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(54) DRAINAGE PUMP

(57) [Object] Provided is a drainage pump which achieves a further improvement in quietness during an operation.

[Solving Means] A rotating blade (50) used in a drainage pump (1) includes: large-diameter blades (60) provided with paddle surfaces (61) formed in a plurality of plate shapes extending in a radial direction from a shaft portion (52) connected to an output shaft of a motor; a plurality of plate-shaped small-diameter blades (54) connected to lower end edge portions of the large-diameter blades (60); and auxiliary blades (70) which are provided with paddle surfaces (71) and are provided between the adjacent large-diameter blades (60). Hitherto, water scraped by the paddle surfaces (61) and (71) of the large-diameter blades (60) and the auxiliary blades (70) becomes a water flow in a yz direction by an upper edge portion (62) and a water flow in an xy direction by a side edge portion (63), and the water flows collide with each other at rear surfaces of the paddle surfaces, generate turbulence, and cause noise. However, the water flows can be suppressed to become water flows in the xy direction by a water flow direction regulation portion (101), and the generation of turbulence is suppressed by the collision of the water flows. Therefore, the generation of noise can be prevented.

FIG. 1A

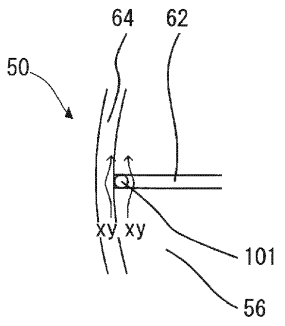

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FIG. 1B

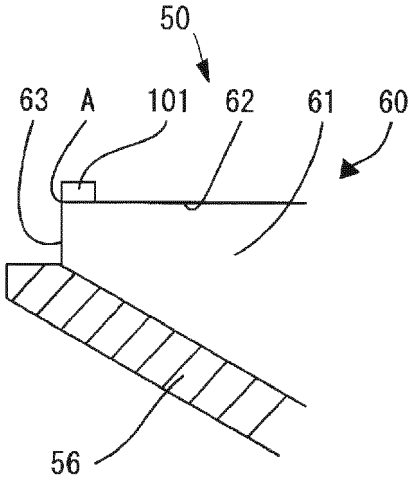
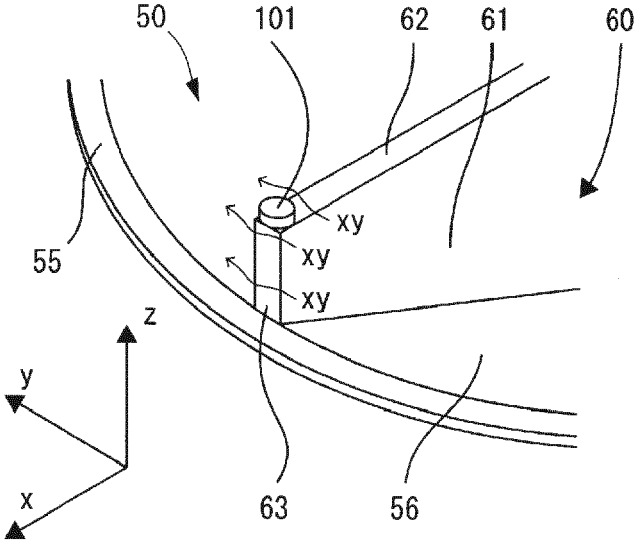


FIG. 1C



Description

TECHNICAL FIELD

[0001] The present invention relates to a drainage pump, particularly relates to a drainage pump which is appropriate for draining drain water from a drain pan that receives water condensed at an indoor heat exchanger of an air conditioner, and particularly provides a drainage pump with high quietness.

BACKGROUND ART

[0002] Hitherto, in a type of air conditioner embedded in an indoor ceiling, a drain pan which receives drain water condensed on the surface of an indoor heat exchanger of the air conditioner is provided. In order to drain the drain water from the drain pan to the outside, a drainage pump (drain pump) is used.

[0003] Hereinafter, a drainage pump which is used in an air conditioner applied and published by the applicant will be described as the background art. Fig. 5 is a partially cutaway front view of a section of a drainage pump in the related art, Fig. 6A is a plan view of an example of a rotating blade used in the drainage pump illustrated in Fig. 5, and Fig. 6B is a front view of the rotating blade illustrated in Fig. 6A. In addition, Fig. 7 is an enlarged view of main portions of the rotating blade illustrated in Fig. 6, Fig. 7A is a plan view, Fig. 7B is a longitudinal sectional front view, and Fig. 7C is a perspective view viewed obliquely from above. In the specification, the terms "upper side or upward", "lower side or downward", "inside or inward", "outside or outward", and the like are relative to the positional relationship based on the directions of xyz coordinate axes shown in Fig. 7C and the rotating shaft of the rotating blade for ease of understanding the description and do not mean absolute directions. That is, "upper side or upward" and "lower side or downward" mean upward and downward along the z coordinate axis of Fig. 7C, and "inside or inward" and "outside or outward" mean a rightward direction and a leftward direction of Fig. 7C along the x coordinate axis of Fig. 7C. Water flows are indicated by arrows xy, yz, and the like, and a side directed by the arrow is used as a downstream side, and the side opposite thereto is used as an upstream side.

[0004] The drainage pump of which the entirety is denoted by reference numeral 1 includes a motor 10, and a pump body 30 which is attached to the motor 10 via a bracket 20. The pump body 30 is made of plastic, and includes a housing 40 which has an upper opening, and a cover 32 which covers the upper opening of the housing 40. The housing 40 includes a pipe-shaped suction port (admission port) 42 having an opening 43 at the lower end portion, a pump chamber 44 formed inside the housing 40, and a discharge port 46 which protrudes toward a side. The cover 32 is formed integrally with the bracket 20 and is connected to the housing 40 in a state of having a seal member 34 interposed between the housing 40 and the cover 32.

[0005] In the pump chamber 44 of the housing 40, a rotating blade (impeller blade) 50 which is rotated by the motor 10 is accommodated. The rotating blade 50 includes a shaft portion 52, a plurality of (in the illustrated example, four) flat plate-shaped large-diameter blades (large blades) 60 which extend radially from the outer circumferential portion of the shaft portion 52, and a plurality of (four, which is the same as that of the large-diameter blades 60) flat plate-shaped small-diameter blades (small blades) 54 which are respectively connected to the lower end edge portions of the large-diameter blades 60 and are inserted into the suction port 42.

[0006] The shaft portion 52 penetrates through a through-hole 36 formed at the center of the cover 32 and protrudes toward the motor 10 side, and a driving shaft (motor shaft) 12 of the motor 10 is inserted into and fixed to a hole 53 provided along the center axis of the shaft portion 52. A drain disc 14 is attached to the upper surface of the shaft portion 52, and the drain disc 14 prevents drain water from scattering toward the motor 10 side even when the drain water is ejected from the through-hole 36 of the cover 32.

[0007] The lower end edge portions of the large-diameter blades 60 are formed in a tapered shape that is inclined downward toward the inner diameter side, and the lower end edge portions are connected by a disk-shaped annular member (annular slope) 56 having an opening 57 at the center. In addition, each of (in an example illustrated in Fig. 6A, four) auxiliary blades (additional blades) 70 is provided upright on the annular member 56 between the adjacent large-diameter blades 60 and 60, and the lift of the pump can be secured by the auxiliary blades 70 and the large-diameter blades 60. The outside edge portions of the large-diameter blades 60 and the auxiliary blades 70 are connected by an annular flat surface 55. The position of the upper end edge portion of the annular flat surface 55 is lower than the positions of the upper end edge portions of the large-diameter blade 60 and the auxiliary blade 70.

[0008] The drainage pump 1 is appropriately installed such that the suction port 42 is positioned on the lower side than the surface of drain water collected in a drain pan, which is not illustrated. In addition, when the rotating blade 50 is rotated (for example, in an arrow R direction (Fig. 6A) by driving the motor 10, the drain water collected in the drain pan is suctioned from the suction port 42 and is discharged to the discharge port 46 via the pump chamber 44.

[0009] In the rotating blade 50 configured as described above, a water flow containing bubbles generated from the inside of the drain water stirred by the rotation of the large-diameter blades 60 and the auxiliary blades 70 smoothly flows over the annular flat surface 55 toward the discharge port 46. Therefore, the collision of bubbles with a bottom surface 35 of the cover 32 is relaxed, resulting in a reduction in noise. In addition, in this config-

uration, when the drainage pump 1 is stopped, water returning from the discharge port 46 to the pump chamber 44 of the housing 40 collides with the annular flat surface 55 and gradually diffuses due to the buffering of the annular flat surface 55. Accordingly, a reduction in noise caused by the returning water can also be achieved.

[0010] Such a drainage pump is disclosed, for example, in Patent Document 1.

CITATION LIST

PATENT DOCUMENT

[0011] Patent Document 1: JP 2002-138992 A

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0012] In the drainage pump of the patent document mentioned above, a certain effect of the drainage pump on quietness is confirmed. However, in the rotating blade of the drainage pump used in the related art, as shown by the water flows indicated by the arrows in Figs. 7A and 7C, in the vicinity of a corner A which is a portion where an upper edge portion 62 and a side edge portion 63 of the rotating blade are connected to each other, the water flow toward the upper side of the rotating blade (flow in the yz direction) and the water flow in an outward direction (flow in the xy direction) are scraped by paddle surfaces (a paddle surface 61 of the large-diameter blade 60 and a paddle surface 71 of the auxiliary blade 70) which are surfaces of the large-diameter blade 60 and the auxiliary blade 70 in the rotational direction, water flows having different vectors collide with each other on surfaces on the side opposite to the paddle surfaces of the rotating blade (that is, on the downstream side interposed between the rotating blades), particularly in the portion where the upper edge portion 62 and the side edge portion 63 of the rotating blade are connected, that is, in the vicinity of the corner. Therefore, turbulent water flows are generated, the surrounding air becomes bubbles and is mixed thereinto, and slight vibration and noise may occur as the bubbles burst. This is similarly applied to the auxiliary blade.

[0013] In recent years, a further improvement in quietness is desired by a space for a living room, and a further improvement in quietness in the drainage pump in the related art is expected.

[0014] The invention has been made taking the foregoing problems into consideration, and an object thereof is to provide a drainage pump which regulates a specific vector direction of water flows scraped by paddle surfaces of a rotating blade and an auxiliary blade to form water flows having the same vector component such that turbulent water flows are suppressed, mixing of bubbles into the water flows is prevented, and quietness is further achieved during an operation.

MEANS FOR SOLVING PROBLEM

[0015] In order to solve the problems, a drainage pump according to the invention includes: a housing in which a lower end portion is provided with a suction port and a side portion is provided with a discharge port; a rotating blade provided in the housing; and a motor which rotates the rotating blade, in which the rotating blade includes a plurality of radial small-diameter blades, and a plurality of large-diameter blades which are formed to be connected to upper sides of the small-diameter blades, auxiliary blades are further included between the plurality of large-diameter blades, each of the large-diameter blades and the auxiliary blades includes a paddle surface, an upper edge portion connected to the paddle surface at an upper edge portion of the paddle surface, and a side edge portion similarly connected to the paddle surface at a side edge portion of the paddle surface, and in the vicinity of a corner which is an outer circumferential end of the upper edge portion and is an upper end of the side edge portion, a water flow direction regulation portion which regulates a water flow having a specific vector of water flows scraped by the paddle surfaces of the rotating blade and the auxiliary blade is formed.

[0016] In the drainage pump according to the invention, the water flow direction regulation portion is formed in a cylindrical shape and is provided in the vicinity of the corner on an outer circumferential side of the upper edge portion.

[0017] In the drainage pump according to the invention, the water flow direction regulation portion is formed in a cylindrical shape and is provided in the vicinity of the corner on an upper end of the side edge portion.

[0018] In the drainage pump according to the invention, the water flow direction regulation portion is formed in a columnar shape with a streamlined shape in which one side of a bottom surface is a small-width portion and the other side thereof is a large-width portion, and is provided in the vicinity of the corner on an outer circumferential side of the upper edge portion.

[0019] In the drainage pump according to the invention, the water flow direction regulation portion is formed in a columnar shape with a streamlined shape in which one side of a bottom surface is a small-width portion and the other side thereof is a large-width portion, is provided on an outer circumferential side of the upper edge portion, and is provided over the entire length of the side edge portion.

EFFECT OF THE INVENTION

[0020] According to the drainage pump of the invention, water scraped by the large-diameter blades collides with the paddle surface of the rotating blade and then becomes relative water flows in two directions toward the upper side and the lateral side of the rotating blade, and the water flows are guided. At the rear surface (that is, downstream side) of the rotating blade, when the water

flow toward the upper side and the water flow toward the lateral side collide with each other, the water flows are regulated to become water flows having a vector in a yz direction, and the vectors of the water flows are aligned with an xy vector direction. Accordingly, the generation of turbulence is suppressed, and mixing of bubbles into the water flows is suppressed. Accordingly, further suppression of the generation of noise is realized.

BRIEF DESCRIPTION OF DRAWINGS

[0021]

Fig. 1 is an enlarged view of main portions illustrating the configuration of a rotating blade used in a drainage pump in a first embodiment of the invention, Fig. 1A is a plan view, Fig. 1B is a sectional view, and Fig. 1C is a perspective view;

Fig. 2 is an enlarged view of main portions illustrating the configuration of a rotating blade used in a drainage pump in a second embodiment of the invention, Fig. 2A is a plan view, Fig. 2B is a sectional view, and Fig. 2C is a perspective view;

Fig. 3 is an enlarged view of main portions illustrating the configuration of a rotating blade used in a drainage pump in a third embodiment of the invention, Fig. 3A is a perspective view, Fig. 3B is a plan view, and Figs. 3C, 3D, and 3E are plan views of other examples;

Fig. 4 is an enlarged perspective view of main portions illustrating the configuration of a rotating blade used in a drainage pump in a fourth embodiment of the invention;

Fig. 5 is a view illustrating an example of a drainage pump in the related art;

Fig. 6 is a view illustrating a rotating blade used in the drainage pump in the related art, Fig. 6A is a plan view, and Fig. 6B is a front view;

Fig. 7 is an enlarged view of main portions of the rotating blade illustrated in Fig. 6, Fig. 7A is a plan view, Fig. 7B is a sectional view, and Fig. 7C is a perspective view; and

Fig. 8 is a view illustrating a rotating blade of a drainage pump of a fifth embodiment of the invention, Fig. 8A is a plan view, Fig. 8B is a front view, and Fig. 8C is a perspective view.

MODE(S) FOR CARRYING OUT THE INVENTION

[0022] Hereinafter, embodiments of a drainage pump according to the invention will be described with reference to the accompanying drawings. Figs. 1 to 4 are views illustrating main portions of a rotating blade of each of the embodiments of the invention, and are views equivalent to Fig. 7. The rotating blade is attached to the output rotating shaft of a motor and is disposed in a pump chamber of a drainage pump as illustrated in Fig. 5. In Figs. 1 to 4, like elements which are common to those of the configuration of the related art are denoted by like reference numerals.

(First Embodiment)

[0023] Fig. 1 is a view illustrating a first embodiment of the rotating blade (large-diameter blade) used in the drainage pump in the invention, Fig. 1A is an enlarged plan view of the main portions of the rotating blade, Fig. 1B is a sectional view illustrating a state of the rotating blade illustrated in Fig. 1A when viewed from an upstream side of a water flow, and Fig. 1C is a perspective view of the rotating blade illustrated in Fig. 1A.

[0024] In a rotating blade 50 of the drainage pump illustrated in Fig. 1, a plurality of large-diameter blades 60 are provided at equal angles for draining drain water from a drain pan, which is not illustrated, and a paddle surface 61 for scraping the drain water flowing over an annular flat surface 55 is formed in the large-diameter blade 60. The paddle surface 61 is one surface of the large-diameter blade 60 in a direction in which the large-diameter blade 60 rotates.

[0025] In addition, in the rotating blade 50, auxiliary blades (not illustrated in Fig. 1) as illustrated in Fig. 6 are disposed at equal intervals between the large-diameter blades 60.

[0026] An upper edge portion 62 which is connected to the paddle surface 61 is formed in the large-diameter blade 60, and a side edge portion 63 is similarly formed to extend from the paddle surface 61. The outer circumferential end of the upper edge portion 62 is connected to the upper end of the side edge portion 63 by a corner A.

[0027] Hereinafter, the configurations of the large-diameter blade 60 will be described in detail, but detailed description of the configurations of the auxiliary blade, which are the same as those of the large-diameter blade 60, will not be repeated.

[0028] As illustrated in Figs. 1A to 1C, a water flow direction regulation portion (a protruding portion of water flow direction regulation) 101 is formed on the outer circumferential side of the upper edge portion 62 of the large-diameter blade 60. The water flow direction regulation portion 101 is formed in a cylindrical shape and stands upright on the upper edge portion 62 to receive water flows at the side surfaces thereof. Since the water flow direction regulation portion 101 is provided, when the rotating blade 50 is rotated to drain the drain water from the drain pan, water scraped by the paddle surface 61 of the large-diameter blade 60 branches off into both sides of the water flow direction regulation portion 101 and flows along the cylindrical surface (the side surface of the cylinder). Accordingly, water flows are not directed in the z-axis direction in Fig. 1C but flow in the xy direction. That is, z-axis components of the vectors of the water flows are suppressed, and in this state, the water flows join at the rear surface (downstream side) of the water flow direction regulation portion 101. Accordingly, at the upper edge portion and the side edge portion of the ro-

tating blade in the related art, that is, in the vicinity of the corner A of the rotating blade, a water flow in the yz direction scraped by the upper edge portion 62 and a water flow in the xy direction scraped by the side edge portion 63 are prevented from three-dimensionally colliding with each other, and so-called two-dimensional water flows limited to the xy direction occur in the vicinity of the corner A. Therefore, variations in the vectors of the water flows are minimized before and after the joint, the generation of turbulence is suppressed, and mixing of bubbles into the water flows is suppressed. Accordingly, further suppression of the generation of noise is realized.

(Second Embodiment)

[0029] Fig. 2 illustrates a rotating blade in a second embodiment of the invention, Fig. 2A is an enlarged plan view of the main portions of the rotating blade, Fig. 2B is a sectional view illustrating a state of the rotating blade illustrated in Fig. 2A when viewed from an upstream side of a water flow, and Fig. 2C is a perspective view of the rotating blade illustrated in Fig. 2A. In the first embodiment, the water flow direction regulation portion 101 is provided on the outer circumferential side of the upper edge portion 62 of the large-diameter blade 60. However, in this embodiment, a water flow direction regulation portion 102 is provided on the upper side of the side edge portion 63 of the large-diameter blade 60. As in the first embodiment, the water flow direction regulation portion 102 is formed in a cylindrical shape, and the vectors of water flows are regulated by the cylindrical surface thereof. The water flows scraped by the paddle surface 61 have vectors in the yz direction in which x-axis components are suppressed, branch off into upper and lower sides of the water flow direction regulation portion 102, and join at the rear surface of the water flow direction regulation portion 102 by the water flow direction regulation portion 102 described above. Even in this configuration, it is possible to minimize variations in the vectors of the water flows in the vicinity of the corner A.

(Third Embodiment)

[0030] Fig. 3A is a perspective view illustrating a rotating blade in a third embodiment of the invention, and Fig. 3B is a plan view of Fig. 3A. Instead of the shape of the water flow direction regulation portion of the first embodiment, a water flow direction regulation portion 103 which is formed as a columnar member in an eggplant shape (that is, streamlined shape) having a small-width portion and a large-width portion at the bottom surface. Accordingly, the water flows can be more smoothly regulated compared to the cylindrical shape of the first embodiment, and the effect of suppressing noise can be enhanced. As illustrated in Figs. 3B to 3E, in the water flow direction regulation portion 103, which one of the large-width portion and the small-width portion is disposed on the upstream side or a tilt at which the large-width portion and the small-width portion are disposed may be appropriately selected.

(Fourth Embodiment)

[0031] Fig. 4(a) is a perspective view illustrating a rotating blade in a fourth embodiment of the invention. In this embodiment, a columnar water flow direction regulation portion 104 in which the entirety of the side edge portion 63 of the large-diameter blade 60 has an eggplant-shaped bottom surface (that is, streamlined bottom surface) is formed integrally with the paddle surface 61. The third embodiment is intended to regulate the vectors of the water flows at the corner A of the large-diameter blade 60 formed by the upper edge portion 62 and the side edge portion 63. However, in this embodiment, the vectors of the water flows on a side lower than the side edge portion 63 can be regulated by the water flow direction regulation portion 104. In this configuration, although the shape becomes complex, higher quietness than that of the third embodiment is realized. As in the third embodiment, in the water flow direction regulation portion 104, which one of the large-width portion and the small-width portion is disposed on the upstream side or a tilt at which the large-width portion and the small-width portion are disposed may be appropriately selected.

[0032] While the embodiments of the invention have been described in detail, the invention is not limited to each of the embodiments described above, and various modifications can be made. For example, regarding the dimensions of the water flow direction regulation portion of each of the embodiments in the height direction thereof, the area or height of the bottom surface of the columnar member may be appropriately changed depending on the size, rotational speed, and the like of the rotating blade. In addition, the cylindrical water flow direction regulation portion 101 illustrated in the first embodiment may be configured to be formed over the entire length of the side edge portion as in the water flow direction regulation portion 104 described in the fourth embodiment.

(Fifth Embodiment)

[0033] Figs. 8A, 8B, and 8C illustrate a rotating blade of a drainage pump of a fifth embodiment of the invention. In the rotating blade 50 of the drainage pump illustrated in Fig. 8, the large-diameter blades 60 which are connected to a plurality of the small-diameter blades 54 for draining drain water from the drain pan are provided, the large-diameter blade 60 is provided with the paddle surface 61 on the front surface in the rotational direction thereof to scrape the drain water flowing over the annular flat surface 55 of a disk-shaped annular member 56, a stepped portion 72 is formed in an upper side end edge portion 77 at the edge portion of the large-diameter blade 60, and a stepped portion 82 is provided in an outside end edge portion 81. Accordingly, upper side end edge portion paddle surfaces 75A and 75B are formed as wall

surfaces that rise from the stepped portion 72 toward the upper side end edge portion 77. In addition, an outside end edge portion paddle surface 85 is formed as a wall surface that rises from the stepped portion 82 in a direction toward the outside end edge portion 81. The outside end edge portion 81 is provided with a water flow direction regulation portion 100 which is slightly higher in height than the large-diameter blade 60.

[0034] In addition, in the fifth embodiment, not only the large-diameter blade 60, but also an auxiliary blade 70 is provided with a paddle surface 71 on the front surface in the rotational direction thereof, an upper side end edge portion 73 is provided with a stepped portion 74, and an outside end edge portion is provided with a stepped portion 84. In addition, an upper side end edge portion paddle surface 76 is formed as a wall surface that rises from the stepped portion 74 toward the upper side end edge portion 73, and an outside end edge portion paddle surface 86 is formed as a wall surface that rises from the stepped portion 84 in a direction toward the outside end edge portion 83. Similar to the outside end edge portion 81 of the large-diameter blade 60, the outside end edge portion 83 is provided with the water flow direction regulation portion 100 which is slightly higher in height than the auxiliary blade 70.

[0035] In the fifth embodiment, the stepped portions 72 and 74 are formed over the entire lengths of the upper side end edge portions 77 and 73 of each of the large-diameter blades 60 and each of the auxiliary blades 70. Accordingly, the stepped portions 72 and 74 cause a splash of the water flows of the drain water upwards and exhibit an action of guiding the splash to the outward upper sides of each of the large-diameter blades 60 and the auxiliary blades 70. The stepped portions 82 and 84 are formed over the entire lengths of the outside end edge portions 81 and 83 of each of the large-diameter blades 60 and each of the auxiliary blades 70. Accordingly, the stepped portions 82 and 84 cause a splash of the water flows of the drain water outward and exhibit an action of guiding the splash to the outside of each of the large-diameter blades 60 and the auxiliary blades 70.

[0036] In the drainage pump of the fifth embodiment of the invention, in addition to the effects of the water flow direction regulation portions described in the other embodiments on quietness, water scraped by the large-diameter blade collides with the paddle surface of the rotating blade and thereafter becomes water flows relative to the rotating blade, and the water flows are guided by the upper side end edge portion paddle surface and the outside end edge portion paddle surface. In addition, the incident direction of the water flowing toward the upper side end edge portion paddle surface and the outside end edge portion paddle surface and the incident angle of the water flowing toward the paddle surface of the rotating blade can be substantially at the same angle. Accordingly, the relative water flows in the front and rear of the guide portions formed in the stepped shapes of the rotating blade become uniform, and the generation of turbulence is suppressed, and mixing of bubbles into the water flows is suppressed. Accordingly, the generation of noise can be further suppressed. Furthermore, at this time, by forming the paddle surface of the large-diameter blade and the upper side end edge portion paddle surface or the outside end edge portion paddle surface into continuous curves having predetermined curvatures, more uniform relative water flows can be achieved. As described above, in the drainage pump of the fifth embodiment, an effect of higher quietness can be achieved.

EXPLANATIONS OF LETTERS OR NUMERALS

[0037]

10 motor
12 driving shaft (motor shaft)
40 housing
42 suction port (admission port)
46 discharge port
50 rotating blade (impeller blade)
52 shaft portion
54 small-diameter blade (small blade)
55 annular flat surface
56 annular member (annular slope)
60 large-diameter blade (large blade)
61 paddle surface (large-diameter blade)
62 upper edge portion (large-diameter blade)
63 side edge portion (large-diameter blade)
A corner (large-diameter blade)
70 auxiliary blade (additional blade)
71 paddle surface (auxiliary blade)
100, 101 to 104 water flow direction regulation portion (protruding portion of water flow direction regulation)

Claims

1. A drainage pump comprising:

a housing in which a lower end portion is provided with a suction port and a side portion is provided with a discharge port;
a rotating blade provided in the housing; and
a motor which rotates the rotating blade,
wherein the rotating blade includes a plurality of radial small-diameter blades, and a plurality of large-diameter blades which are formed to be connected to upper sides of the small-diameter blades,
auxiliary blades are further included between the plurality of large-diameter blades,
each of the large-diameter blades and the auxiliary blades includes a paddle surface, an upper edge portion connected to the paddle surface, and a side edge portion similarly connected to the paddle surface, and

in the vicinity of a corner which is an outer circumferential end of the upper edge portion and is an upper end of the side edge portion, a water flow direction regulation portion is formed.

2. The drainage pump according to claim 1, wherein the water flow direction regulation portion is formed in a cylindrical shape and is provided on an outer circumferential side of the upper edge portion.

3. The drainage pump according to claim 1, wherein the water flow direction regulation portion is formed in a cylindrical shape and is provided on an upper end of the side edge portion.

4. The drainage pump according to claim 1, wherein the water flow direction regulation portion is formed in a columnar shape with a streamlined shape having a small-width portion and a large-width portion at a bottom surface, and is provided on an outer circumferential side of the upper edge portion.

5. The drainage pump according to claim 1, wherein the water flow direction regulation portion is formed in a columnar shape with a streamlined shape having a small-width portion and a large-width portion at a bottom surface, is provided on an outer circumferential side of the upper edge portion, and is provided over the entire length of the side edge portion.

FIG. 1A

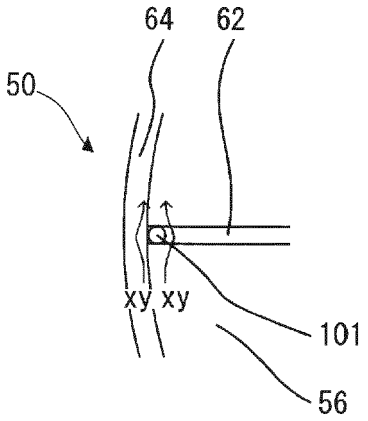


FIG. 1B

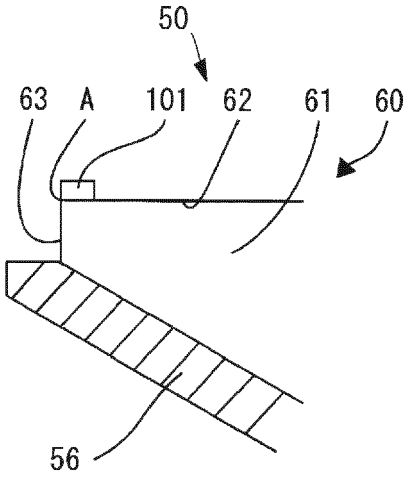


FIG. 1C

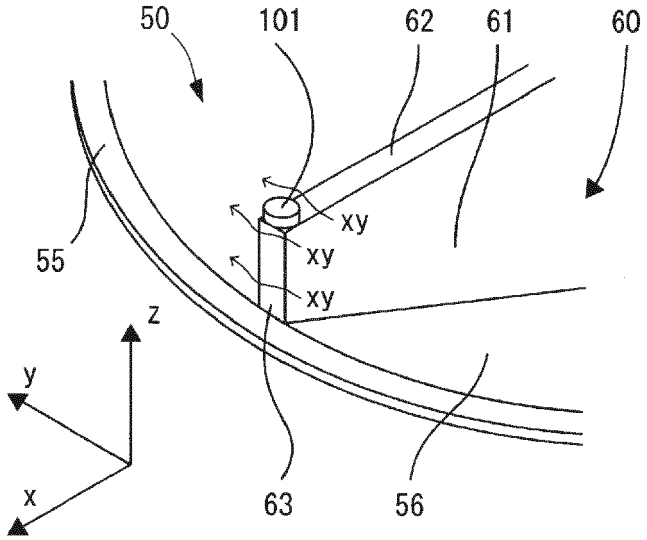


FIG. 2A

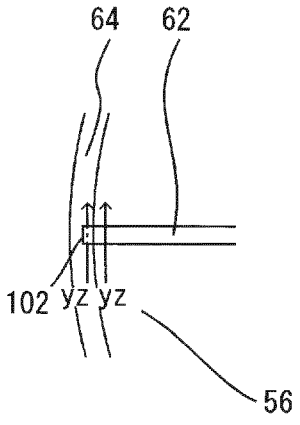


FIG. 2B

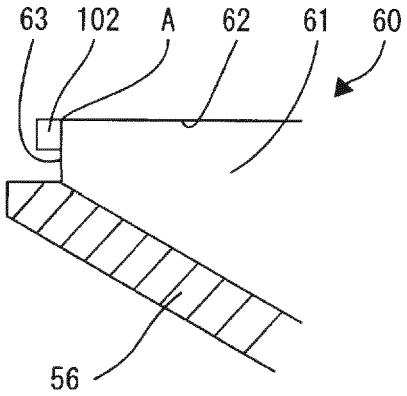


FIG. 2C

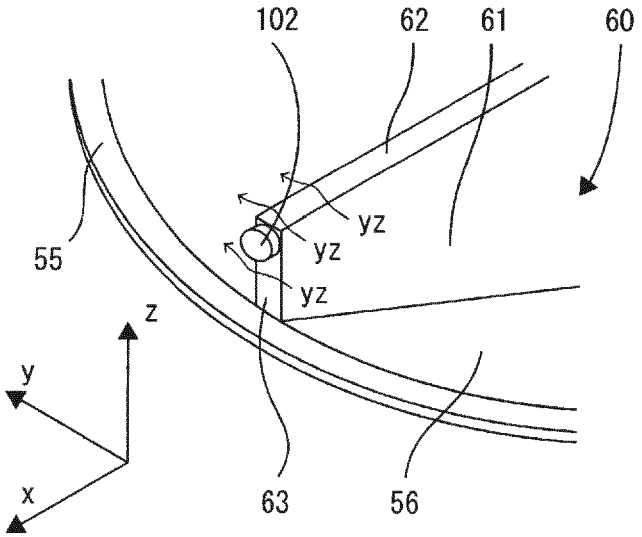


FIG. 3A

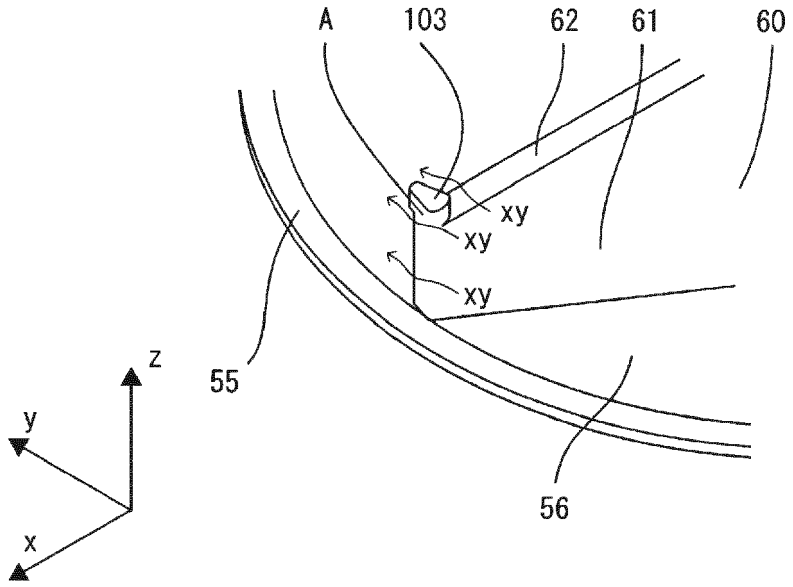


FIG. 3B

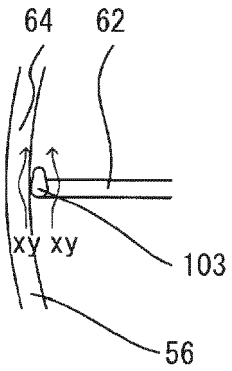


FIG. 3C

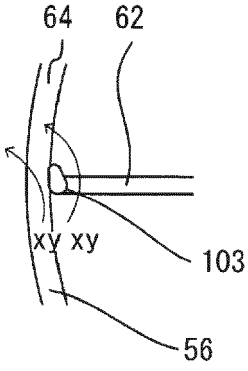


FIG. 3D

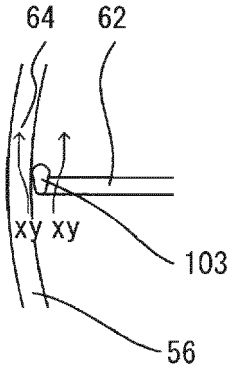


FIG. 3E

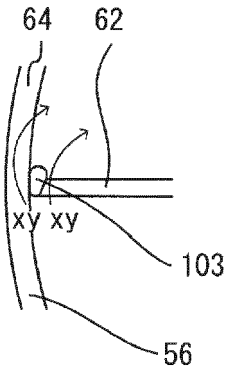
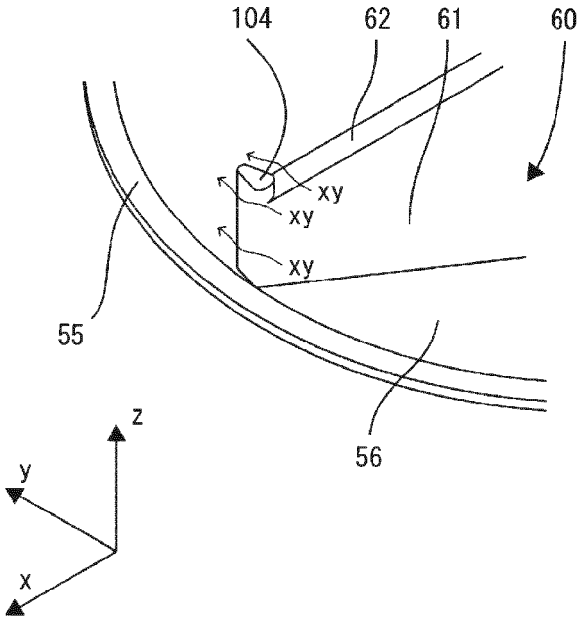


FIG. 4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xy
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z
y
x

FIG. 5

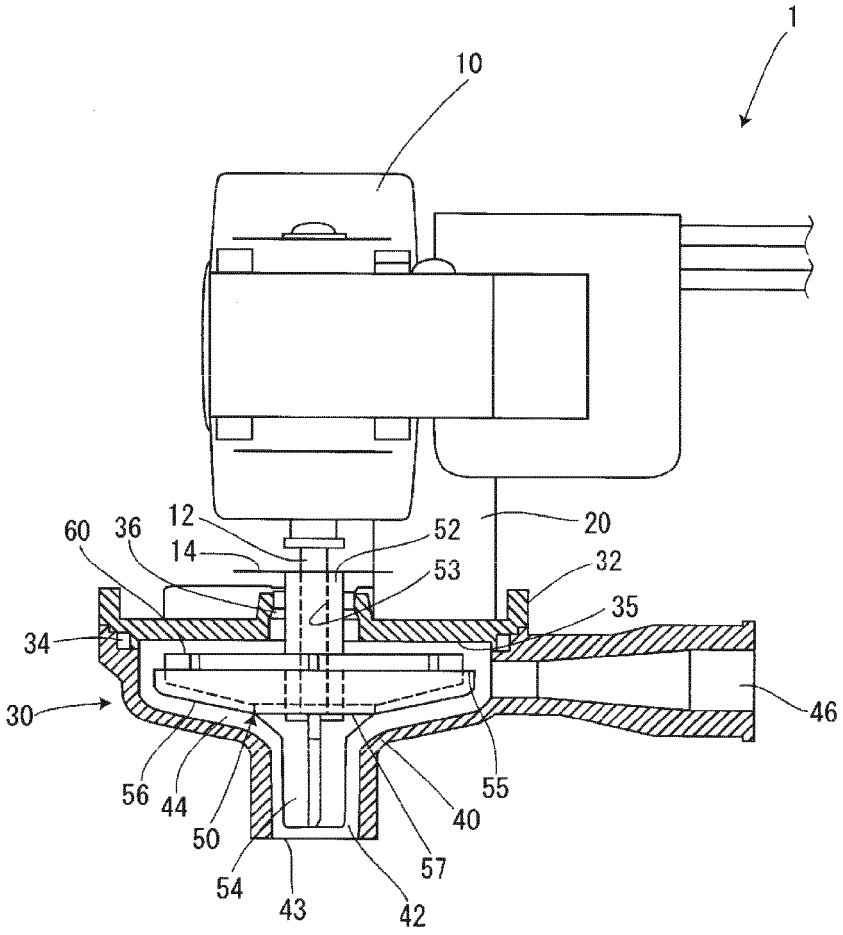
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FIG. 6A

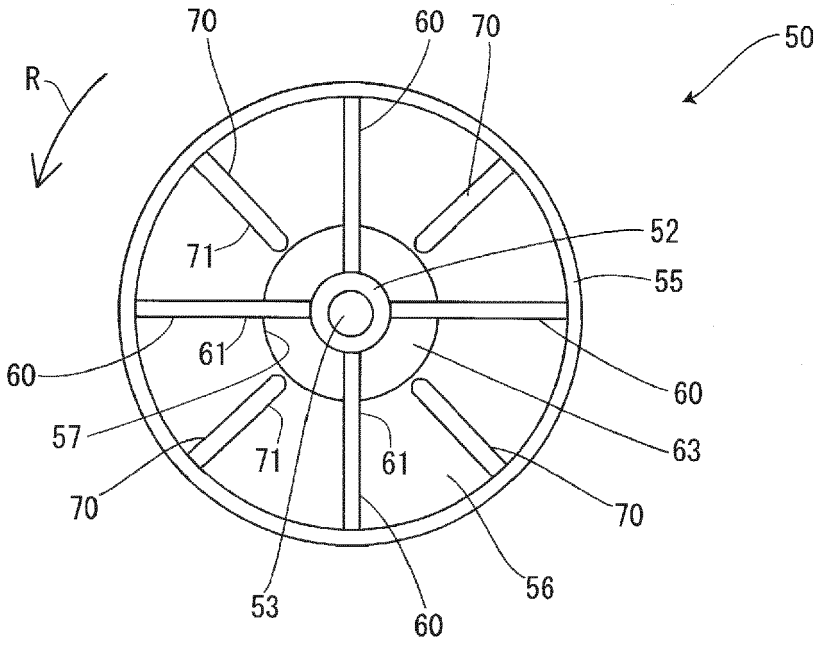
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FIG. 6B

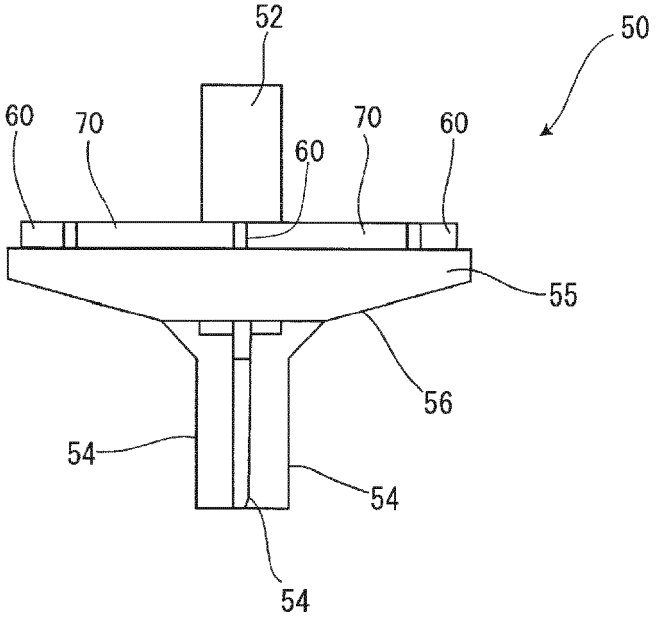
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FIG. 7A

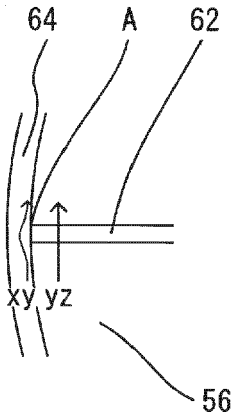


FIG. 7B

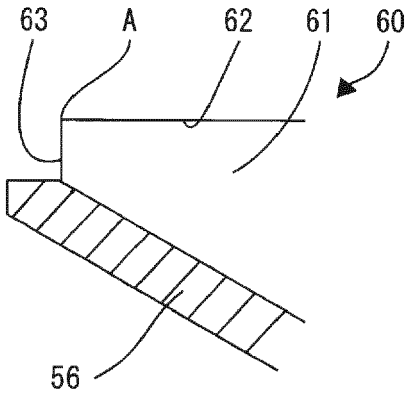


FIG. 7C

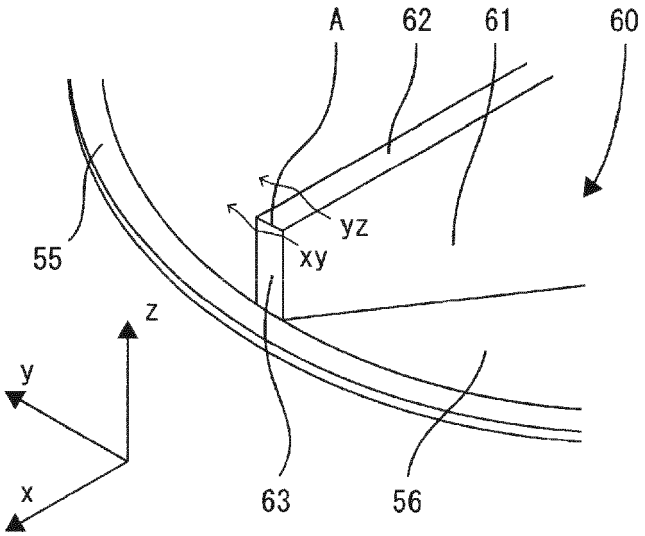


FIG. 8A

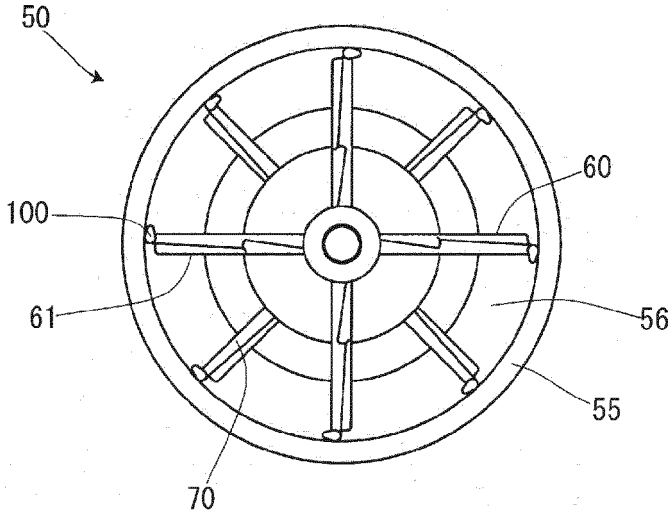


FIG. 8B

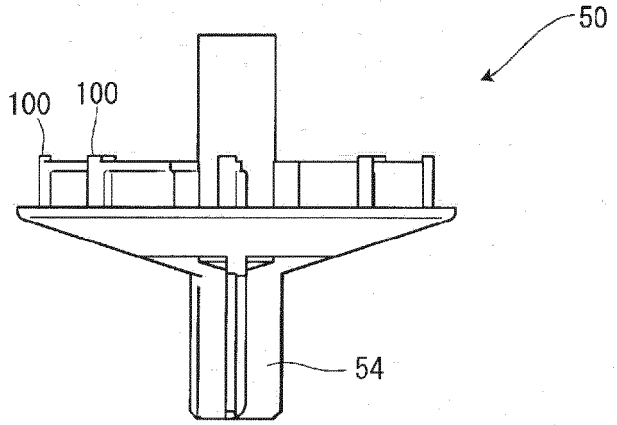
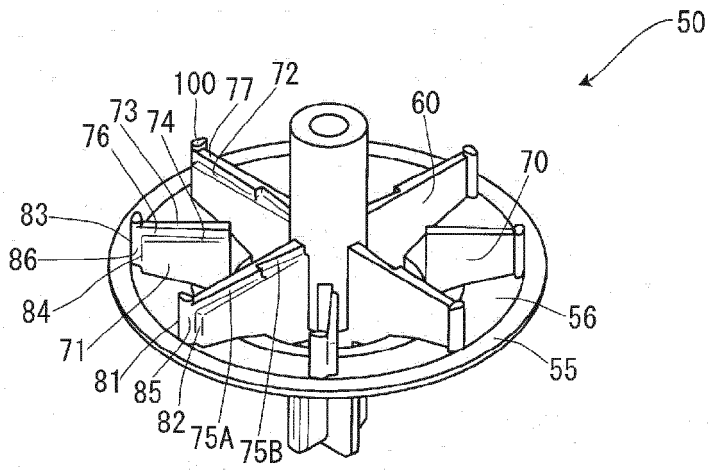


FIG. 8C



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EUROPEAN SEARCH REPORT

Application Number
EP 16 18 8691

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2011 069257 A (FUJI KOKI KK) 7 April 2011 (2011-04-07) * abstract; figures 1, 2, 3c, 4 * -----	1-5	INV. F04D29/24 F04D29/66
X	EP 1 617 084 A1 (FUJIKOKI CORP [JP]) 18 January 2006 (2006-01-18) * abstract; figures 1,3a * -----	1-5	
A	EP 0 836 010 A1 (FUJIKOKI CORP [JP]) 15 April 1998 (1998-04-15) * abstract; figure 2 * -----	1	
A	US 2011/008153 A1 (KACHEUSI S; KATO T; KATO Y; KATSUJI S; KENJI K; KENJI Y; NEMOTO S; SAT) 13 January 2011 (2011-01-13) * abstract; figure 9 * -----	1	

TECHNICAL FIELDS SEARCHED (IPC)

F04D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 March 2017	de Martino, Marcello

CATEGORY OF CITED DOCUMENTS

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08-03-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2011069257 A	07-04-2011	NONE	
EP 1617084 A1	18-01-2006	CN 1757935 A	12-04-2006
		EP 1617084 A1	18-01-2006
		JP 2006029214 A	02-02-2006
		KR 20060050184 A	19-05-2006
		TW I359910 B	11-03-2012
EP 0836010 A1	15-04-1998	CN 1220351 A	23-06-1999
		DE 69723387 D1	14-08-2003
		DE 69723387 T2	22-04-2004
		EP 0836010 A1	15-04-1998
		JP 3910665 B2	25-04-2007
		JP H10115294 A	06-05-1998
		KR 100433506 B1	01-09-2004
		TW 489948 U	01-06-2002
		US 5961283 A	05-10-1999
US 2011008153 A1	13-01-2011	CN 101943181 A	12-01-2011
		EP 2287470 A2	23-02-2011
		KR 20110004298 A	13-01-2011
		TW 201115030 A	01-05-2011
		US 2011008153 A1	13-01-2011

EPO FORM P0459

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Patent documents cited in the description

- JP 2002138992 A **[0011]**