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

(11) EP 4 530 476 A2

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
02.04.2025 Bulletin 2025/14

(21) Application number: **25152288.4**

(22) Date of filing: **13.03.2023**

(51) International Patent Classification (IPC):
F04D 25/08 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F24F 1/0025; F04D 17/04; F04D 29/441; F24F 1/0007; F24F 1/0057; F24F 13/20; F24F 13/24; F05D 2250/51

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

(30) Priority: **22.03.2022 JP 2022044828**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
23774622.7 / 4 498 014

(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**
Kadoma-shi, Osaka 571-0057 (JP)

(72) Inventors:
- **WADA, Masanobu**
  Kadoma-shi, Osaka, 571-0057 (JP)
- **OSHIRO, Takahiro**
  Kadoma-shi, Osaka, 571-0057 (JP)
- **NAGATA, Takeshi**
  Kadoma-shi, Osaka, 571-0057 (JP)

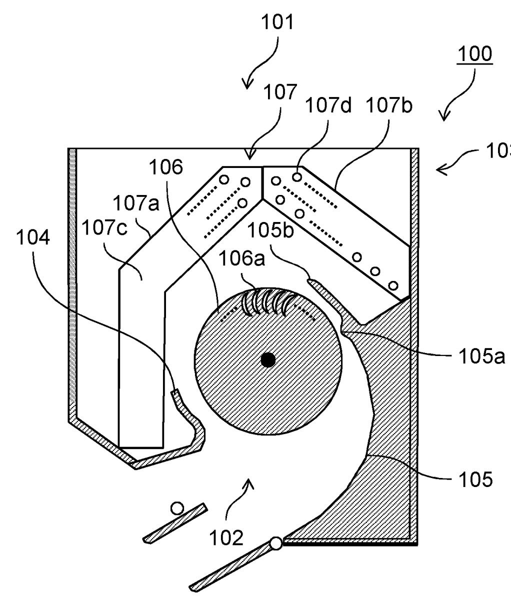
(74) Representative: **Eisenführ Speiser**
Patentanwälte Rechtsanwälte PartGmbB
Gollierstraße 4
80339 München (DE)

Remarks:
This application was filed on 16.01.2025 as a divisional application to the application mentioned under INID code 62.

(54) **AIR CONDITIONER**

(57) An air conditioner according to the present disclosure includes cross flow fan (106), rear guider (105), and rear heat exchanger (107b). Rear guider (105) includes upper end protrusion (105b) having arcuate portion (105c), and distal end point B positioned on arcuate portion (105c) is positioned at a side of cross flow fan (106) with respect to center line W of upper end protrusion (105b). When a diameter of arcuate portion (105c) is defined as D and a shortest distance between a surface of upper end protrusion (105b) on the side of cross flow fan (106) and a surface of upper end protrusion (105b) on a side of rear heat exchanger (107b) is defined as T, D/T < 0.6 is satisfied.

FIG. 1



EP 4 530 476 A2

Description

TECHNICAL FIELD

[0001] The present disclosure mainly relates to an air conditioner for household.

BACKGROUND ART

[0002] In general, an air conditioner includes, within a housing, a cross flow fan having a plurality of blades, a stabilizer, a rear guider, and a heat exchanger. The heat exchanger includes a front heat exchanger disposed on a front side of the cross flow fan and a rear heat exchanger disposed on a rear side of the cross flow fan. Such an air conditioner is configured to suck air from a top surface side of the housing of the air conditioner, exchange heat between the sucked air and a refrigerant flowing inside the heat exchanger, and blow out the air from a bottom surface side of the housing. Accordingly, indoor air conditioning is performed.

[0003] PTL 1 discloses an air conditioner that suppresses noise. The air conditioner includes an air blowing passage that allows an air outlet and a suction port to communicate with each other. The air conditioner includes a cross flow fan, a rear guider, a stabilizer, a front heat exchanger, and a rear heat exchanger within the air blowing passage. The cross flow fan includes a plurality of blades. The rear guider includes a proximity portion that approach to face the cross flow fan and is separated from the cross flow fan by a predetermined dimension, and an upper end protrusion that further extends from the proximity portion toward an upper side of the rear heat exchanger. The front heat exchanger is disposed in front of the cross flow fan, and the rear heat exchanger is disposed behind the cross flow fan.

Citation List

Patent Literature

[0004] PTL 1: Unexamined Japanese Patent Publication No. 2001-124362

SUMMARY OF THE INVENTION

[0005] However, in the air conditioner described in PTL 1, there is a problem that air blowing performance deteriorates due to collision of a suction airflow generated by rotation of the cross flow fan with a reverse vortex and flowing of a turbulent airflow into the cross flow fan.

[0006] The present disclosure provides an air conditioner that rectifies an airflow flowing into a cross flow fan and improves air blowing performance.

[0007] An air conditioner according to the present disclosure includes a cross flow fan, a stabilizer, a rear guider, a front heat exchanger disposed at a front side of the cross flow fan, and a rear heat exchanger disposed at a rear side of the cross flow fan. The rear guider includes a proximity portion facing the cross flow fan and disposed to be in vicinity of the cross flow fan at a predetermined distance, and an upper end protrusion extending upward from the proximity portion. In sectional view of the rear guider orthogonal to an axis of rotation of the cross flow fan, the upper end protrusion of the rear guider has an arcuate portion that circumscribes straight line X perpendicular to a downstream surface of the rear heat exchanger. When a contact point between straight line X and the arcuate portion is defined as distal end point B, distal end point B is positioned at a side of the cross flow fan with respect to a center line of the upper end protrusion, and when a diameter of the arcuate portion is defined as D and a thickness of the upper end protrusion is defined as T, $D/T < 0.6$ is satisfied.

[0008] The air conditioner of the present disclosure can improve the air blowing performance by improving the turbulence of the airflow flowing into the cross flow fan.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a longitudinal sectional view of an air conditioner according to a first exemplary embodiment of the present disclosure.

Fig. 2 is a diagram illustrating a longitudinal sectional configuration near an upper end protrusion of the air conditioner according to the first exemplary embodiment.

Fig. 3 is a flowchart illustrating a flow of air near the upper end protrusion of the air conditioner according to the first exemplary embodiment.

Fig. 4A is a diagram illustrating a change in blown air volume ratio of the air conditioner with respect to D/T and a shape of the upper end protrusion in the first exemplary embodiment.

Fig. 4B is a graph representing the change in blown air volume ratio of the air conditioner with respect to D/T in the first exemplary embodiment.

Fig. 5A is a diagram illustrating an input change of the cross flow fan of the air conditioner with respect to D/T and the shape of the upper end protrusion according to the first exemplary embodiment.

Fig. 5B is a graph representing the input change of the cross flow fan of the air conditioner with respect to D/T in the first exemplary embodiment.

Fig. 6 is a longitudinal sectional view illustrating an air conditioner according to PTL 1.

Fig. 7 is a diagram illustrating a longitudinal sectional configuration near an upper end protrusion of the air conditioner according to PTL 1.

Fig. 8 is a flowchart illustrating a flow of air near the upper end protrusion of the air conditioner according to PTL 1.

DESCRIPTION OF EMBODIMENT

(Underlying knowledge and the like of present disclosure)

[0010] At a time when the present inventors have conceived the present disclosure, there has been a problem that, in the air conditioner, a surrounding airflow is entrained to form a vortex flow upstream of the proximity portion between the cross flow fan and the rear guider and the blade passes through the vortex flow to generate interference noise. The vortex flow is generated when a reverse flow in a direction opposite to a rotation direction of the cross flow fan is generated in a gap between the cross flow fan and the rear guider, and the reverse flow passes through the proximity portion between the cross flow fan and the rear guider. As a solution to this problem, there is a technique for suppressing noise by the upper end protrusion provided from the proximity portion that partitions upstream and downstream behind the cross flow fan toward above the cross flow fan.

[0011] Here, PTL 1 will be described as an example of the air conditioner of the related art with reference to Figs. 6 to 8. Fig. 6 is a longitudinal sectional view of air conditioner 1 according to PTL 1. Fig. 7 is a diagram illustrating a longitudinal sectional configuration near upper end protrusion 6b of air conditioner 1. Fig. 8 is a flowchart illustrating a flow of air near upper end protrusion 6b of air conditioner 1.

[0012] A structure of air conditioner 1 disclosed in PTL 1 will be described with reference to Fig. 6. Air conditioner 1 includes air blowing passage 4 that allows air outlet 2 and suction port 3 to communicate with each other. Air conditioner 1 includes cross flow fan 5, rear guider 6, and stabilizer 7 within air blowing passage 4, front heat exchanger 8 on a front side of cross flow fan 5, and rear heat exchanger 9 on a rear side of cross flow fan 5. Cross flow fan 5 includes a plurality of blades 5a. Rear guider 6 includes proximity portion 6a that faces cross flow fan 5 and is disposed to be in vicinity of cross flow fan 5 at a predetermined distance. Cross flow fan 5 includes upper end protrusion 6b further extending from proximity portion 6a toward an upper side of rear heat exchanger 9.

[0013] A flow of air of air conditioner 1 disclosed in PTL 1 will be described with reference to Fig. 7. Upper end protrusion 6b includes upper end 6c of upper end protrusion 6b, surface 6d of upper end protrusion 6b facing rear heat exchanger 9, and surface 6e of upper end protrusion 6b facing cross flow fan 5. A suction airflow having passed through a portion of rear heat exchanger 9 positioned below upper end 6c of upper end protrusion 6b flows upward along surface 6d of upper end protrusion 6b facing rear heat exchanger 9, swirls toward cross flow fan 5 near the upper end of upper end protrusion 6b, and flows into cross flow fan 5. The suction airflow having passed through a portion of rear heat exchanger 9 positioned above the upper end of upper end protrusion 6b merges with the suction airflow having passed through rear heat exchanger 9 positioned below the upper end of upper end protrusion 6b near the upper end of upper end protrusion 6b, and flows into cross flow fan 5. A reverse vortex rotating in a direction opposite to a rotation direction of cross flow fan 5 is generated in a space between cross flow fan 5 and surface 6e of upper end protrusion 6b facing cross flow fan 5. In air conditioner 1, the reverse vortex is attached to surface 6e of upper end protrusion 6b facing cross flow fan 5, and a vortex center of the reverse vortex is positioned upstream of proximity portion 6a. Thus, interference with blades 5a can be alleviated and noise can be suppressed.

[0014] Next, the flow of air near upper end protrusion 6b of air conditioner 1 disclosed in PTL 1 will be described with reference to Fig. 8. In Fig. 8, a solid line indicates a streamline of the airflow, and a contour indicates an eddy viscosity coefficient of the airflow. Upper end protrusion 6b has a uniform shape in a longitudinal direction parallel to an axis of rotation of cross flow fan 5. A sectional shape of the upper end of upper end protrusion 6b in a cross section perpendicular to the axis of rotation of cross flow fan 5 is formed by an arc tangent to the surface of upper end protrusion 6b facing rear heat exchanger 9 and the surface of upper end protrusion 6b facing cross flow fan 5. The reverse vortex generated in the space between cross flow fan 5 and the surface of upper end protrusion 6b facing cross flow fan 5 and rotating in the direction opposite to the rotation direction of cross flow fan 5 flows along the arc of upper end protrusion 6b toward the surface of upper end protrusion 6b facing rear heat exchanger 9. The suction airflow having passed through rear heat exchanger 9 positioned below the upper end of upper end protrusion 6b flows upward along the surface of upper end protrusion 6b facing rear heat exchanger 9, and flows toward the surface of upper end protrusion 6b facing cross flow fan 5 along the arc of upper end protrusion 6b. The reverse vortex and the suction airflow collide with each other near the upper end of upper end protrusion 6b, become a turbulent airflow, and flow into cross flow fan 5. When the airflow flows into cross flow fan 5, since blade 5a crosses the turbulent airflow, a friction loss may occur between blade 5a and the suction airflow on a surface of blade 5a, or noise due to interference may occur. In such a case, the inventors have found that there is a problem that the air blowing performance of the air conditioner is deteriorated, specifically, a blown air volume is reduced, the input power of the fan is increased, or noise cannot be suppressed. The inventors have come to construct the subject matter of the present disclosure to solve the problem.

[0015] The present disclosure provides an air conditioner capable of improving air blowing performance by suppressing collision between a suction airflow having passed through a rear heat exchanger and a reverse vortex generated in a space between a cross flow fan and a surface of an upper end protrusion facing the cross flow fan and improving turbulence of an airflow flowing into the cross flow fan.

[0016] Hereinafter, an exemplary embodiment will be described in detail with reference to the drawings. However, unnecessarily detailed description may be omitted. For example, detailed descriptions of already well-known matters and redundant descriptions of substantially identical configurations may be omitted. This is to avoid an unnecessary redundancy in the following description and to facilitate understanding of a person skilled in the art.

[0017] Note that, the accompanying drawings and the following descriptions are only provided to facilitate a person skilled in the art to fully understand the present disclosure, and are not intended to limit the subject matter as defined in the claims in any way.

(First exemplary embodiment)

[0018] Hereinafter, air conditioner 100 of a first exemplary embodiment will be described with reference to Figs. 1 to 3. Fig. 1 is a longitudinal sectional view of air conditioner 100 according to the first exemplary embodiment of the present disclosure. Fig. 2 is a diagram illustrating a longitudinal sectional configuration near upper end protrusion 105b of air conditioner 100. Fig. 3 is a flowchart illustrating a flow of air near upper end protrusion 105b of air conditioner 100. Note that, in the present exemplary embodiment, a left side in Fig. 1 is referred to as a front side, and a right side in Fig. 1 is referred to as a rear side.

[1-1. Configuration]

[0019] As illustrated in Fig. 1, air conditioner 100 includes body casing 103 having suction port 101 and air outlet 102, stabilizer 104, rear guider 105, cross flow fan 106, and heat exchanger 107.

[0020] Rear guider 105 includes proximity portion 105a and upper end protrusion 105b. Proximity portion 105a is a portion that faces cross flow fan 106 and is disposed to be in vicinity of cross flow fan 106 at a predetermined distance. Upper end protrusion 105b is a portion extending upward from proximity portion 105a. Rear guider 105 is disposed between cross flow fan 106 and rear heat exchanger 107b to be described later.

[0021] Cross flow fan 106 includes an axis of rotation and a plurality of blades 106a disposed in a cylindrical shape.

[0022] Heat exchanger 107 includes front heat exchanger 107a and rear heat exchanger 107b. Heat exchanger 107 may include an auxiliary heat exchanger. Front heat exchanger 107a is disposed at a front side of cross flow fan 106. Rear heat exchanger 107b is disposed at a rear side of cross flow fan 106. In a case where the auxiliary heat exchanger is provided, the auxiliary heat exchanger is disposed, for example, on a surface of rear heat exchanger 107b opposite to a surface facing cross flow fan 106 and rear heat exchanger 107b. In other words, the auxiliary heat exchanger is disposed on a surface of rear heat exchanger 107b upstream of air flowing in from suction port 101 when the cross flow fan rotates.

[0023] Heat exchanger 107 includes a plurality of fins 107c and a plurality of heat transfer tubes 107d penetrating the plurality of fins 107c. Outer diameter Dt of each heat transfer tube 107d is less than or equal to 5 mm, for example, Dt = 5 mm in the present exemplary embodiment.

[0024] Next, in Fig. 2, detailed shapes of proximity portion 105a and upper end protrusion 105b of rear guider 105 will be described. A point having a shortest distance on proximity portion 105a to cross flow fan 106 is defined as proximity point A. A straight line perpendicular to a downstream surface of rear heat exchanger 107b is defined as straight line X. Upper end protrusion 105b has arcuate portion 105c circumscribing straight line X, and a contact point between straight line X and arcuate portion 105c is defined as distal end point B. Distal end point B is positioned at a side of cross flow fan 106 with respect to center line W of the upper end protrusion. Upper end protrusion 105b is configured to satisfy $D/T < 0.6$ when a diameter of arcuate portion 105c is defined as D and a thickness of upper end protrusion 105b is defined as T.

[0025] Here, in the present exemplary embodiment, center line W of the upper end protrusion and thickness T of upper end protrusion 105b are determined as follows. A straight line connecting proximity point A and distal end point B is defined as straight line Y, and a length of straight line Y is defined as L. A point that is on straight line Y and that satisfies $K = 0.25 \times L$ when a distance from distal end point B is defined as K is defined as point P. A point that is on surface 105f of upper end protrusion 105b facing cross flow fan 106 and that is at a shortest distance from point P to surface 105f of upper end protrusion 105b facing cross flow fan 106 is defined as point Q. A point that is on surface 105e of upper end protrusion 105b facing rear heat exchanger 107b and that is at a shortest distance from point Q to surface 105e of upper end protrusion 105b facing rear heat exchanger 107b is defined as point R. A straight line connecting point Q and point R is defined as straight line Z. A straight line passing through a midpoint of straight line Z and orthogonal to straight line Z is defined as center line W of the upper end protrusion. A length of line segment QR on straight line Z is defined as thickness T of upper end protrusion 105b.

[0026] Upper end protrusion 105b has flat portion 105d that is tangent to arcuate portion 105c and faces rear heat exchanger 107b. Upper end protrusion 105b is configured to satisfy $U/T < 1.0$ when a length of flat portion 105d is defined as U.

[1-2. Operation]

[0027] Hereinafter, an operation of air conditioner 100 having the above configuration will be described with reference to Fig. 3.

[0028] In air conditioner 100, cross flow fan 106 rotates, and thus, an indoor air is sucked into body casing 103 from suction port 101. The indoor air sucked into body casing 103 passes through front heat exchanger 107a and rear heat exchanger 107b, flows into cross flow fan 106, and is blown out into an indoor space from air outlet 102. Note that, in Figs. 1 to 3, cross flow fan 106 rotates clockwise.

[0029] A suction airflow having passed through a portion of rear heat exchanger 107b positioned below an upper end of upper end protrusion 105b due to the rotation of cross flow fan 106 flows upward along surface 105e of upper end protrusion 105b facing rear heat exchanger 107b, swirls toward cross flow fan 106 near the upper end of upper end protrusion 105b, and flows into cross flow fan 106. The suction airflow passing through a portion of rear heat exchanger 107b positioned above the upper end of upper end protrusion 105b merges with the suction airflow passing through a portion of rear heat exchanger 107b positioned below the upper end of upper end protrusion 105b near the upper end of upper end protrusion 105b, and flows into cross flow fan 106. In a space between cross flow fan 106 and upper end protrusion 105b, a reverse vortex rotating in a direction opposite to a rotation direction of cross flow fan 106 is generated. The reverse vortex adheres to surface 105f of upper end protrusion 105b facing cross flow fan 106, and a vortex center of the reverse vortex is positioned above proximity portion 105a.

[0030] The suction airflow passing through the portion of rear heat exchanger 107b positioned below the upper end of upper end protrusion 105b flows upward along surface 105e of upper end protrusion 105b facing rear heat exchanger 107b and reaches flat portion 105d. The suction airflow passing through the portion of rear heat exchanger 107b positioned below the upper end of upper end protrusion 105b peels off from surface 105e of upper end protrusion 105b facing rear heat exchanger 107b at connection point S between surface 105e of upper end protrusion 105b facing rear heat exchanger 107b and flat portion 105d by an inertial force of the suction airflow.

[0031] In the present exemplary embodiment, surface 105e of upper end protrusion 105b facing rear heat exchanger 107b and flat portion 105d are not continuous, and length U of flat portion 105d satisfies $U/T < 1.0$ with respect to thickness T of upper end protrusion 105b. Accordingly, the suction airflow peeling off from surface 105e of upper end protrusion 105b facing rear heat exchanger 107b does not adhere to flat portion 105d again and merges with the flow flowing into cross flow fan 106.

[0032] The reverse vortex flows upward along surface 105f of upper end protrusion 105b facing cross flow fan 106 and reaches arcuate portion 105c. In the present exemplary embodiment, in arcuate portion 105c, distal end point B is positioned at the side of cross flow fan 106 with respect to center line W of upper end protrusion 105b, and diameter D of arcuate portion 105c satisfies $D/T < 0.6$ with respect to thickness T of upper end protrusion 105b. As a result, the reverse vortex has a small deflection radius and is steeply deflected when the reverse vortex flows along arcuate portion 105c. However, due to the inertial force of the reverse vortex, the reverse vortex peels off from arcuate portion 105c and merges with the flow flowing into cross flow fan 106. Since distal end point B is positioned at the side of cross flow fan 106 with respect to center line W of upper end protrusion 105b, the reverse vortex peels off from arcuate portion 105c at a position close to cross flow fan 106 and merges with the flow flowing into cross flow fan 106.

[0033] The improvement of the air blowing performance with respect to a numerical value of D/T will be described in detail with reference to Figs. 4A to 5B. Fig. 4A is a diagram illustrating a change in blown air volume ratio of air conditioner 100 with respect to D/T and a shape of upper end protrusion 105b. Fig. 4B is a graph representing the change in blown air volume ratio of air conditioner 100 with respect to the D/T. Fig. 5A is a diagram illustrating an input change (change in input power) of cross flow fan 106 of air conditioner 100 with respect to D/T and the shape of upper end protrusion 105b. Fig. 5B is a graph representing the input change (change in input power) of cross flow fan 106 of air conditioner 100 with respect to D/T.

[0034] First, in Figs. 4A and 4B, an air volume change with respect to D/T will be described. Figs. 4A and 4B illustrate air volume ratios when the number of rotations of cross flow fan 106 of air conditioner 100 per unit time is set to the same number of rotations by using D/T by numerical analysis as a parameter. Note that, regarding the air volume ratio in Figs. 4A and 4B, an air volume ratio when $D/T = 1.0$ is set to 100. In Fig. 4A, the value of D/T is illustrated in an upper part, the air volume ratio is illustrated in a middle part, and the shape of upper end protrusion 105b is illustrated in a lower part. In Fig. 4B, a horizontal axis represents D/T, and a vertical axis represents an air volume ratio with respect to D/T. Assuming that D/T is decreased from 1 to 0.27, as illustrated in Fig. 4B, the air volume ratio rapidly increases when D/T is between 1.0 and 0.6, and on the other hand, when D/T becomes less than 0.6, the air volume ratio maintains a substantially constant value. That is, the air volume ratio is rapidly improved when D/T is between 1.0 and 0.6, and the air volume ratio reaches an upper limit when D/T reaches 0.6. Accordingly, it can be said that, when D/T is less than 0.6, the air volume ratio is improved and the air blowing performance is improved.

[0035] In Figs. 5A and 5B, the input change with respect to D/T will be described. Figs. 5A and 5B illustrate an input ratio when a volume of air blown out from air conditioner 100 is set to the same blown air volume by using D/T by numerical analysis as a parameter. Note that, the input ratio in Figs. 5A and 5B is 100 when $D/T = 1.0$. In Fig. 5A, the value of D/T is illustrated in an upper part, the input ratio is illustrated in a middle part, and the shape of upper end protrusion 105b is illustrated in a lower part. In Fig. 5B, a horizontal axis represents D/T, and a vertical axis represents the input ratio. Assuming that D/T is decreased from 1.0 to 0.27, as illustrated in Fig.

5B, the input ratio is maintained at a substantially constant value when D/T is between 1.0 and 0.6, and the input ratio is rapidly decreased when D/T is less than 0.6. That is, it can be said that an effect of improving the input ratio is small when D/T is between 1.0 and 0.6 and an effect of improving the input ratio is exerted when the value of D/T is less than 0.6 with 0.6 as a boundary. That is, it can be said that, when D/T is less than 0.6, the input ratio rapidly decreases and the air blowing performance is improved. As illustrated in Fig. 5B, it is found that the input ratio can be reduced by 0.5% at D/T = 0.5 as compared with D/T = 1.0. Accordingly, it can be said that, when D/T is 0.5 or less, the input ratio is further improved, and the air blowing performance is further improved.

[1-3. Effects and the like]

[0036] As described above, in the present exemplary embodiment, air conditioner 100 includes body casing 103 having suction port 101 and air outlet 102, stabilizer 104, rear guider 105, cross flow fan 106, front heat exchanger 107a, and rear heat exchanger 107b. Rear guider 105 includes proximity portion 105a facing cross flow fan 106 and approaching cross flow fan 106 with a predetermined dimension (distance), and upper end protrusion 105b extending upward from proximity portion 105a. Upper end protrusion 105b has arcuate portion 105c, and distal end point B of arcuate portion 105c is positioned at the side of cross flow fan 106 with respect to center line W of upper end protrusion 105b. Upper end protrusion 105b is configured to satisfy D/T < 0.6 when the diameter of arcuate portion 105c is defined as D and the thickness of upper end protrusion 105b is defined as T.

[0037] In arcuate portion 105c, since distal end point B is positioned at the side of cross flow fan 106 with respect to center line W of upper end protrusion 105b and D/T < 0.6 is satisfied, the generated reverse vortex has a small deflection radius and is steeply deflected when the reverse vortex flows along arcuate portion 105c. However, due to the inertial force of the reverse vortex, the reverse vortex peels off from arcuate portion 105c and merges with the flow flowing into cross flow fan 106. Since distal end point B is positioned at the side of cross flow fan 106 with respect to center line W of upper end protrusion 105b, the reverse vortex peels off from arcuate portion 105c at a position close to cross flow fan 106 and merges with the flow flowing into cross flow fan 106.

[0038] Accordingly, in air conditioner 100 of the present exemplary embodiment, at the upper end of upper end protrusion 105b, the flowing of the reverse vortex along arcuate portion 105c of upper end protrusion 105b toward surface 105e of upper end protrusion 105b facing rear heat exchanger 107b is suppressed. Accordingly, the occurrence of collision between the reverse vortex and the suction airflow can be suppressed or alleviated. Thus, the turbulence of the airflow flowing into cross flow fan 106 is improved, and thus, the blown air volume of cross flow fan 106 can be increased. As a result, the input power to cross flow fan 106 can be reduced. The turbulence of the airflow flowing into cross flow fan 106 is improved, and thus, noise can be suppressed.

[0039] Preferably, upper end protrusion 105b has flat portion 105d and is configured to satisfy U/T < 1.0 when the length of flat portion 105d is defined as U. With this configuration, surface 105e of upper end protrusion 105b facing rear heat exchanger 107b and flat portion 105d are connected not to be continuous. Accordingly, at connection point S between surface 105e of upper end protrusion 105b facing rear heat exchanger 107b and flat portion 105d, the suction airflow passing through rear heat exchanger 107b positioned below the upper end of upper end protrusion 105b peels off from surface 105e of upper end protrusion 105b facing rear heat exchanger 107b due to the inertial force of the suction airflow. Since flat portion 105d is configured to satisfy U/T < 1.0, the suction airflow peeling off from surface 105e of upper end protrusion 105b facing rear heat exchanger 107b does not adhere to flat portion 105d again and merges with the flow flowing into cross flow fan 106.

[0040] Accordingly, air conditioner 100 can suppress the suction airflow from flowing toward surface 105f of upper end protrusion 105b facing cross flow fan 106 along arcuate portion 105c of upper end protrusion 105b at the upper end of upper end protrusion 105b, and can suppress or alleviate the occurrence of the collision with the reverse vortex. Thus, the turbulence of the airflow flowing into cross flow fan 106 is improved, and thus, the input power in cross flow fan 106 can be reduced. As a result, the noise can be suppressed.

[0041] As in the present exemplary embodiment, outer diameter Dt of heat transfer tube 107d may be Dt = 5 mm. However, outer diameter Dt of heat transfer tube 107d described in the present exemplary embodiment is merely an example. Heat transfer tube 107d may satisfy Dt ≤ 5 mm.

[0042] As described above, even in a case where air conditioner 100 includes rear heat exchanger 107b in which a pressure loss is reduced by setting outer diameter Dt of heat transfer tube 107d to Dt = 5 mm, the turbulence of the airflow flowing into cross flow fan 106 is improved, and thus, the blown air volume in cross flow fan 106 can be increased. As a result, the input power of cross flow fan 106 can be reduced. The turbulence of the airflow flowing into cross flow fan 106 is improved, and thus, noise can be suppressed.

[0043] Note that, the exemplary embodiment described above is to exemplify the technique in the present disclosure, and thus, various modifications, replacements, additions, omissions, and the like can be made in the scope of claims or in an equivalent scope of the claims.

INDUSTRIAL APPLICABILITY

[0044] The present disclosure can improve the air blowing performance by suppressing or alleviating the occurrence of the collision between the suction airflow and the reverse vortex formed upstream of the proximity portion of the rear guider and improving the turbulence of the airflow flowing into the cross flow fan. Accordingly, it can be suitably used for household air conditioning and commercial air conditioning.

REFERENCE MARKS IN THE DRAWINGS

[0045]

100	air conditioner
101	suction port
102	air outlet
103	body casing
104	stabilizer
105	rear guider
105a	proximity portion
105b	upper end protrusion
105c	arcuate portion
105d	flat portion
106	cross flow fan
106a	blade
107	heat exchanger
107a	front heat exchanger
107b	rear heat exchanger
107c	fin
107d	heat transfer tube

It follows a list of further embodiments of the invention:

Embodiment 1.

[0046] An air conditioner comprising:

a cross flow fan;
a stabilizer;
a rear guider;
a front heat exchanger that is disposed at a front side of the cross flow fan; and
a rear heat exchanger that is disposed at a rear side of the cross flow fan,
wherein
the rear guider includes

a proximity portion that faces the cross flow fan, and is disposed to be in vicinity of the cross flow fan at a predetermined distance, and
an upper end protrusion that extends upward from the proximity portion,

in sectional view of the rear guider orthogonal to an axis of rotation of the cross flow fan,
the upper end protrusion of the rear guider has an arcuate portion circumscribing a straight line X perpendicular to a downstream surface of the rear heat exchanger, and
when a contact point at which the arcuate portion circumscribes the straight line X is a distal end point B, the distal end point B is positioned at a side of the cross flow fan with respect to a center line of the upper end protrusion, and when a diameter of the arcuate portion is defined as D and a thickness of the upper end protrusion is defined as T, $D/T < 0.6$ is satisfied.

Embodiment 2.

[0047] The air conditioner according to embodiment 1, wherein $D/T \leq 0.5$ is satisfied.

Embodiment 3.

[0048] The air conditioner according to embodiment 1 or 2, wherein

in the sectional view of the rear guider, the upper end protrusion has a flat portion tangent to the arcuate portion and facing the rear heat exchanger, and when a length of the flat portion is U, $U/T < 1.0$ is satisfied.

Embodiment 4.

[0049] The air conditioner according to any one of embodiment 1 to 3, wherein

the rear heat exchanger includes a fin, and a heat transfer tube penetrating through the fin, and
an outer diameter Dt of the heat transfer tuber satisfies $Dt \leq 5$ mm.

Claims

1. An air conditioner (100) comprising:

a cross flow fan (106);
a stabilizer (104);
a rear guider (105);
a front heat exchanger (107a) that is disposed at a front side of the cross flow fan (106); and
a rear heat exchanger (107b) that is disposed at a rear side of the cross flow fan (106),
wherein
the rear guider (105) includes

a proximity portion (105a) that faces the cross flow fan (106), and is disposed to be in vicinity of the cross flow fan (106) at a predetermined distance, and
an upper end protrusion (105b) that extends upward from the proximity portion (105a),

in sectional view of the rear guider (105) ortho-

gonal to an axis of rotation of the cross flow fan (106),
the upper end protrusion (105b) of the rear guider (105) has an arcuate portion (105c) circumscribing a straight line X perpendicular to a downstream surface of the rear heat exchanger (107b), and
when a contact point at which the arcuate portion (105c) circumscribes the straight line X is a distal end point (B), the distal end point (B) is positioned at a side of the cross flow fan (106) with respect to a center line (W) of the upper end protrusion (105b), wherein a diameter of the arcuate portion (105c) is defined as D and a thickness of the upper end protrusion is defined as T.

2. The air conditioner (100) according to claim 1, wherein $D/T < 1.0$ is satisfied.

3. The air conditioner (100) according to claim 2, wherein $D/T \leq 0.82$ is satisfied.

4. The air conditioner (100) according to claim 3, wherein $D/T \leq 0.64$ is satisfied.

5. The air conditioner (100) according to claim 4, wherein $D/T < 0.6$ is satisfied.

6. The air conditioner (100) according to claim 4, wherein $D/T \leq 0.5$ is satisfied.

7. The air conditioner (100) according to any one of claims 1 to 6, wherein in the sectional view of the rear guider (105), the upper end protrusion (105b) has a flat portion (105d).

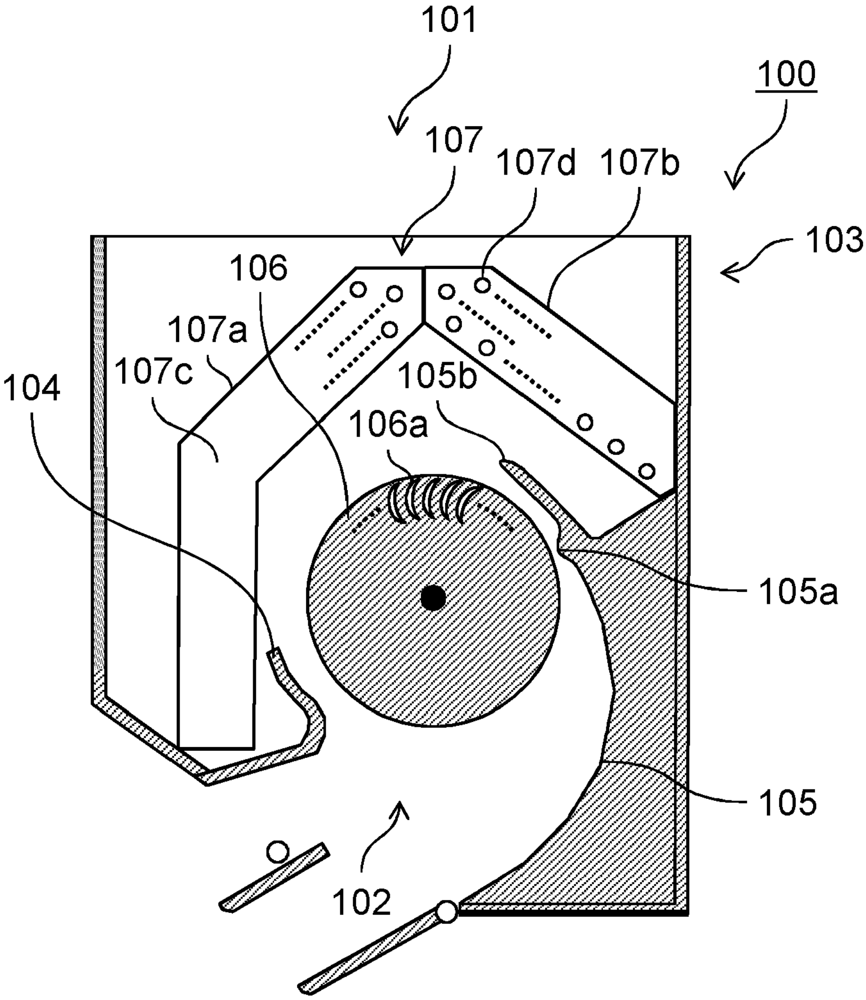
8. The air conditioner (100) according to claim 7, wherein the flat portion (105d) is tangent to the arcuate portion (105c).

9. The air conditioner (100) of claims 7 or 8, wherein the flat portion (105d) faces the rear heat exchanger (107b).

10. The air conditioner (100) of any of claims 7 to 9, wherein when a length of the flat portion (105d) is U, $U/T < 1.0$ is satisfied.

11. The air conditioner (100) according to any one of claims 1 to 10, wherein the rear heat exchanger (107b) includes a fin (107c), and a heat transfer tube (107d) penetrating through the fin (107c), and an outer diameter (Dt) of the heat transfer tube (107d) satisfies $Dt \leq 5$ mm.

FIG. 1



101
100
107
107d
107b
103
106
107a
107c
105b
104
106a
105a
105
102

FIG. 2

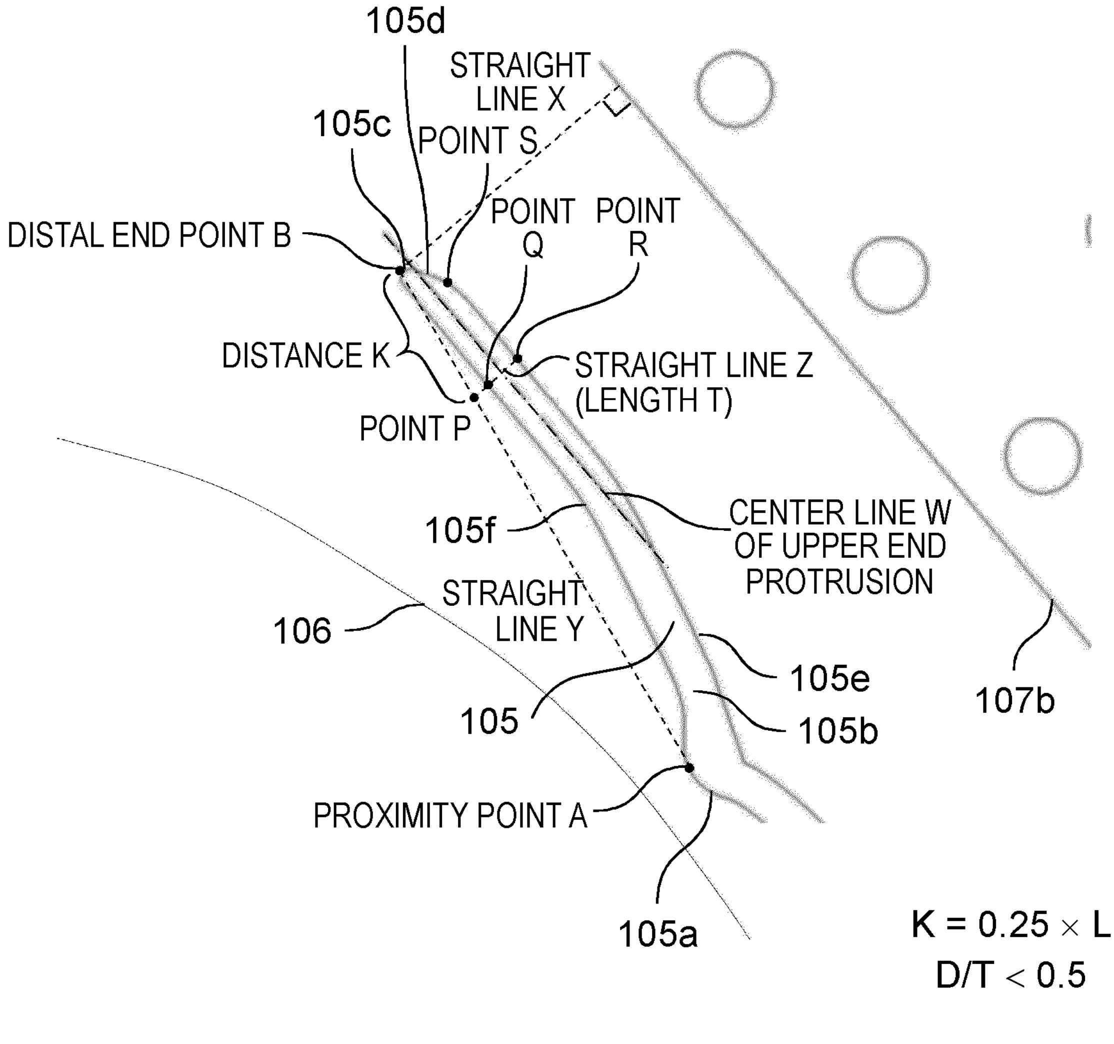

105d
STRAIGHT LINE X
105c
POINT S
POINT Q
POINT R
DISTAL END POINT B
DISTANCE K
STRAIGHT LINE Z (LENGTH T)
POINT P
CENTER LINE W OF UPPER END PROTRUSION
105f
STRAIGHT LINE Y
106
105e
105
105b
107b
PROXIMITY POINT A
105a
K = 0.25 × L
D/T < 0.5

FIG. 3

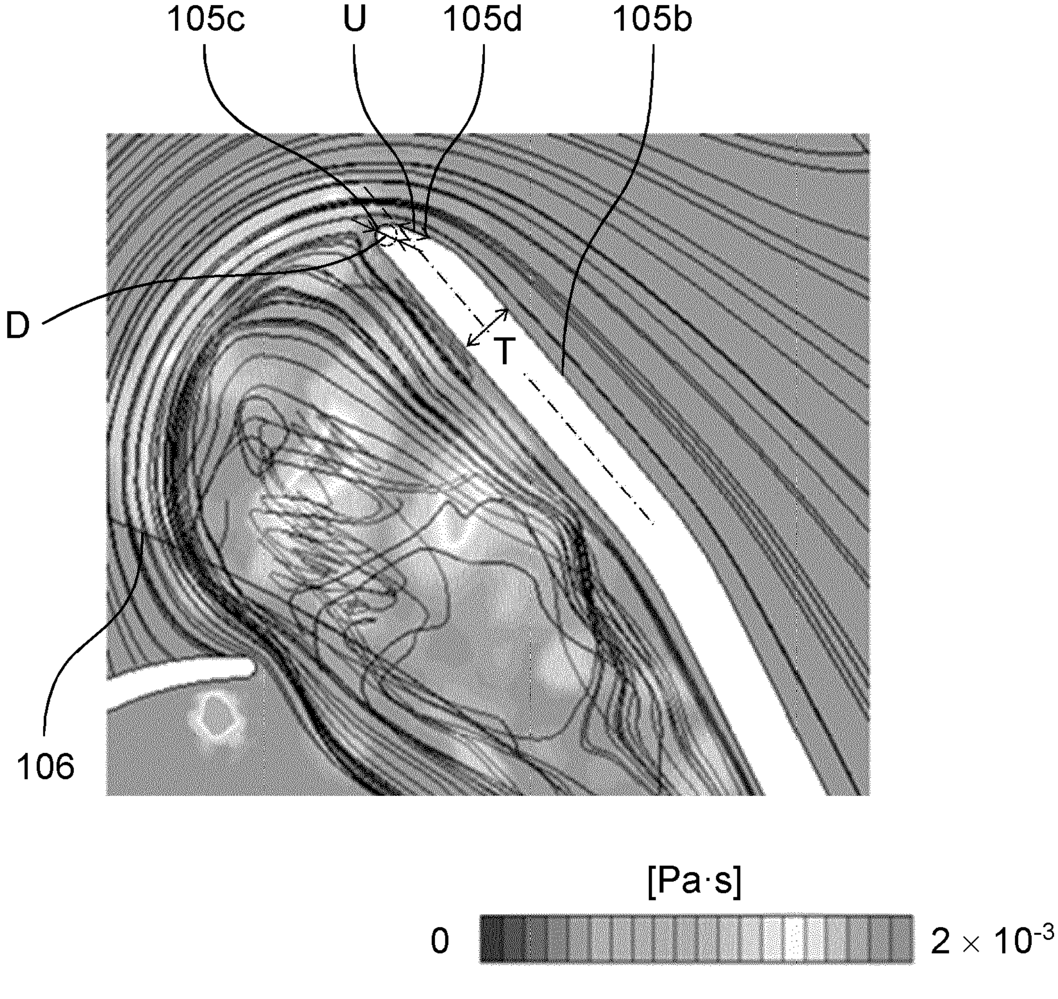


FIG. 4A

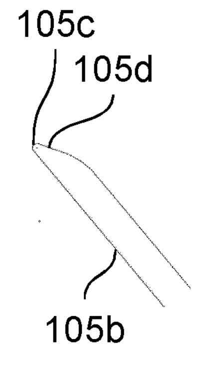
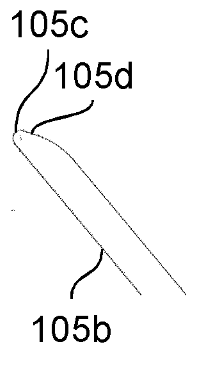
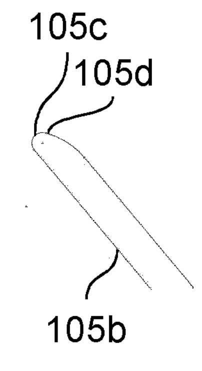
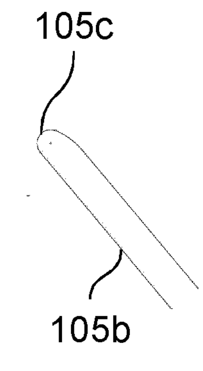
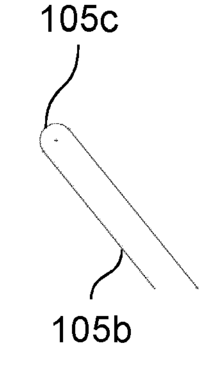
D/T	0.27	0.45	0.64	0.82	1.0
AIR VOLUME RATIO	101.7	101.5	101.5	100.8	100.0
SHAPE					

FIG. 4B

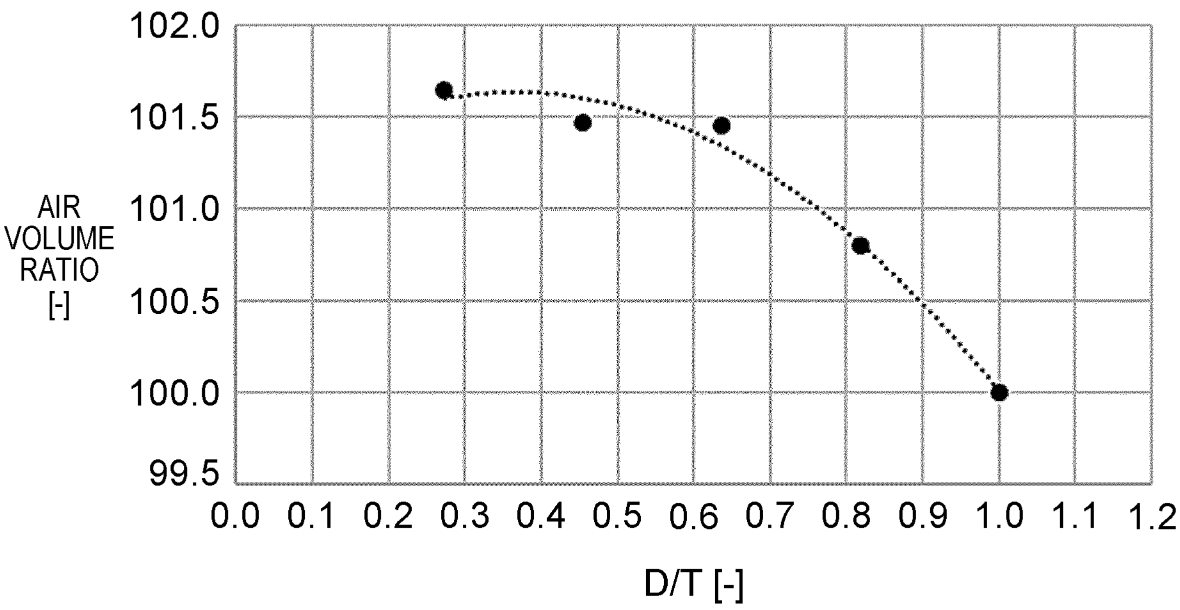


FIG. 5A

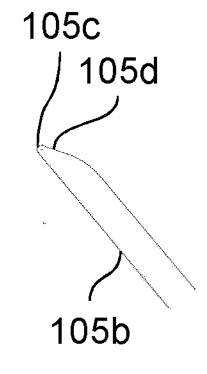
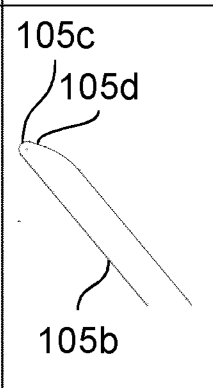
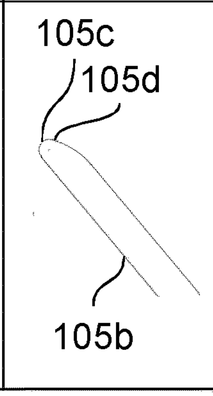
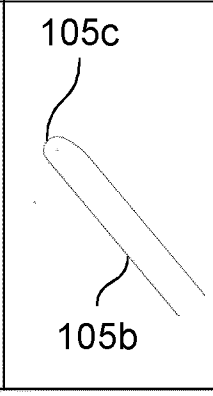
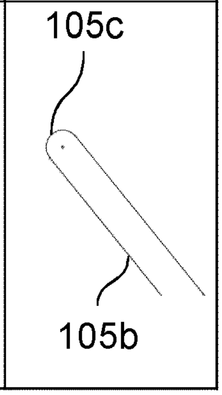
D/T	0.27	0.45	0.64	0.82	1.0
INPUT RATIO	98.6	99.3	99.8	99.7	100.0
SHAPE					

FIG. 5B

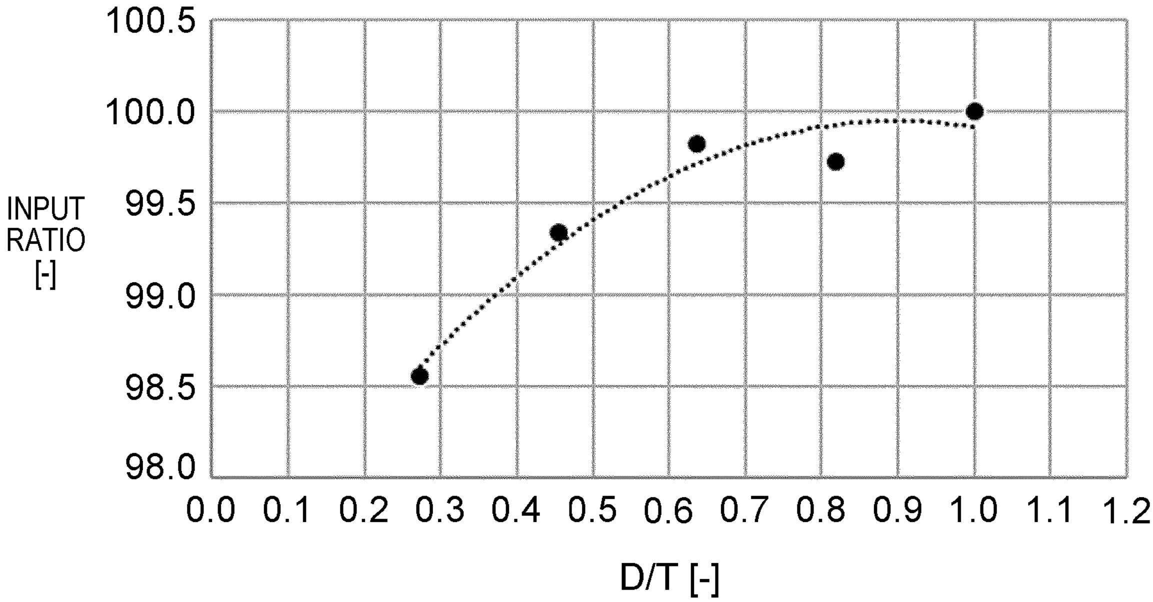


FIG. 6

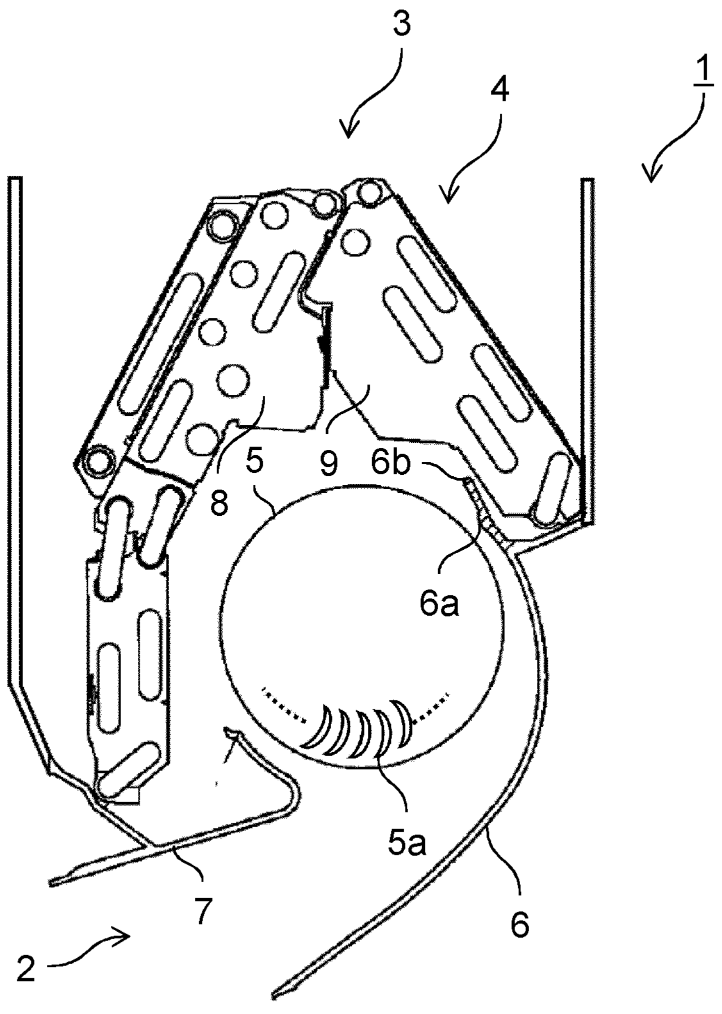


FIG. 7

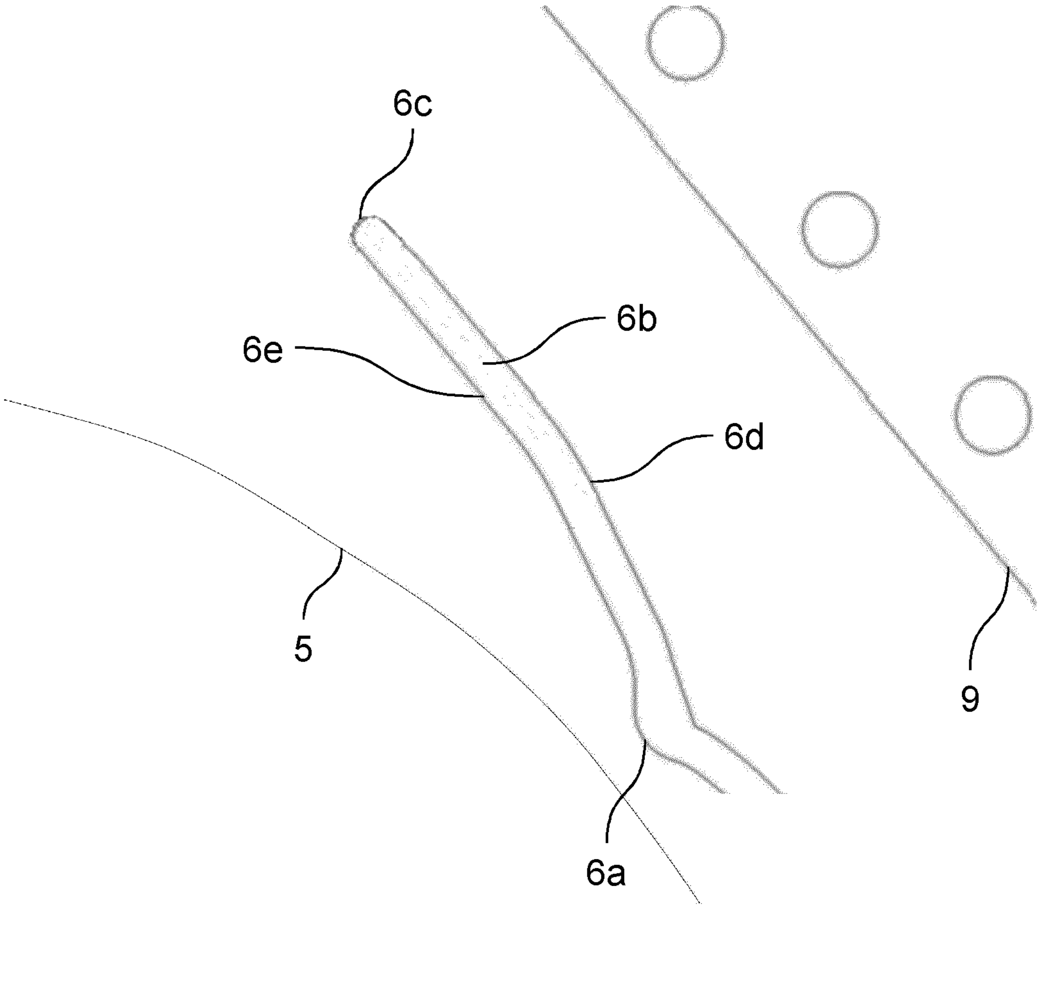
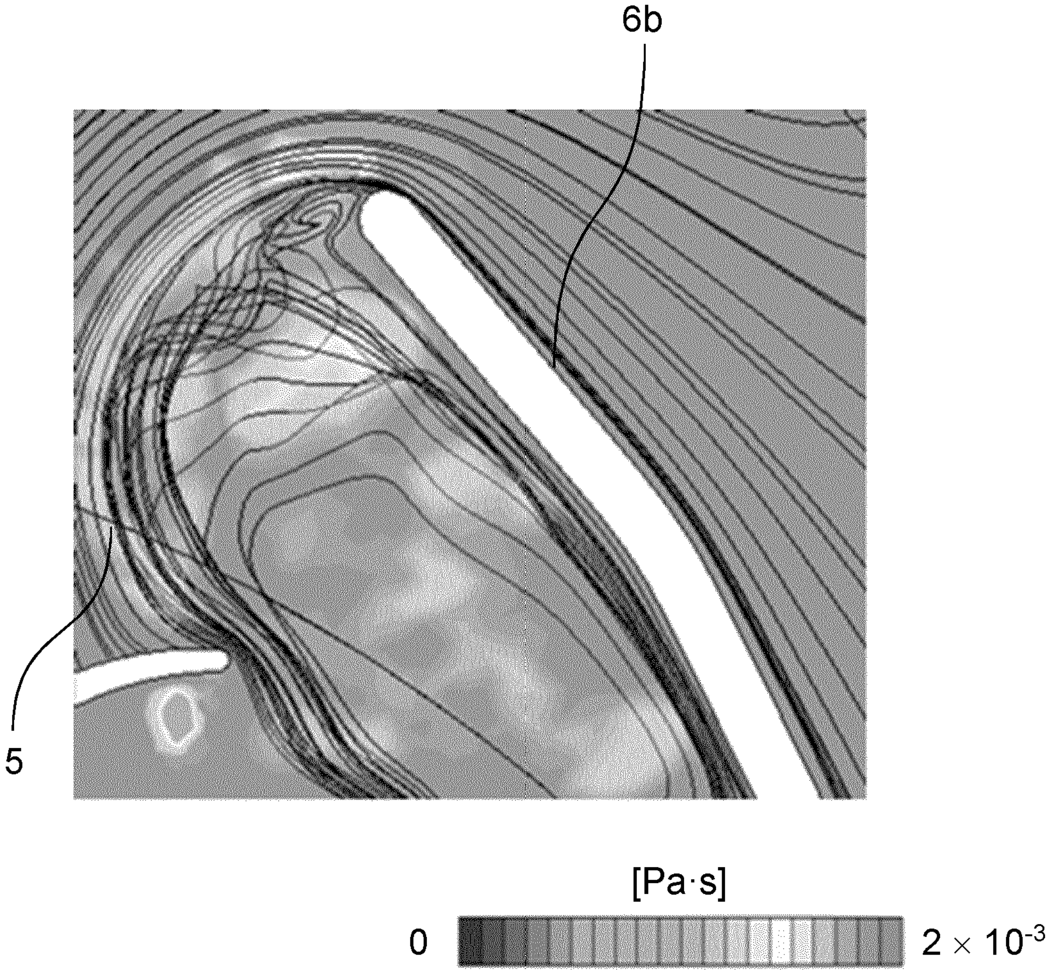


FIG. 8



REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2001124362 A **[0004]**