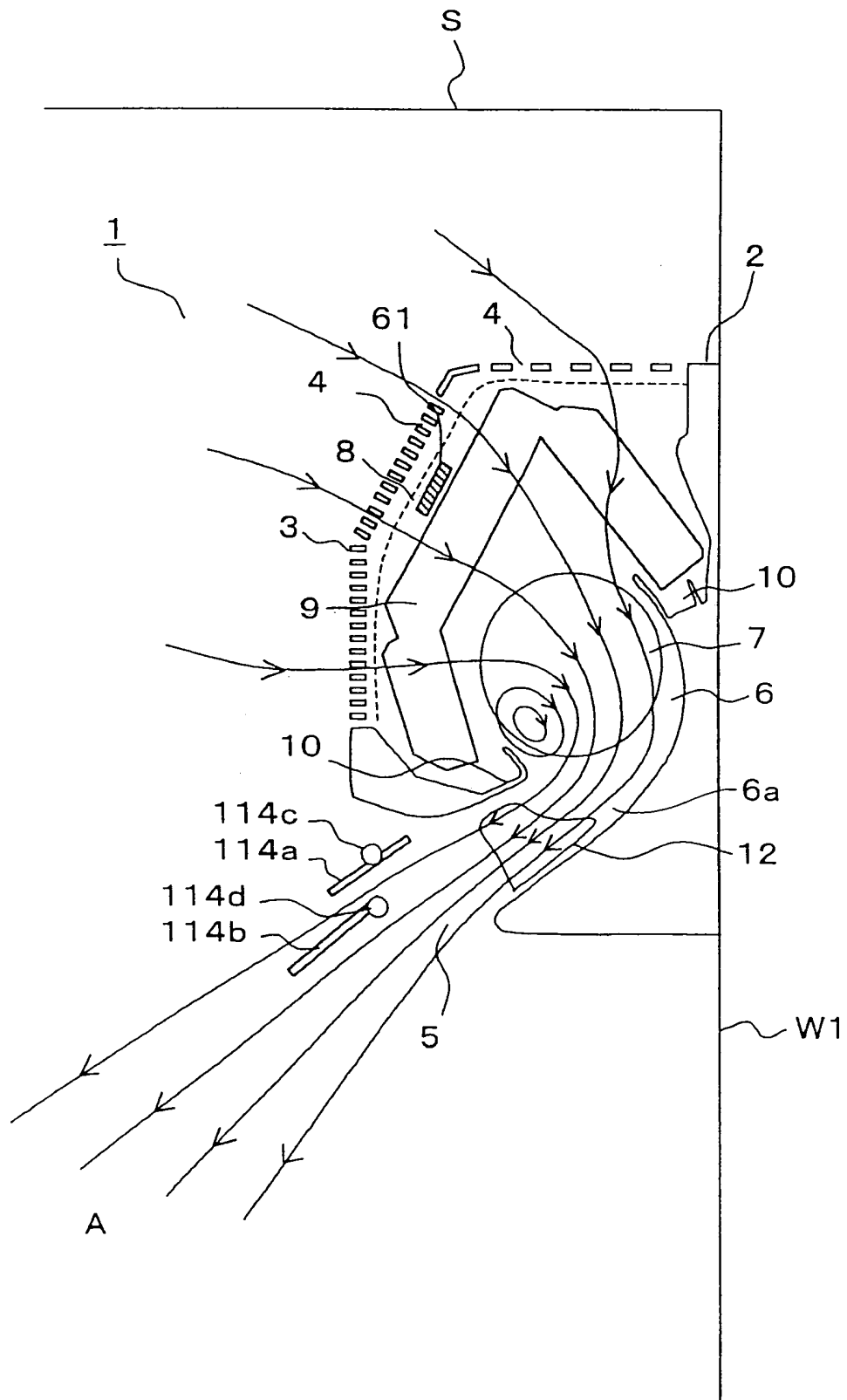


FIG.29

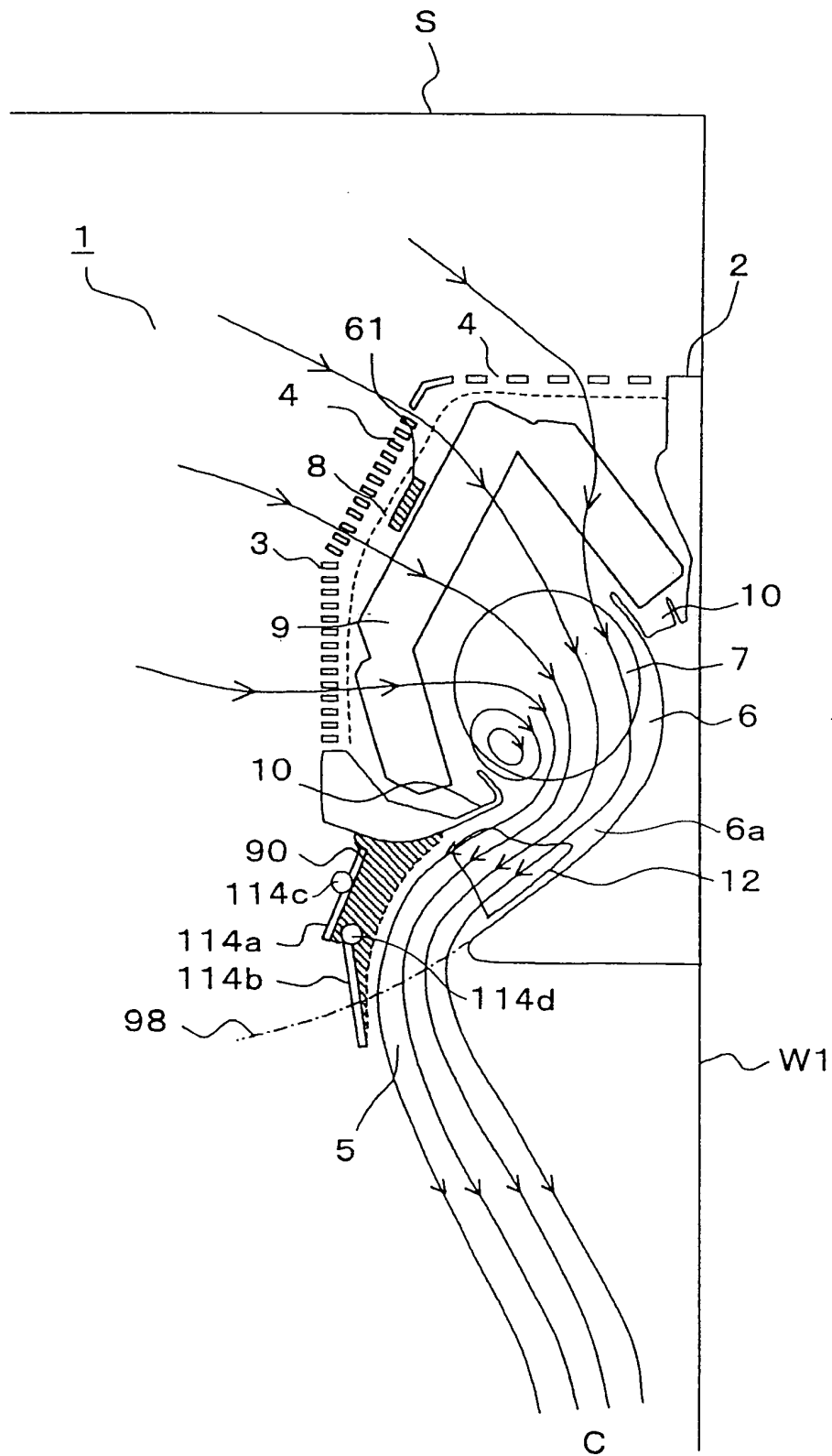


FIG.30

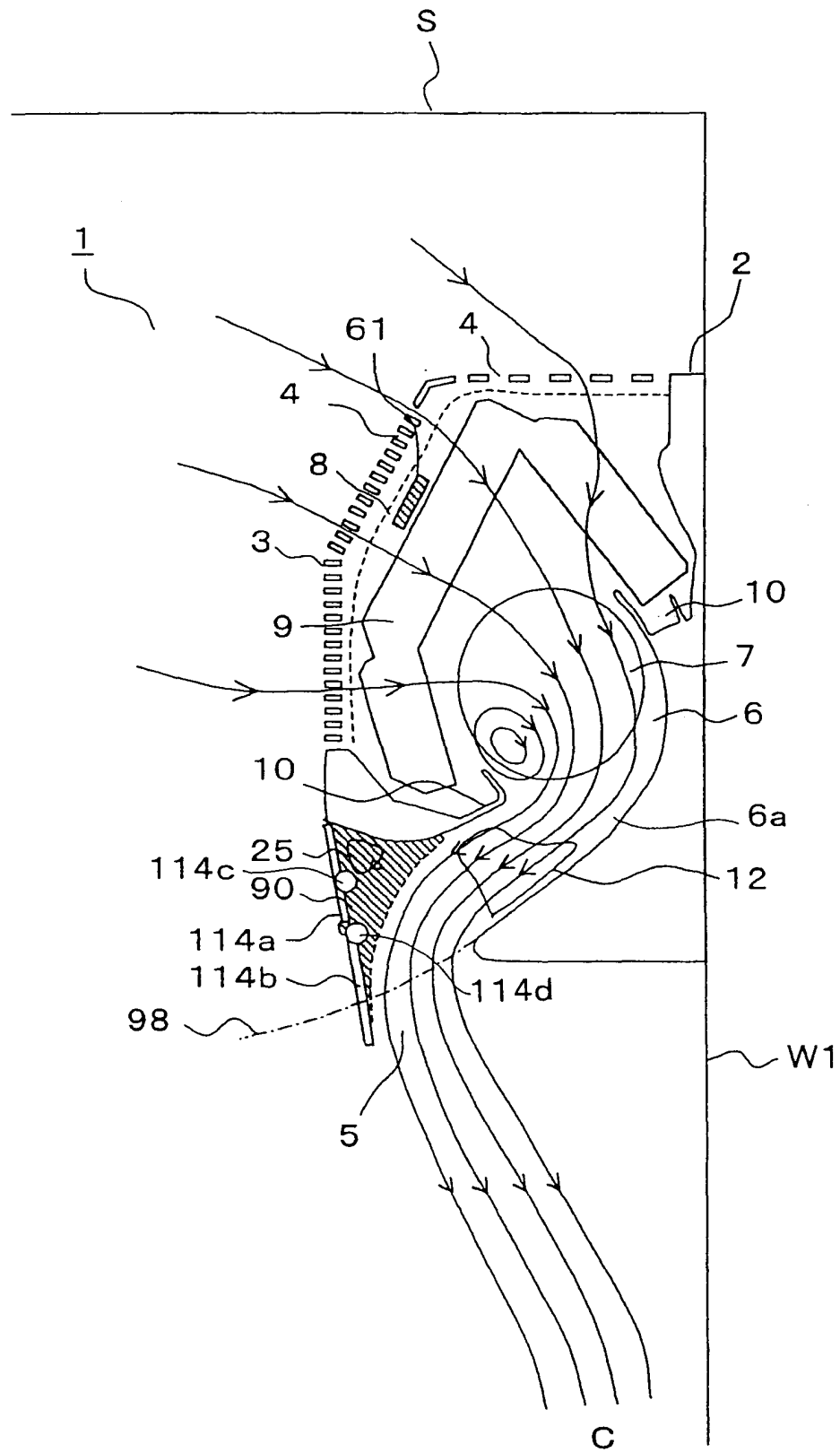


FIG.31

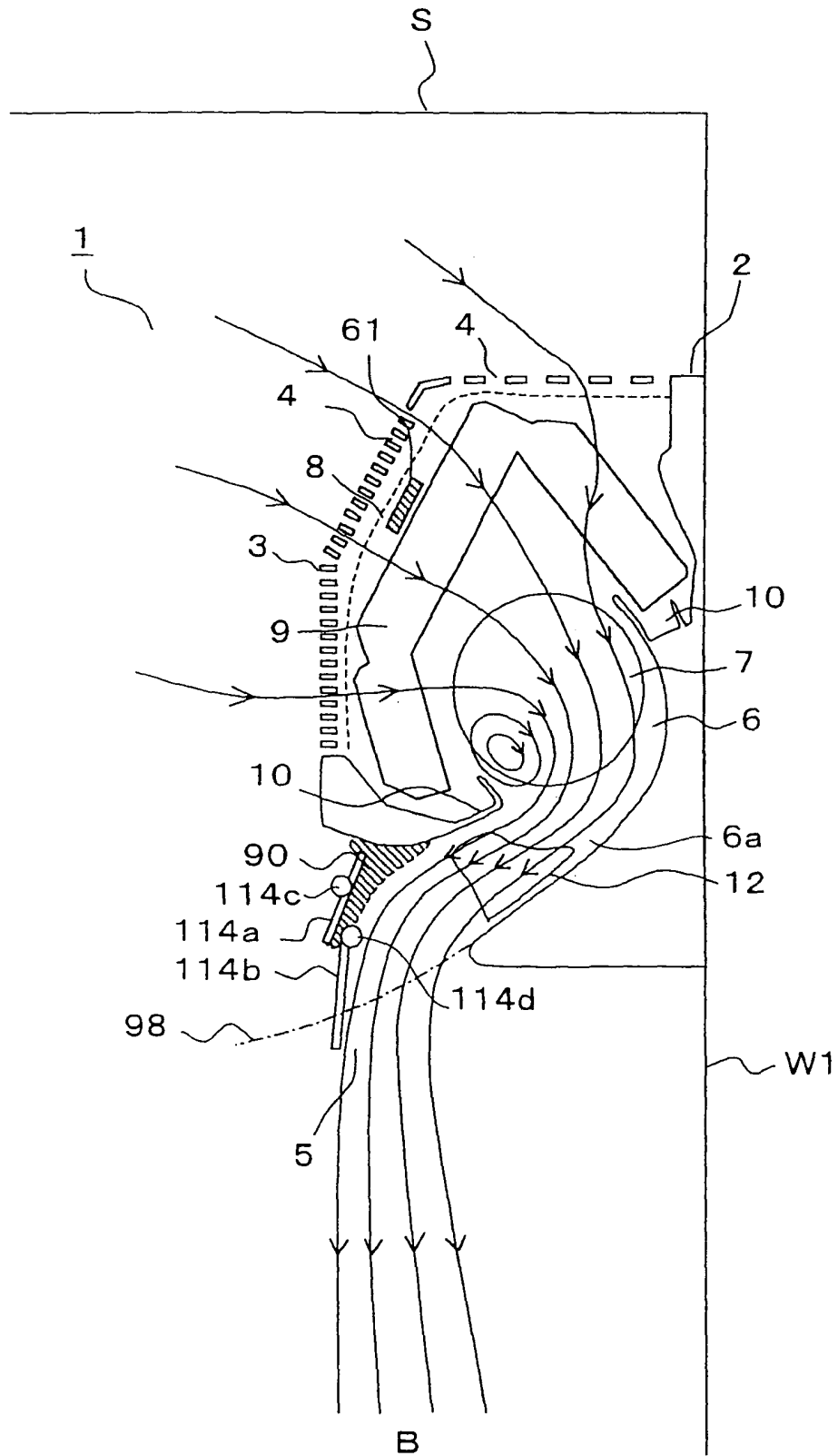


FIG.32

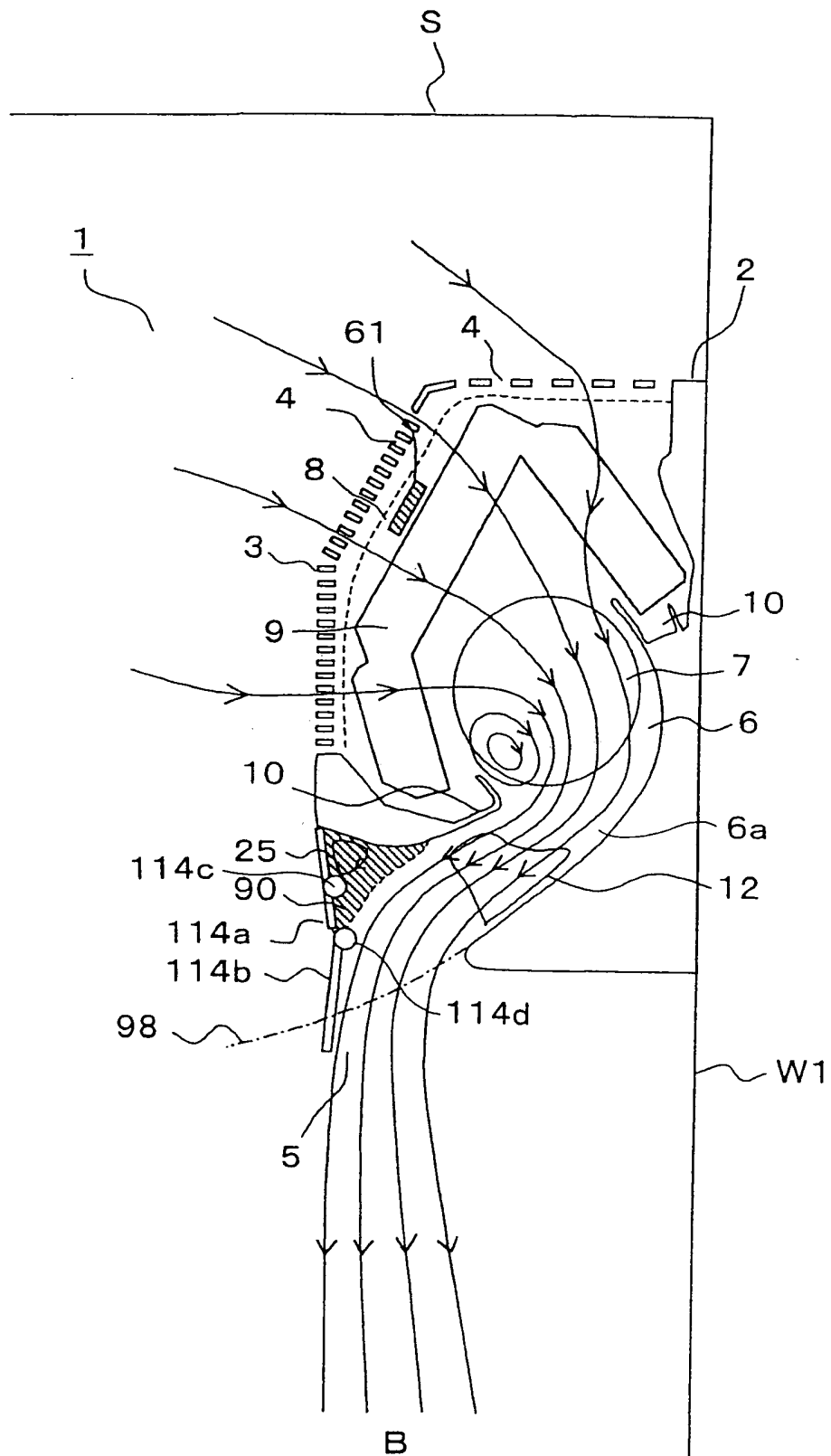


FIG.33

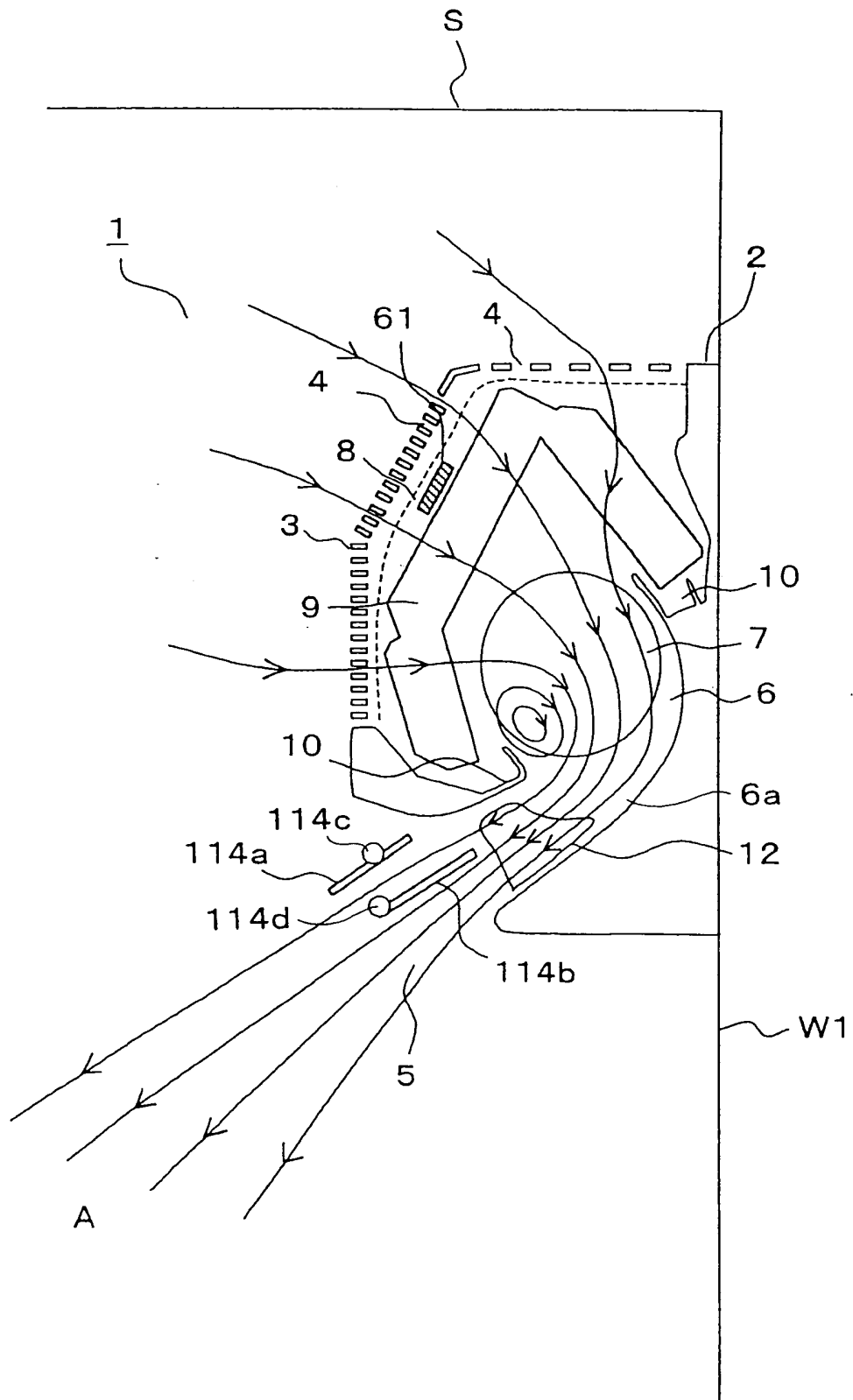


FIG.34

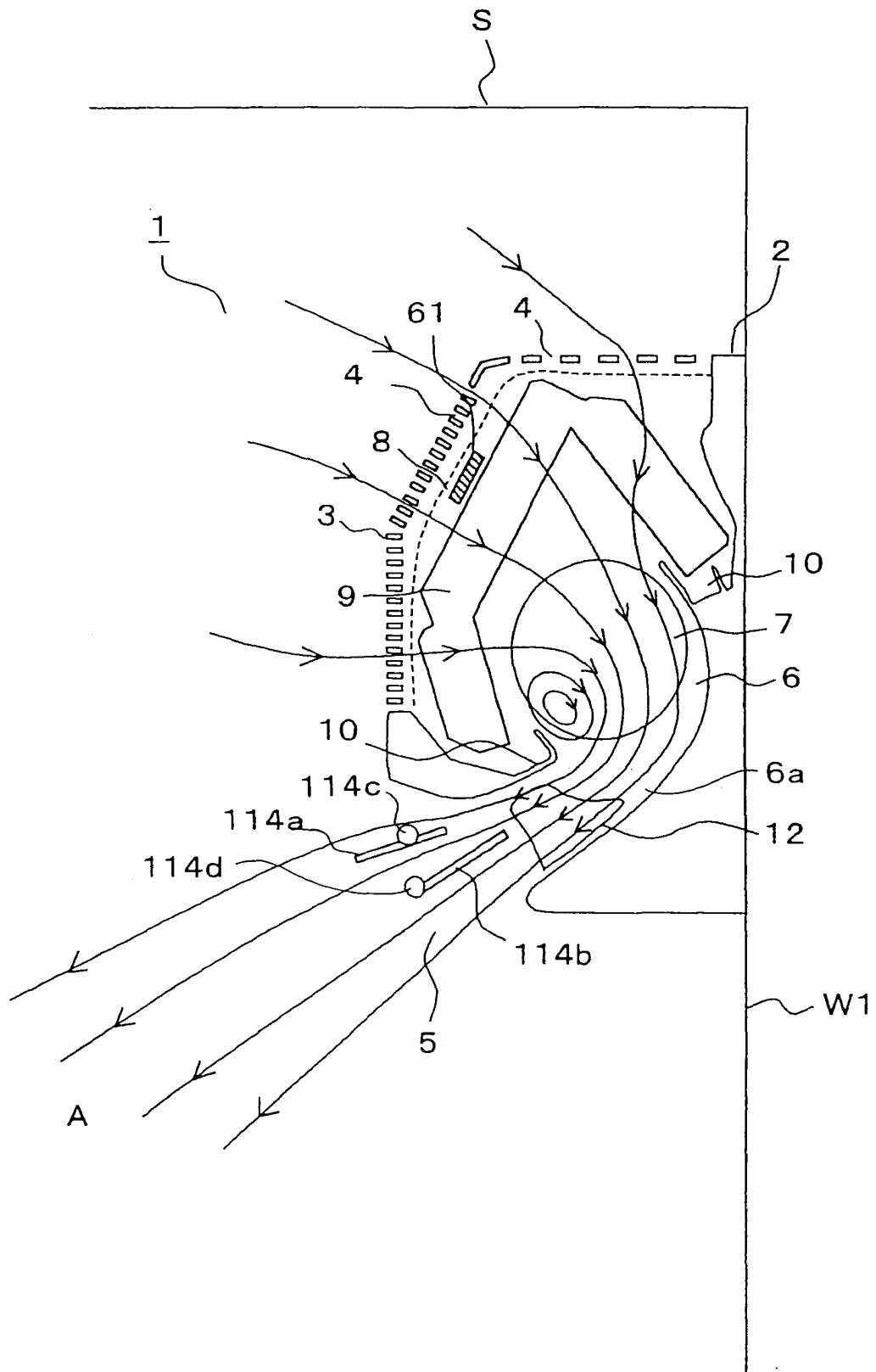


FIG.35

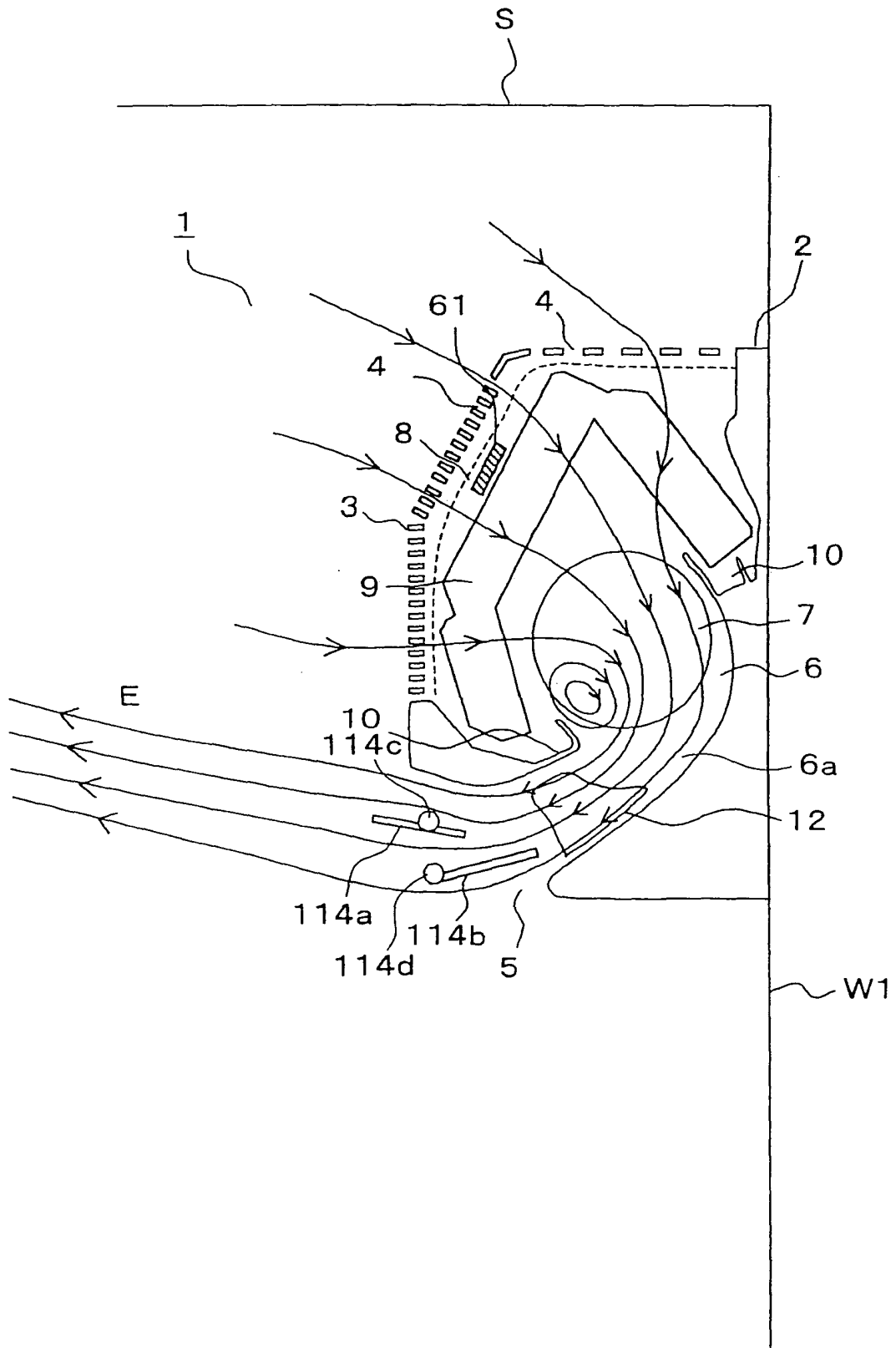


FIG.36

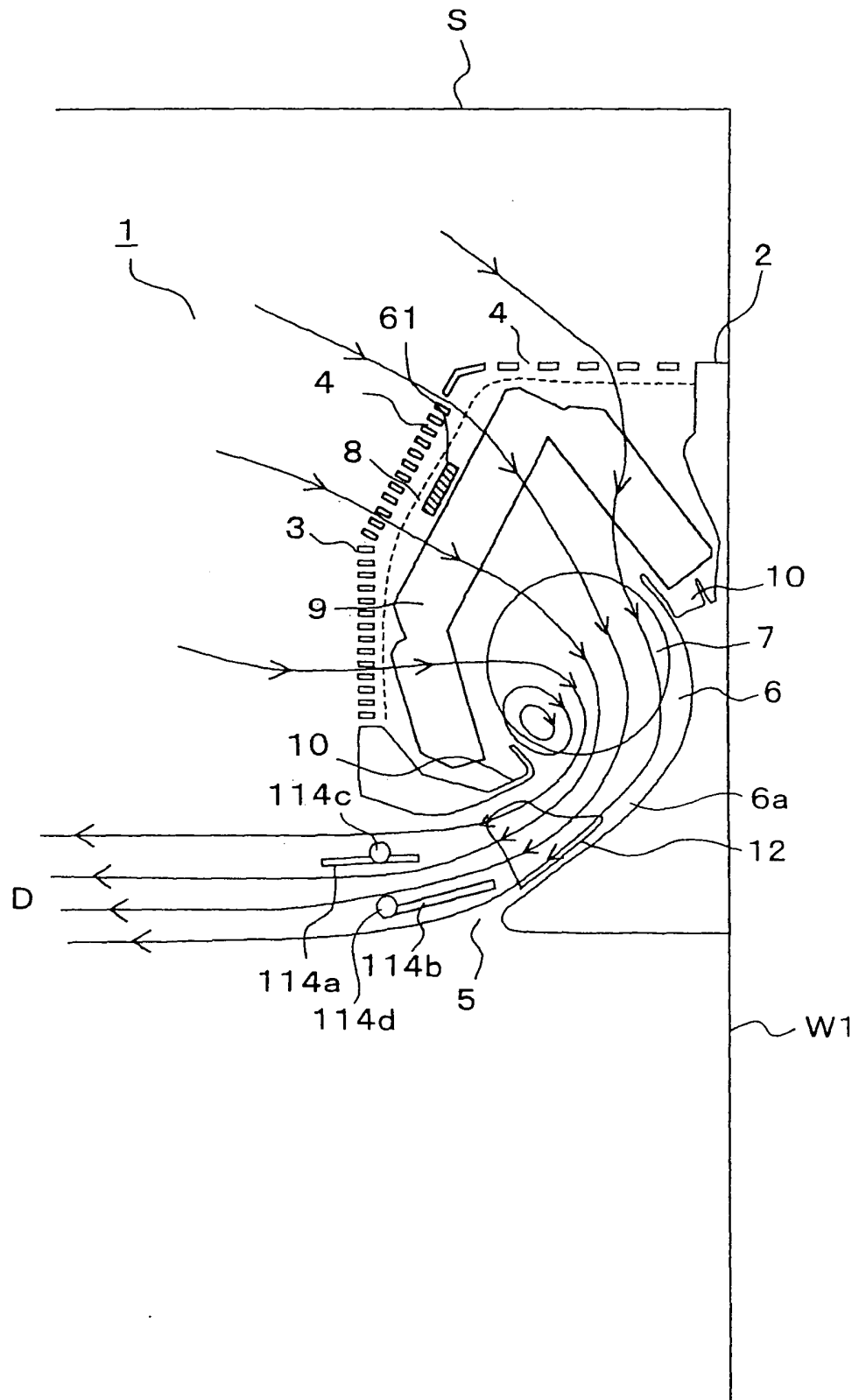


FIG.37

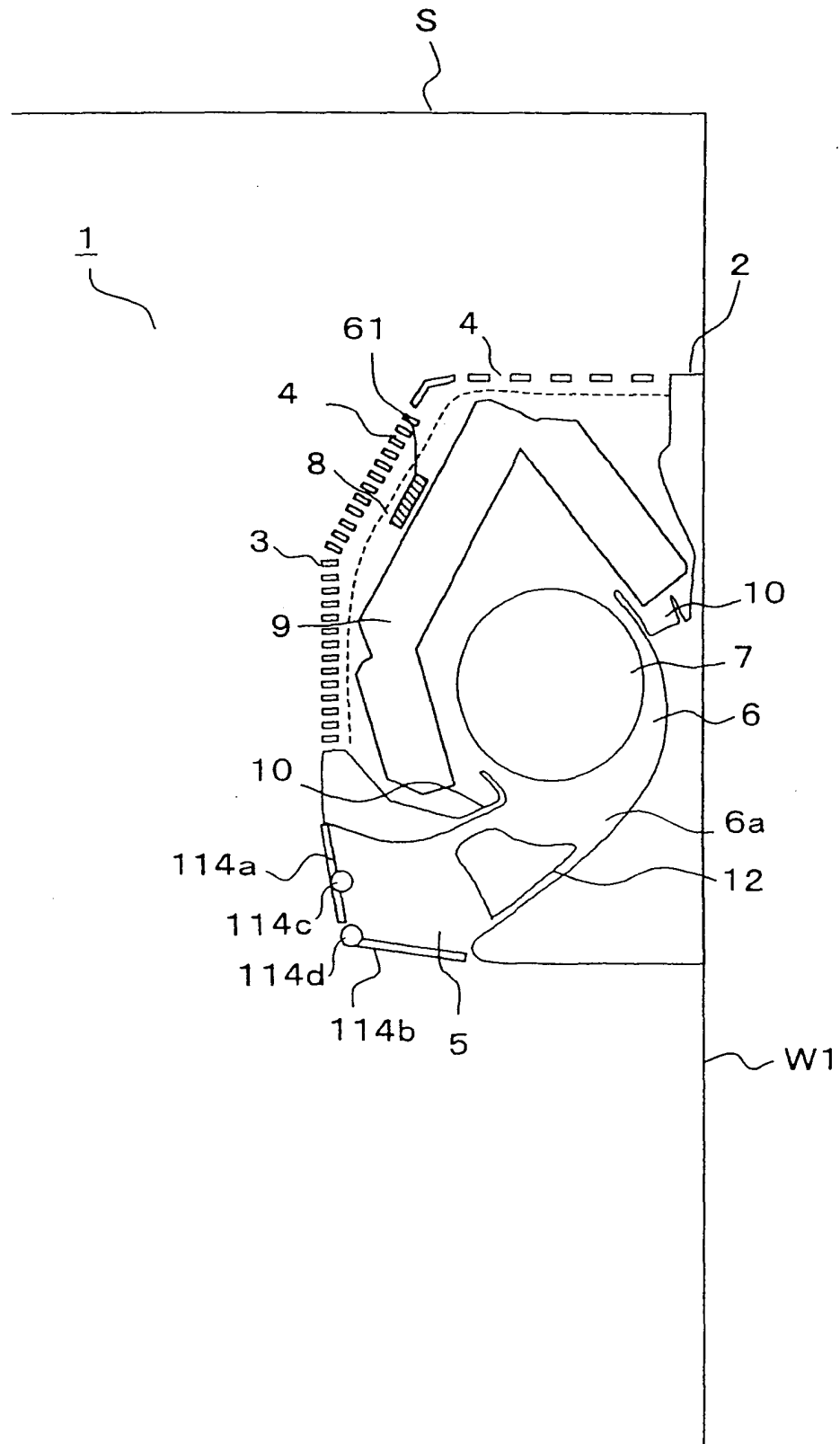


FIG.38

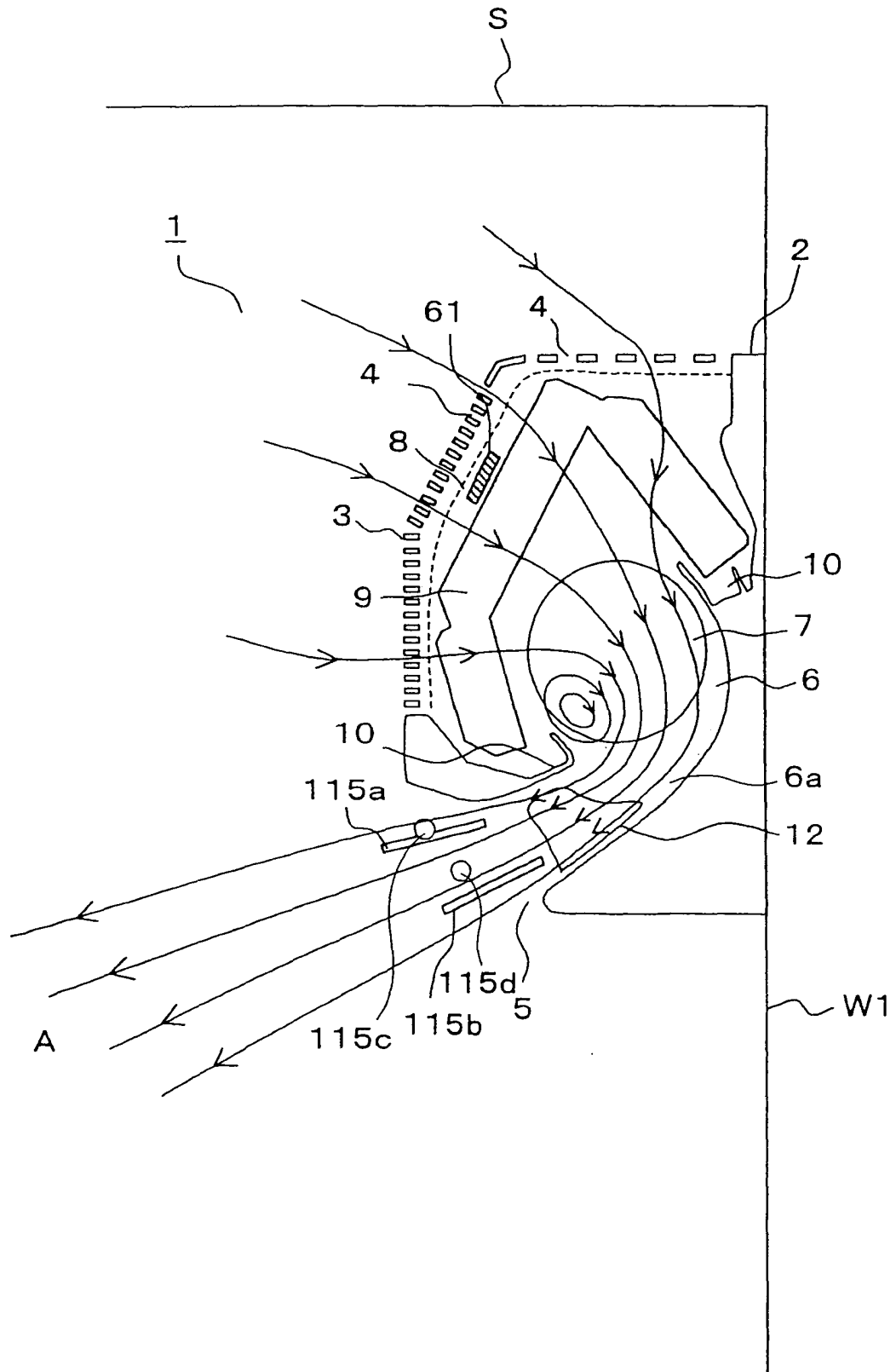


FIG.39

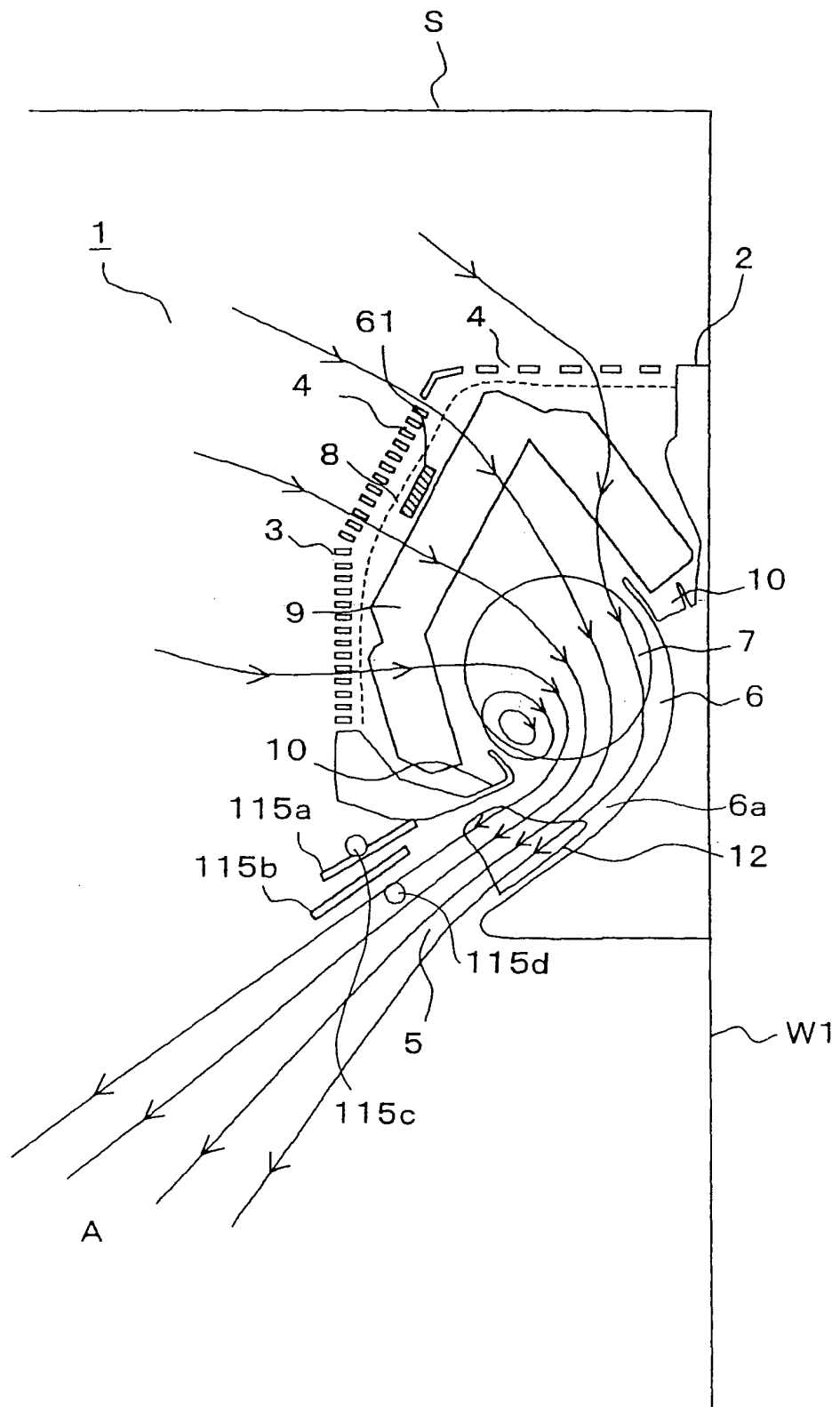


FIG.40

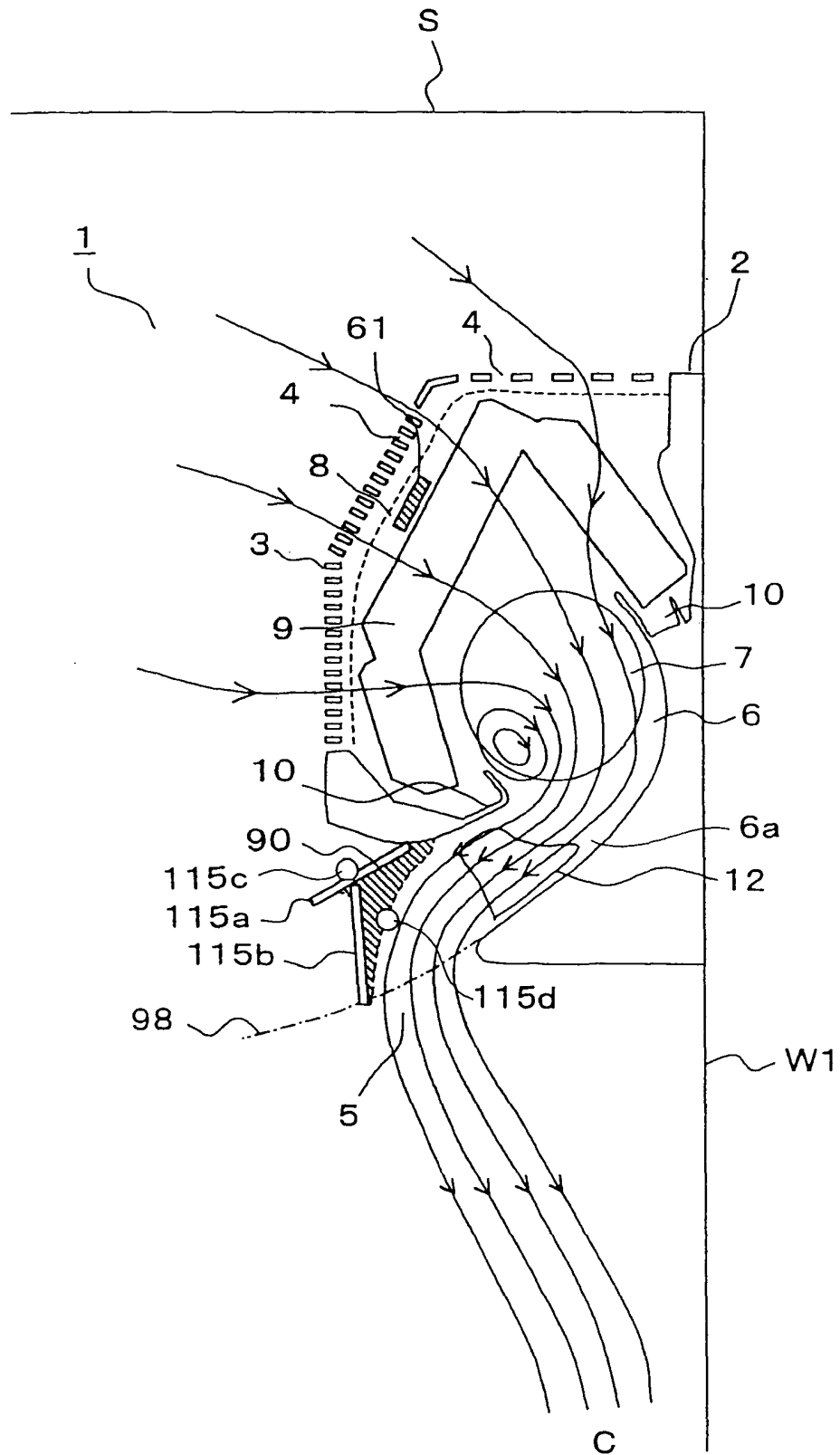


FIG.41

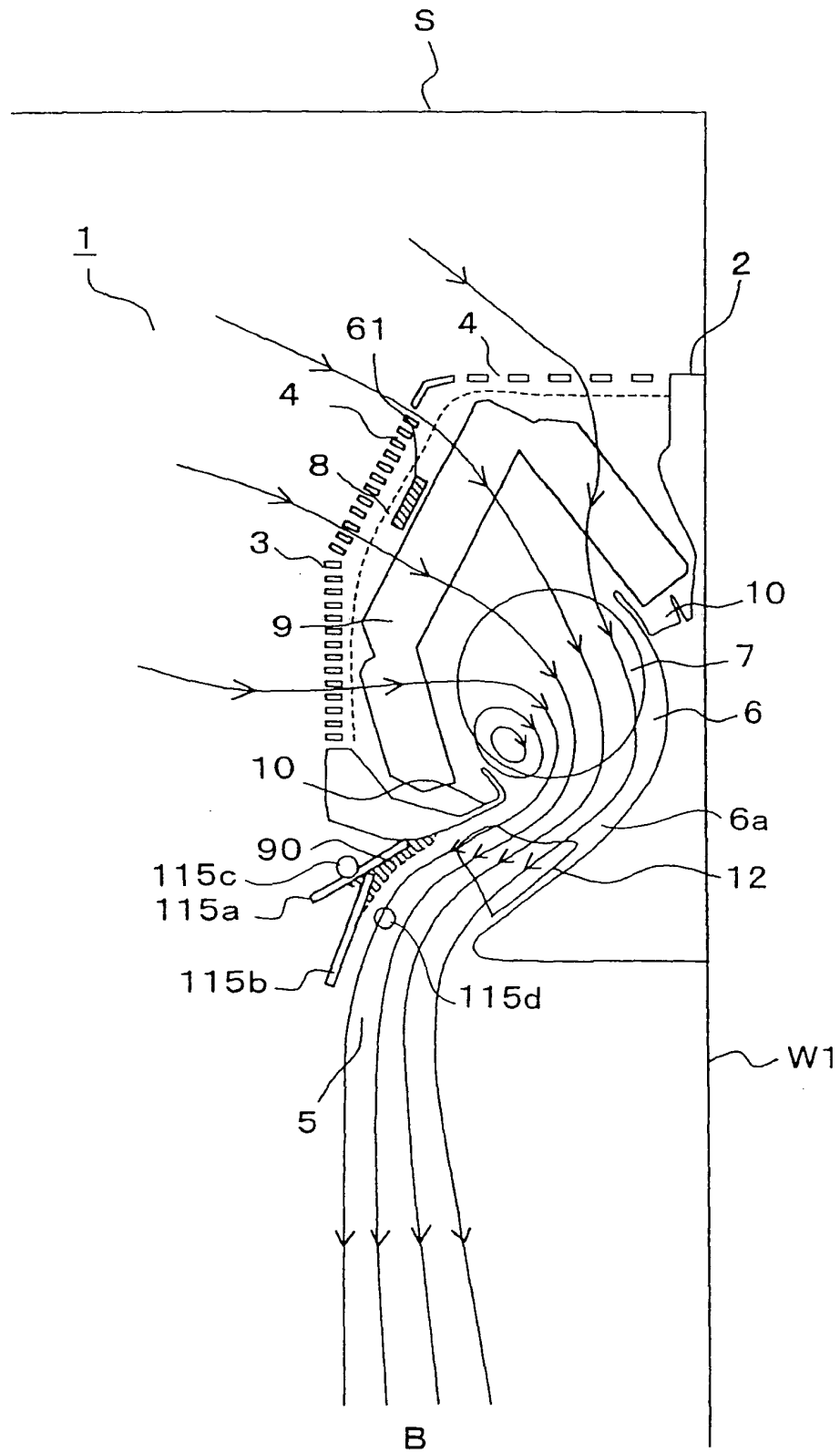


FIG.42

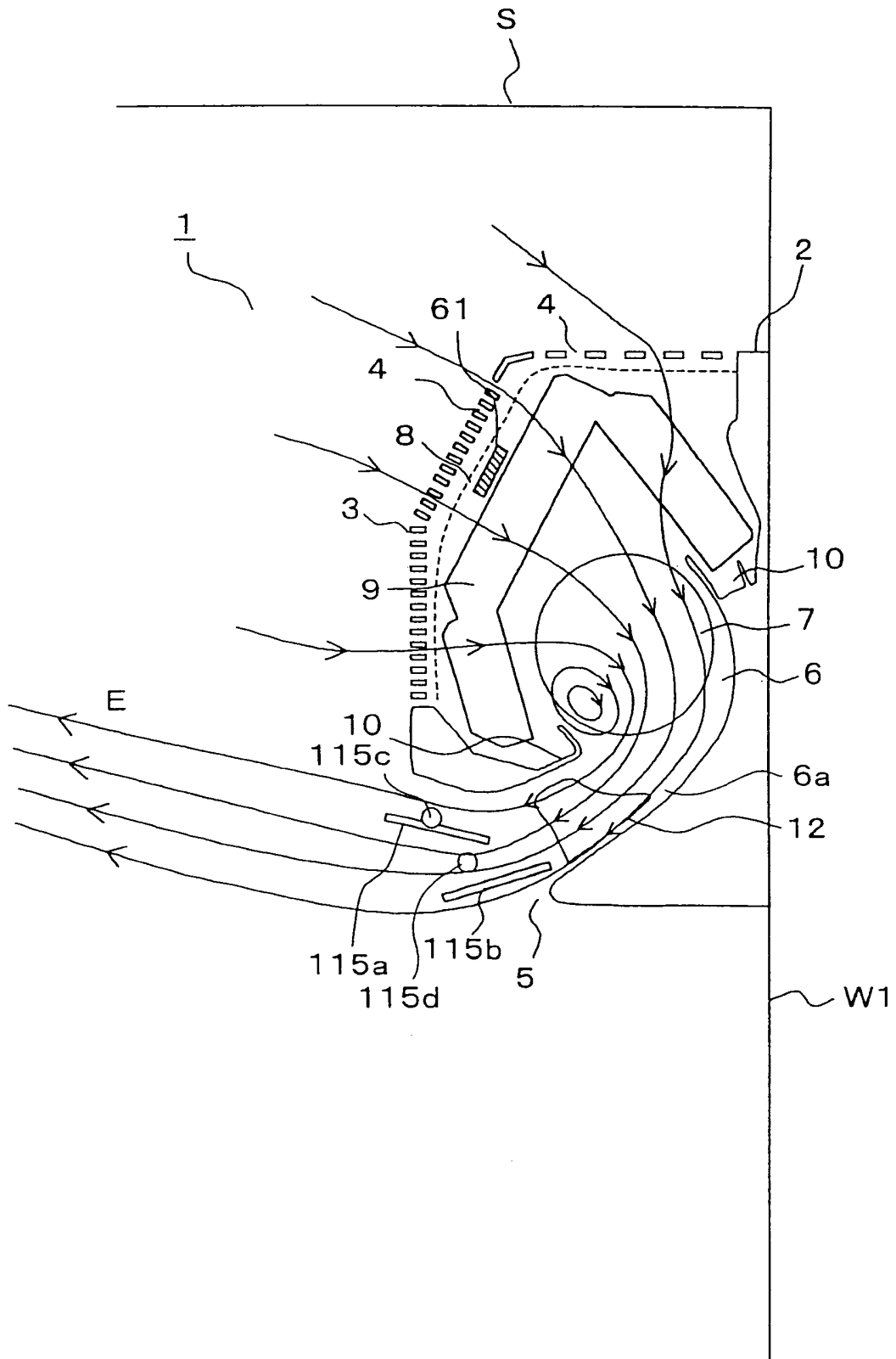


FIG.43

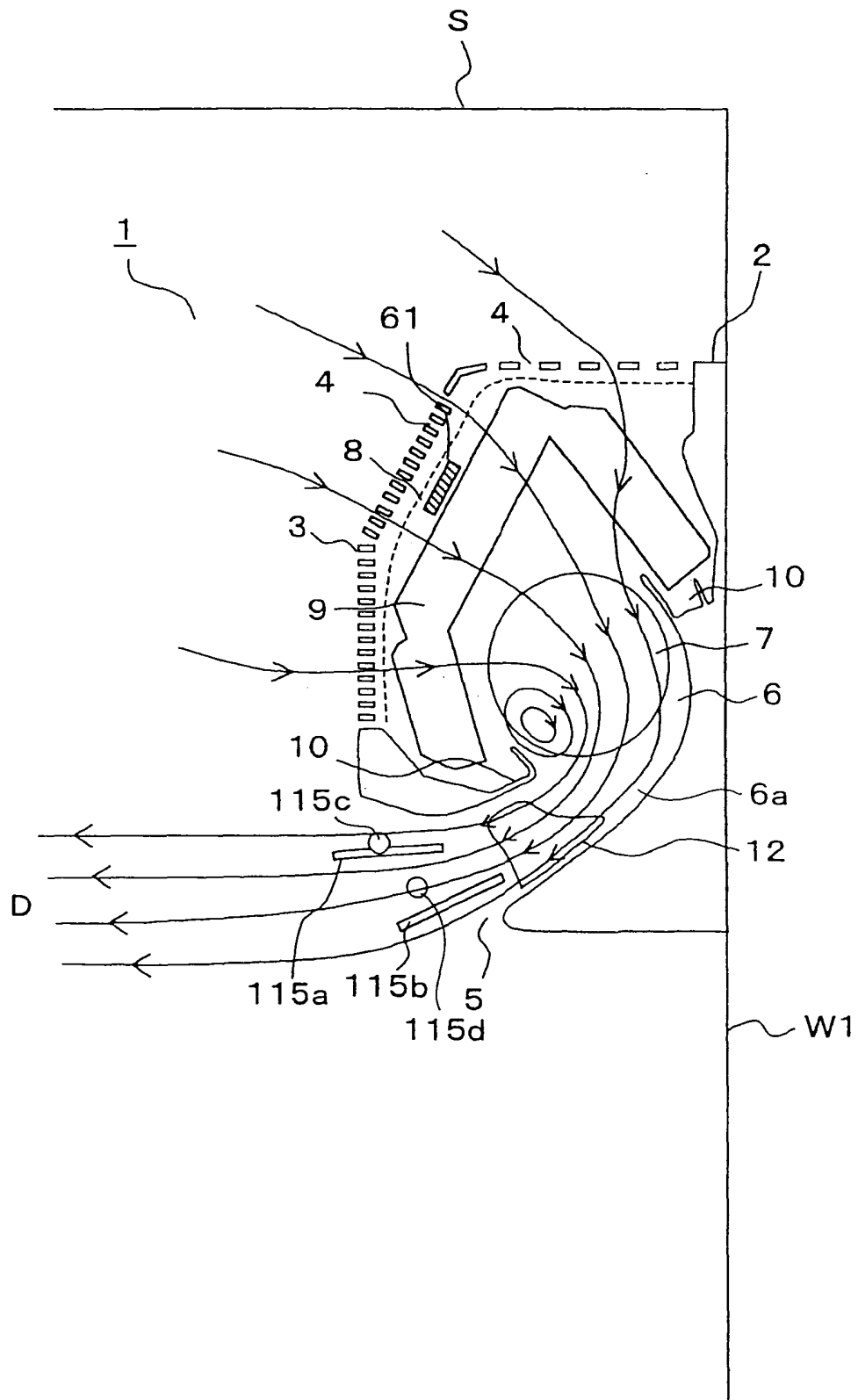


FIG.44

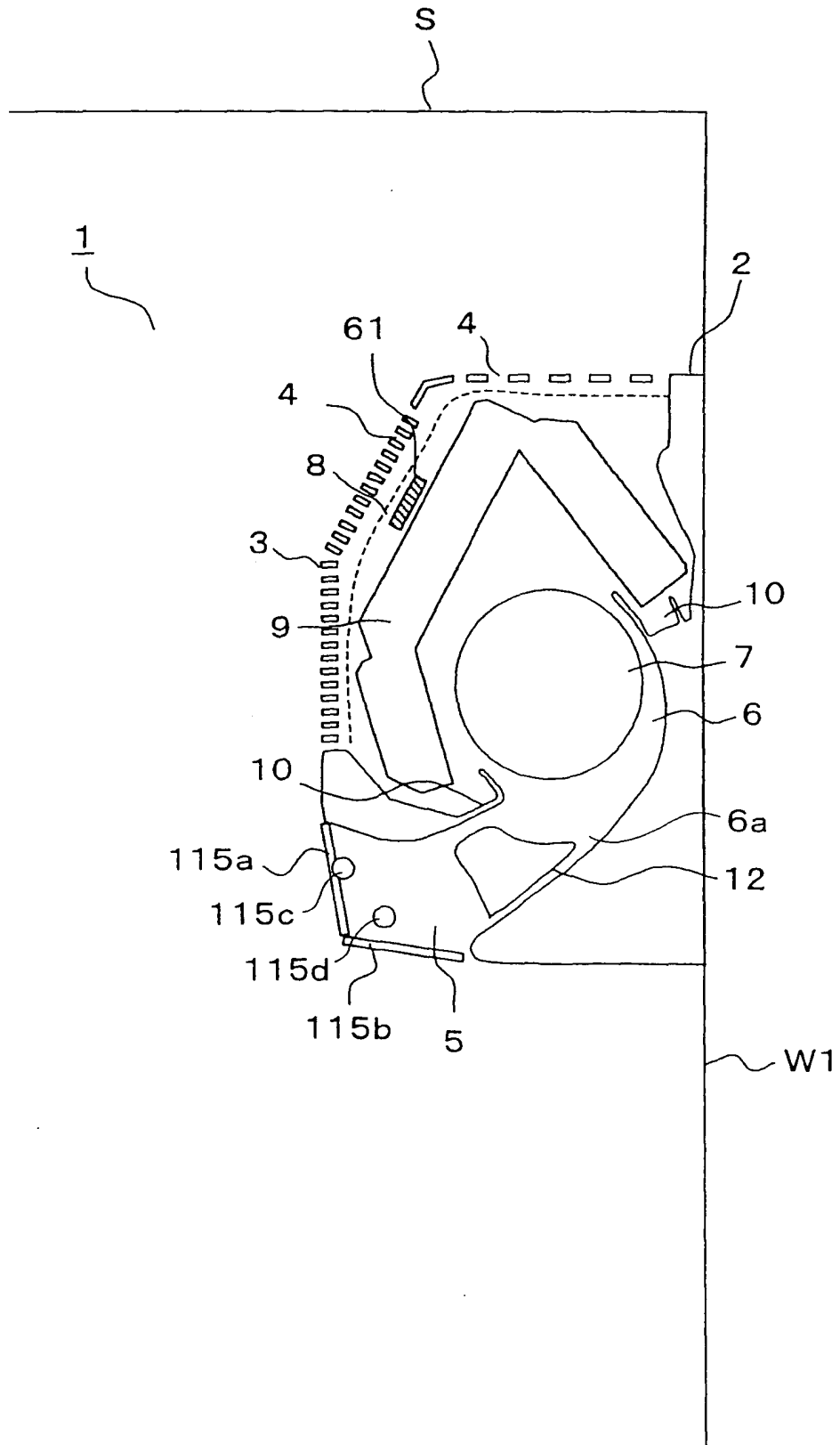


FIG.45

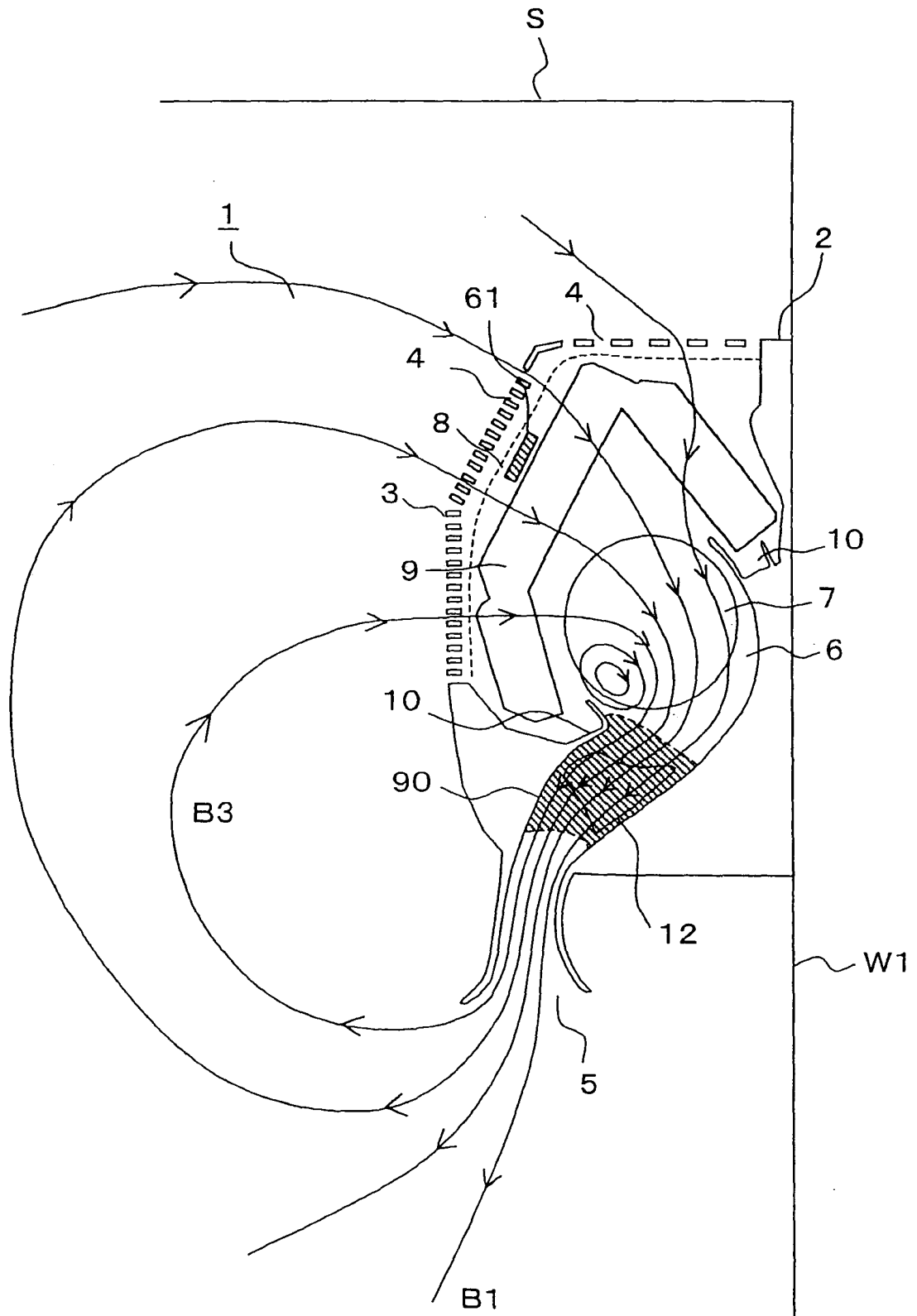


FIG.46

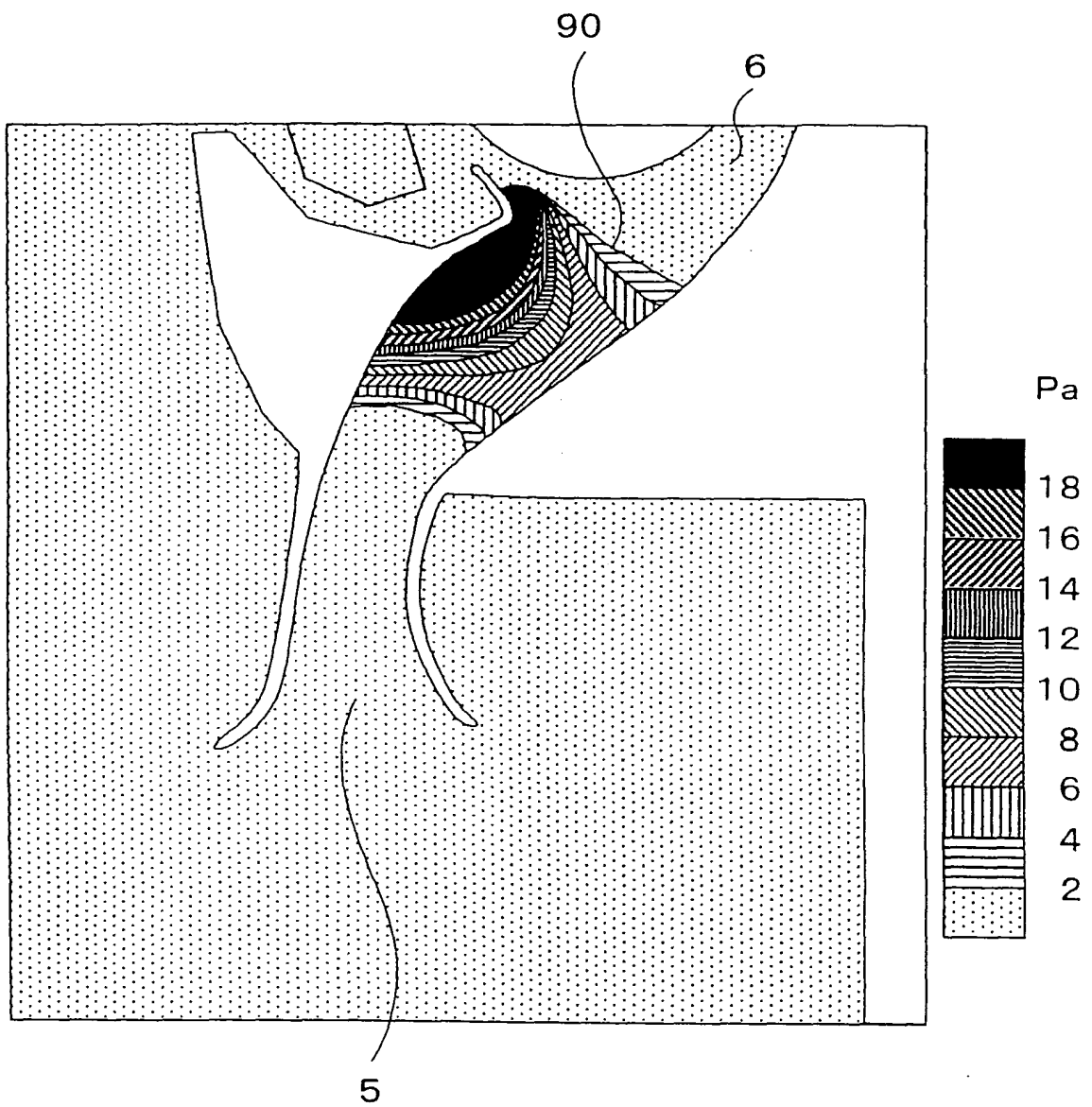


FIG.47

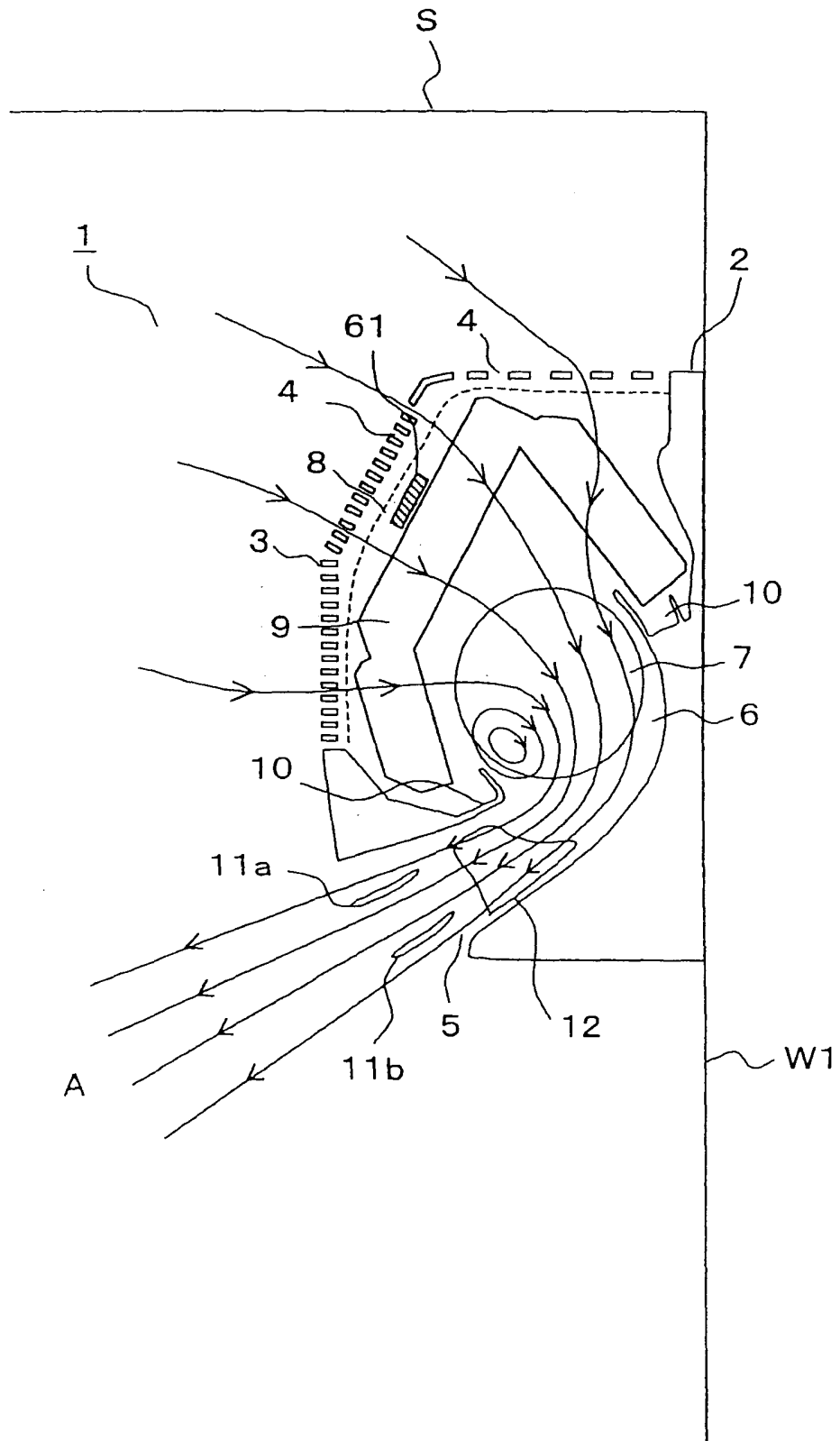


FIG.48

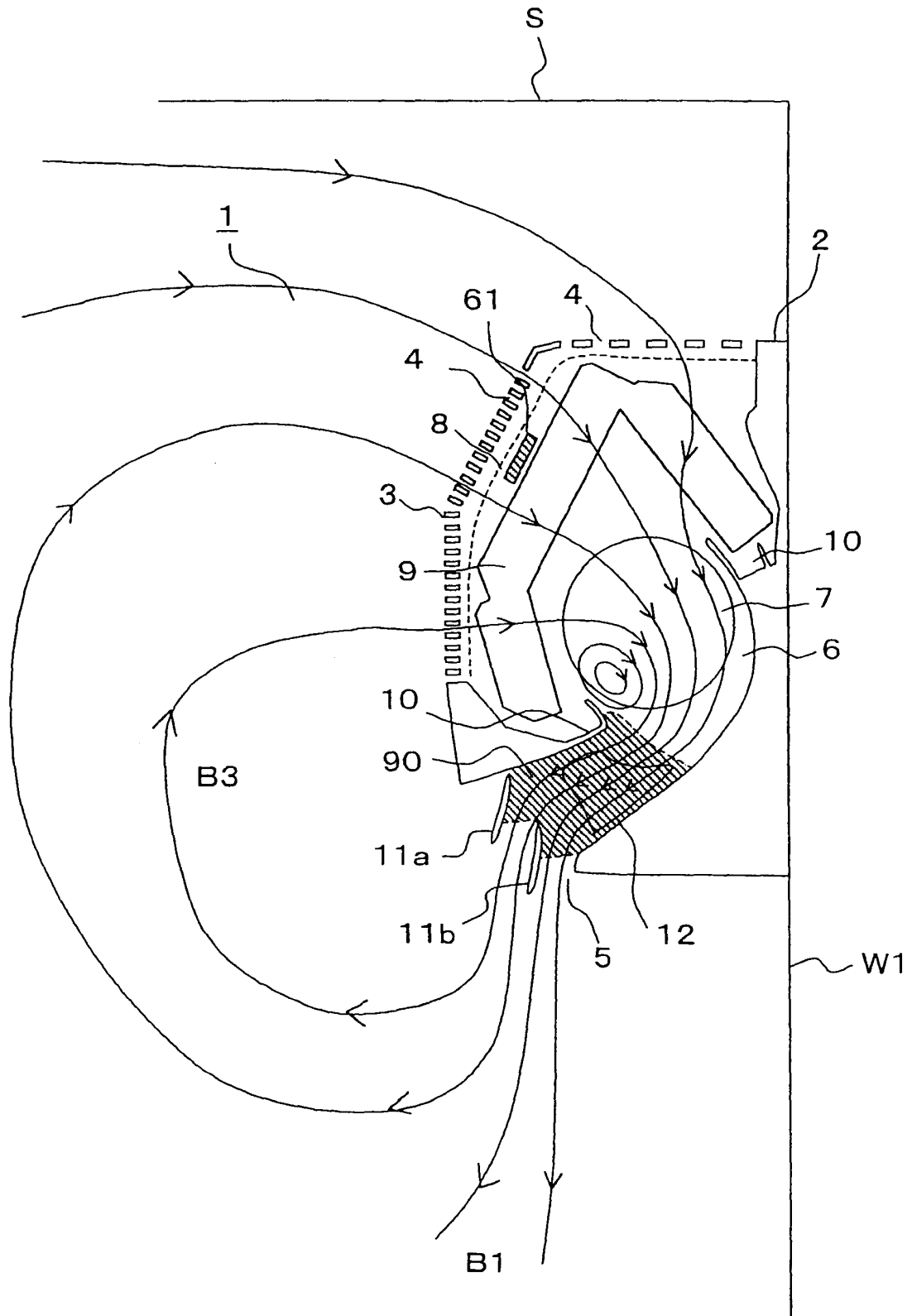


FIG.49

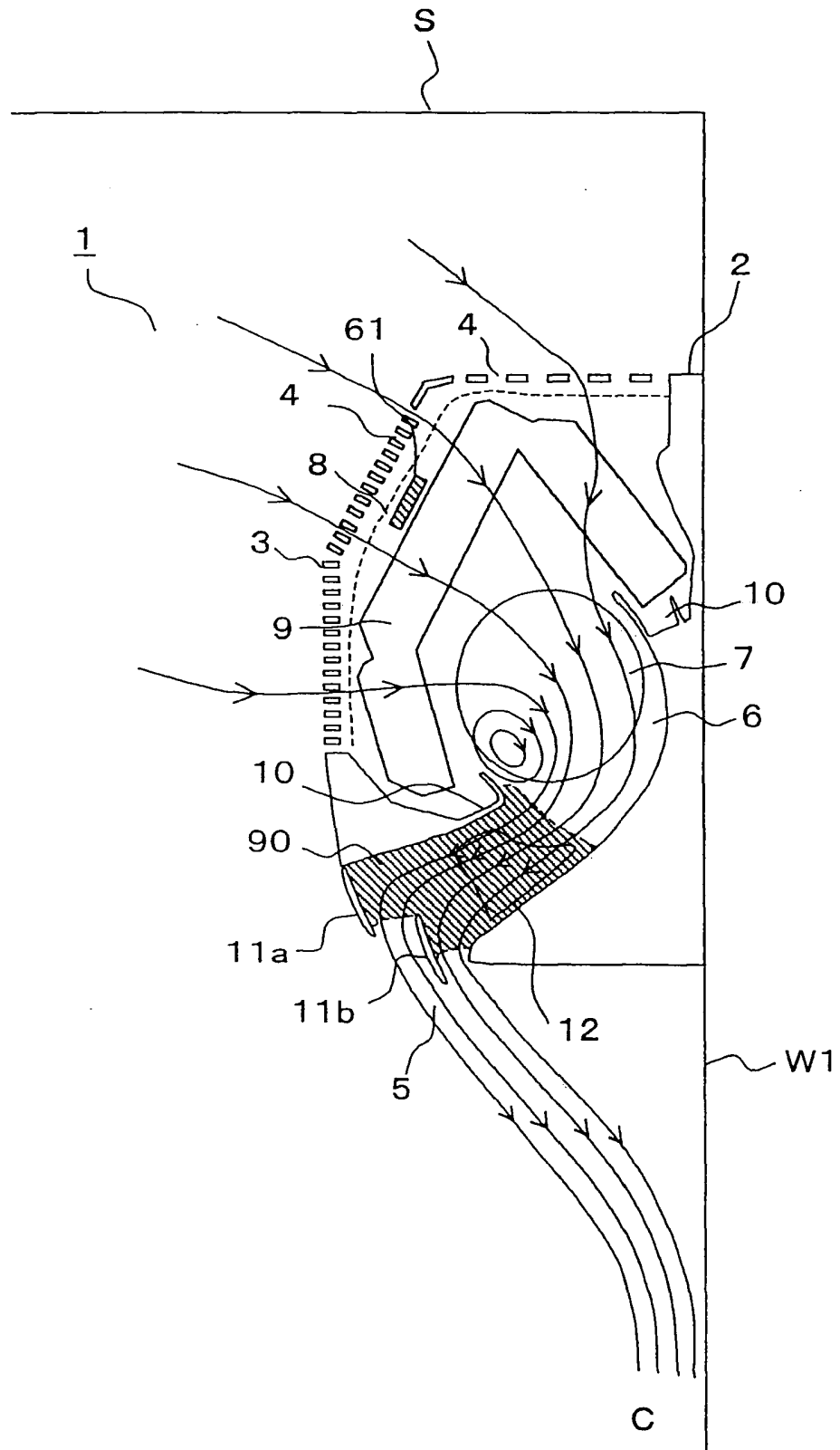


FIG. 50

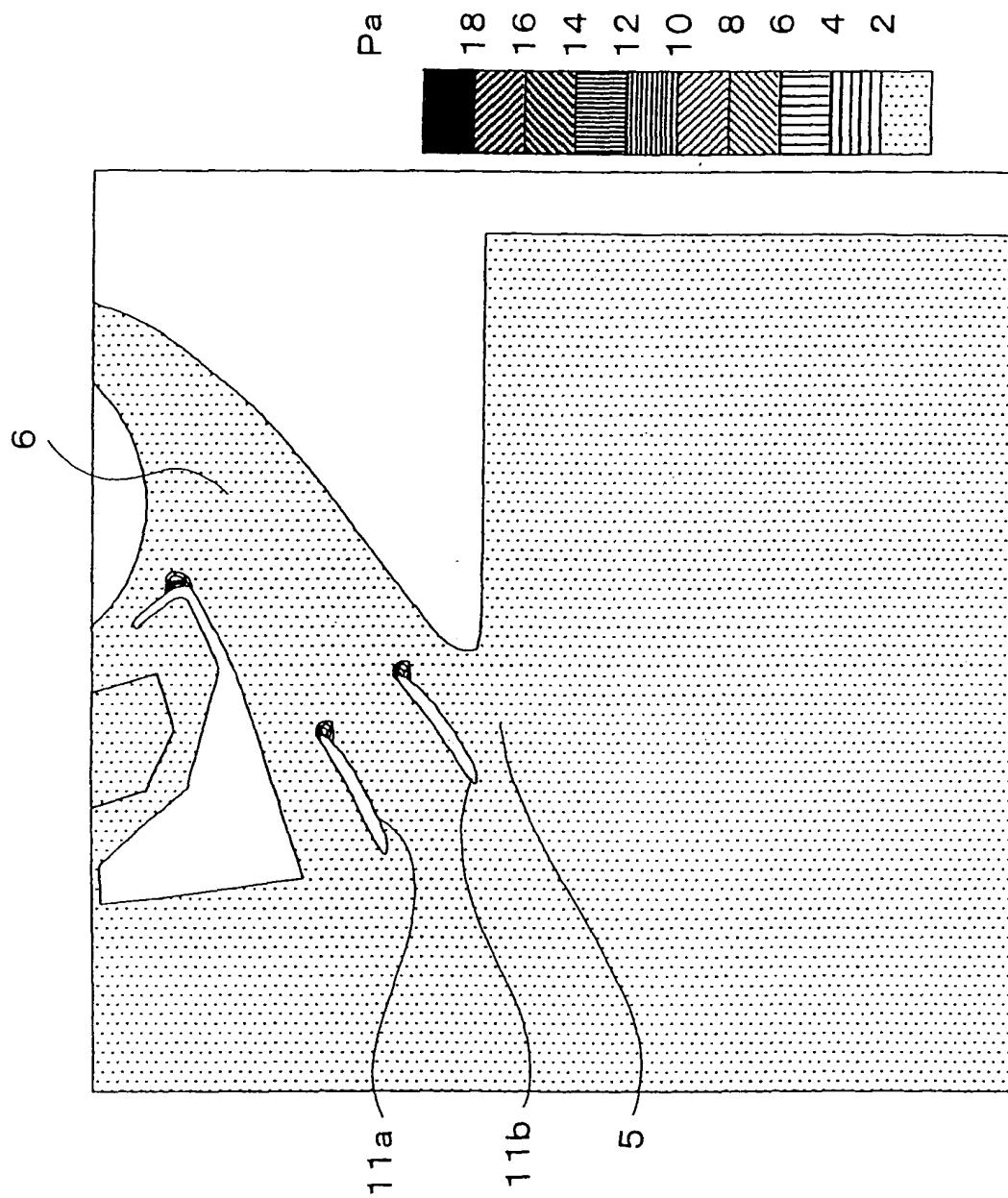


FIG.51

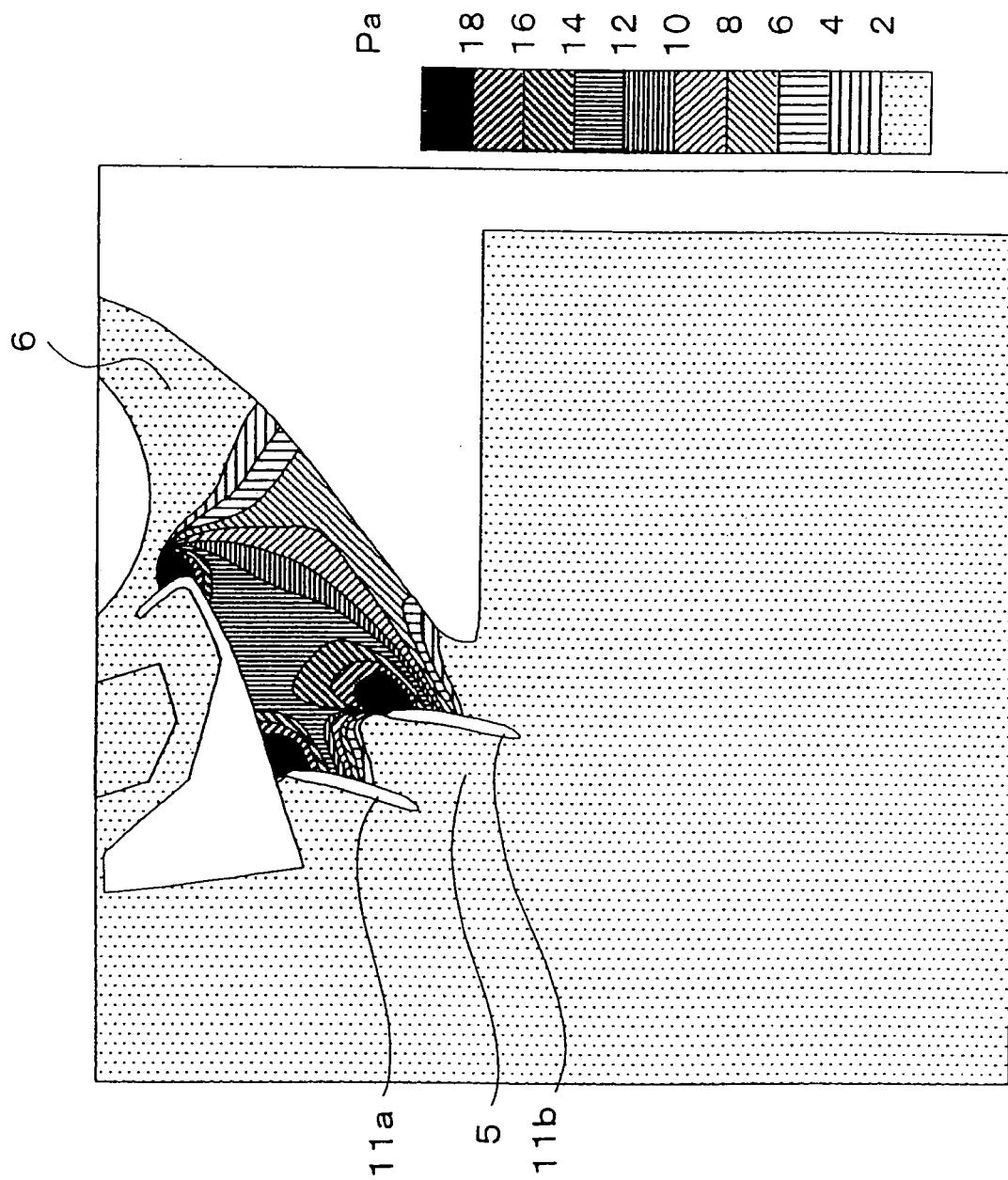
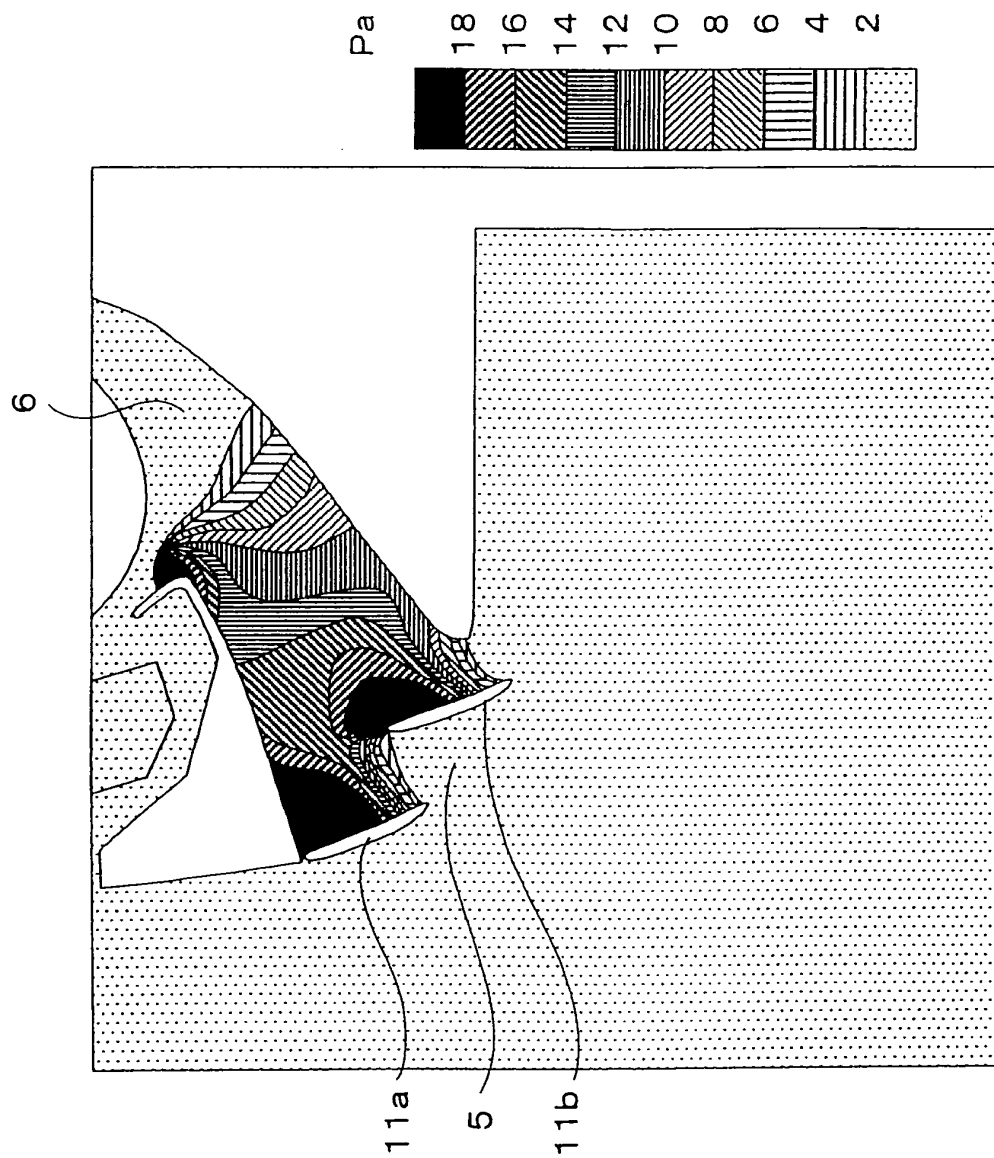


FIG.52



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/017582

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. ⁷ F24F13/06		
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 F24F13/06		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2005 Kokai Jitsuyo Shinan Koho 1971-2005 Toroku Jitsuyo Shinan Koho 1994-2005		
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.
Y	JP 10-73302 A (Toshiba Corp.), 17 March, 1998 (17.03.98), Full text; Fig. 4 & EP 819894 A2, A3	1-7, 9-25, 29-32
Y	JP 10-9657 A (Toshiba Corp.), 16 January, 1998 (16.01.98), Full text; Figs. 4, 7, 8 (Family: none)	1-7, 9-25, 29-32
Y	JP 10-19300 A (Toshiba Corp.), 23 January, 1998 (23.01.98), Full text; Fig. 8 (Family: none)	1-7, 9-32
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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