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

(11) **EP 2 314 881 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
27.04.2011 Bulletin 2011/17

(21) Application number: **09770060.3**

(22) Date of filing: **17.06.2009**

(51) Int Cl.:
F04D 29/48 *(2006.01)* ***F04D 13/06*** *(2006.01)*

(86) International application number:
PCT/JP2009/060990

(87) International publication number:
WO 2009/157350 (30.12.2009 Gazette 2009/53)

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

(30) Priority: **26.06.2008 JP 2008167730**

(71) Applicant: **Panasonic Electric Works Co., Ltd.**
Kadoma-shi
Osaka 571-8686 (JP)

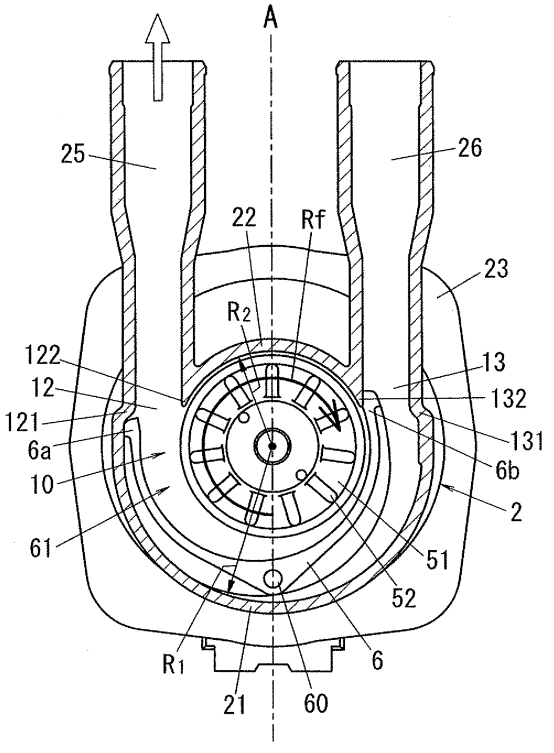
(72) Inventors:
- **TOKUNAGA, Ryohei**
  Kadoma-shi
  Osaka 571-8686 (JP)
- **HIRATA, Masahiro**
  Kadoma-shi
  Osaka 571-8686 (JP)
- **UEDA, Hidetoshi**
  Kadoma-shi
  Osaka 571-8686 (JP)

(74) Representative: **Appelt, Christian W.**
Forrester & Boehmert
Pettenkoferstrasse 20-22
80336 München (DE)

(54) **PUMP**

(57) A pump has a casing, a rotating device and a switch valve. The casing includes an enclosed space, an inlet and first and second outlets. The device includes an impeller. The valve is in the shape of a circular arc. The valve is configured to turn on the pivot so as to: close the second outlet side to form a first volute around the central axis of the impeller inside the valve if a rotation direction of the impeller is a first direction, and also close the first outlet side to form a second volute around the central axis of the impeller inside the valve if a rotation direction of the impeller is a second direction. The first volute becomes gradually wider from the second outlet to the first outlet. The second volute becomes gradually wider from the first outlet to the second outlet.

FIG. 4



EP 2 314 881 A1

Description

TECHNICAL FIELD

[0001] The invention relates generally to pumps and, more particularly, to a volute pump configured to select one of first and second outlets to drain a fluid (e.g., liquid, gas, etc.) through the selected one.

BACKGROUND ART

[0002] For example, Japanese Patent Application Publication No. H10-141287 published on May 26, 1998 discloses a heated water circulating pump. This pump includes a casing (a pump housing), an impeller and a switch valve (a plate). The casing has a circular enclosed space, an inlet and first and second outlets. The impeller is put in the casing and configured to rotate around a central axis in first and second directions. The inlet is formed in front of the center of the impeller so that water can enter the enclosed space through the inlet. The casing further includes first and second exhaust channels (first and second pipes) that are extended continuously from the first and second outlets, respectively. The switch valve is located at the first and second outlets adjacent to the enclosed space within the casing. The switch valve is also configured: to turn on a pivot to drain the water in the enclosed space through the first outlet and the first exhaust channel, by force of water generated with the impeller rotating in the first direction; and also to turn on the pivot to drain the water in the enclosed space through the second outlet and the second exhaust channel, by force of water generated with the impeller rotating in the second direction.

[0003] In this pump, if the impeller rotates in the first direction, the switch valve turns on the pivot so as to open and close the first and second outlets in the first and second exhaust channels, respectively, by the force of the water flowing in the first direction. Thereby, the water in the enclosed space flows out through the first outlet and the first exhaust channel from a flow channel around the central axis of the impeller. Similarly, if the impeller rotates in the second direction, the water in the enclosed space flows out through the second outlet and the second exhaust channel from the invariable flow channel around the central axis of the impeller. The flow channel has a constant width around the central axis, but if two different volutes becoming gradually wider toward the first and second outlets can be formed around the central axis, the pump can have higher liquid-carrying performance, because the pressure of the liquid (water) can be smoothly increased. However, in the configuration, it is difficult to form such two different volutes around the central axis of the impeller.

[0004] Japanese Patent Application Publication No. 2003-003995 published on January 8, 2003 discloses a pump. In this pump, a switch valve turns on a pivot by force of the liquid generated with an impeller rotating in a first direction, and then a first volute is formed around a central axis of the impeller. The first volute becomes gradually wider from the root of a first exhaust channel to the side of the root of a second exhaust channel. However, when the impeller rotates in a second direction, a second volute becoming gradually narrower from the side of the root of the second exhaust channel to the root of the first exhaust channel is formed around the central axis. Because of this, when the impeller rotates in the second direction, the pump cannot have higher liquid-carrying performance.

DISCLOSURE OF THE INVENTION

[0005] It is an object of the present invention to have higher fluid-carrying performance even if an impeller rotates in any of first and second directions.

[0006] A pump of the present invention comprises a casing, a rotating device and a switch valve. The casing comprises an enclosed space, an inlet and first and second outlets. The casing is configured so that a fluid can enter the enclosed space through the inlet and the fluid in the enclosed space can flow out through the first and second outlets. The rotating device includes an impeller which has a central axis and is put in the enclosed space. The rotating device is configured to rotate the impeller around the central axis in first and second directions. The switch valve has a pivot and is put in the casing. The switch valve is also configured to turn on the pivot so that the fluid in the enclosed space can: flow out through the first outlet if a rotation direction of the impeller is the first direction; and also flow out through the second outlet if a rotation direction of the impeller is the second direction. In an aspect of the invention, the switch valve is in the shape of a circular arc as seen from a side of the switch valve. The switch valve is further configured to turn on the pivot so as to: close the side of the second outlet to form a first volute around the central axis of the impeller inside the switch valve if a rotation direction of the impeller is the first direction; and also close the side of the first outlet to form a second volute around the central axis of the impeller inside the switch valve if a rotation direction of the impeller is the second direction. The first volute becomes gradually wider from the second outlet to the first outlet. The second volute becomes gradually wider from the first outlet to the second outlet.

[0007] In this invention, even if the impeller rotates in any of the first and second directions, a volute becoming gradually wider to an opened outlet can be formed. Therefore, the present invention can have higher fluid-carrying performance even if the impeller rotates in any of the first and second directions.

[0008] Preferably, the pump further comprises: an intake channel extended from the inlet; and first and second exhaust channels extended from the first and second outlets, respectively. The switch valve is put in the enclosed space. The switch valve is configured to turn on the pivot by force of the fluid in the enclosed space generated with

the impeller rotating in the first direction so as to close the side of the second outlet to form the first volute around the central axis of the impeller inside the switch valve and to drain the fluid in the enclosed space through the first volute, the first outlet and the first exhaust channel. The switch valve is also configured to turn on the pivot by force of the fluid in the enclosed space generated with the impeller rotating in the second direction so as to close the side of the first outlet to form the second volute around the central axis of the impeller inside the switch valve and to drain the fluid in the enclosed space through the second volute, the second outlet and the second exhaust channel.

[0009] In an embodiment, the pump is symmetry with respect to a line. The pump is configured so that: the center on the central axis of the impeller and the pivot of the switch valve are located on said line; the impeller and the casing are equally divided by said line; the first and second exhaust channels are located at both sides of said line; and the first and second volutes are symmetry with respect to said line In this embodiment, the pump can have the same performance as a one·way volute pump.

[0010] Preferably, the central axis of the impeller and the pivot of the switch valve are arranged so that the central axis exists between the first and second outlets and the pivot.

[0011] In an embodiment, the switch valve is put in the casing so that a part of outer circumference of the switch valve makes contact with the inner face of the casing. In addition, the switch valve further comprises a recess formed on the outer circumference of the switch valve. In this embodiment, even of a foreign substance enters between the outer circumference of the switch valve and an inner face of the casing, the foreign substance can be drawn into the space of the recess. Therefore, it is possible to prevent a foreign substance from obstructing the operation of the switch valve.

[0012] In an embodiment, the switch valve further comprises a projection formed on a side of the switch valve, and is put in the casing so that the projection slides on an inner face of the casing when turning on the pivot. In this embodiment, when the switch valve turns on the pivot, the projection formed on a side of the switch valve slides on an inner face of the casing. Accordingly, dynamic friction between the switch valve and the casing can be reduced, and the switch valve can smoothly turn on the pivot. In addition, even if a foreign substance enters a place between a side of the switch valve and the casing, the foreign substance can be let out from the place. Therefore, it is possible to prevent a foreign substance from obstructing the operation of the switch valve.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Preferred embodiments of the invention will now be described in further details. Other features and advantages of the present invention will become better understood with regard to the following detailed description and accompanying drawings where:

FIG. 1 is a longitudinal sectional view of a pump in accordance with an embodiment of the present invention;
FIG. 2 is a transverse sectional view of the pump;
FIG. 3 is a transverse sectional view of the pump;
FIG. 4 is a transverse sectional view of a pump in an embodiment;
FIG. 5A is a perspective view of a switch valve of the pump in FIG. 4;
FIG. 5B is a side view of the switch valve; and
FIG. 6 is a perspective view of a switch valve of a pump in an embodiment.

BEST MODE FOR CARRYING OUT THE INVENTION

[0014] FIGS. 1-3 show a pump (a volute pump) in accordance with an embodiment of the present invention. This pump includes a casing 1, a rotating device 4 and a switch valve 6, and is characterized by, especially the switch valve 6.

[0015] The casing 1 includes an enclosed space 10, an inlet 11 and first and second outlets 12 and 13, and is configured so that a fluid, e.g., a liquid such as water, etc. can enter the enclosed space 10 through the inlet 11 and the liquid in the enclosed space 10 can flow out through the first and second outlets 12 and 13. In the example of FIG. 1, the casing 1 is formed of first and second cases 2 and 3, which are hereinafter referred to as, e.g., front and rear cases, respectively.

[0016] The front case 2 includes a gibbous shaped base 20, sides 21 and 22, a square flange 23, an intake channel 24, first and second exhaust channels 25 and 26, a plurality of (e.g., three) supporting pieces 27, and a top cap 28. In an example, the intake channel 24 and the first and second exhaust channels 25 and 26 can be attached to and detached from the casing 1.

[0017] The base 20 has the inlet 11 at a position corresponding to the center of the square flange 23. The sides 21 and 22 are formed on the circumference of the base 20. The side 21 is in the shape of a semicircular arc of a circle having a radius "R_1". The center of the circle having the radius "R_1" is on the central axis of an impeller 5 included in the rotating device 4. The side 22 is in the shape of a bow including a circular arc of a circle having a radius "R_2" corresponding to the impeller 5. The first and second outlets 12 and 13 are formed at both ends of the side 22. The center of the circle having the radius "R_2" is on the central axis of an impeller 5, and the radius "R_2" is smaller than the radius "R_1". The flange 23 is an external flange stuck out from the circumference of the tip end of the sides 21 and 22. The intake channel 24 is continuously extended outwards from the circumference of the inlet 11. The first and second exhaust channels 25 and 26 are continuously extended outwards from the circumferences of the first and second outlets 12 and

13, respectively and are parallel to each other. The supporting pieces 27 are continuously extended inwards from the circumference of the inlet 11. The top cap 28 is fixed to the tips of the supporting pieces 27.

[0018] The rear case 3 includes a circular base 30, a cylindrical side 31, a square flange 32 and a bottom cup part 33. The side 31 is formed around the circumference of the base 30. The flange 32 is an external flange stuck out from the circumference of the tip end of the side 31. The bottom cup part 33 is formed of a cylindrical partition stuck out from the inner face of the base 30 toward the top cap 28 of the front case 2. The front and rear cases 2 and 3 constitute the casing 1 by being joined to each other at the circumferences of the flanges 23 and 32, and the space in the front case 2 and the space in the rear case 3 constitute the enclosed space 10.

[0019] The rotating device 4 includes the impeller 5 which has the central axis (an axis of the shaft 43 to be described) and is put in the enclosed space 10, and is configured to rotate the impeller 5 around the central axis in first and second directions. In the example of FIG. 1, the rotating device 4 is formed of permanent magnets 41, a bearing 42, a shaft 43, electromagnets 44, a controller 45 and a housing 40 in addition to the impeller 5.

[0020] The impeller 5 includes a hollow cylinder 50, a flange 51 and a plurality of (11 in the example of FIG. 2 or the like.) vanes 52. The flange 51 is an external flange stuck out from the circumference of the tip end of the cylinder 50. The vanes 52 are formed on the end face of the flange 51, and arranged around the central axis of the impeller 5.

[0021] The permanent magnets 41 are fixed on the outer face of the base of the cylinder 50, and arranged around the central axis of the impeller 5. The bearing 42 is in the shape of a hollow cylinder, and fit into the inside of the base of the cylinder 50. The shaft 43 is inserted into the top cap 28 of the front case 2 and the bottom cap part 33 of the rear case 3, and fixed between the top cap 28 and the bottom cap part 33. In short, the impeller 5 is supported by the shaft 43 inserted into the bearing 42 so that it can rotate around the shaft 43. The electromagnets 44 and the controller 45 are incorporated into the housing 40 which is attached to the back of the rear case 3. Specifically, the housing 40 includes a square base 400 and four sides 401. The electromagnets 44 are incorporated inside the housing 40 so as to be arranged around the permanent magnets 41 through the side 31 of the rear case 3. Each electromagnet 44 is formed of a winding, a core and so on. The controller 45 is incorporated into the base 400 of the housing 40 by insert molding, and is configured to activate the electromagnets 44 to rotate the impeller 5 around the central axis in a first or second direction, in accordance with an input signal from an external device. That is, the electromagnets 44 generate a rotating magnetic field, and attract or repel the permanent magnets 44. Thereby, the impeller 5 rotates around the central axis.

[0022] The switch valve 6 has a pivot 60 and is put in the casing 1. The switch valve 6 is configured to turn on the pivot 60 so that the liquid in the enclosed space 10 can: flow out through the first outlet 12 and the first exhaust channel 25 if a rotation direction of the impeller 5 is the first direction (clockwise) as shown in FIG. 2; and also flow out through the second outlet 13 and the second exhaust channel 26 if a rotation direction of the impeller 5 is the second direction (counterclockwise) as shown in FIG. 3.

[0023] According to an aspect of the present invention, the switch valve 6 is in the shape of a circular arc (a semicircular arc in FIG. 2, etc.) as seen from a side of itself. The switch valve 6 is further configured to turn on the pivot 60 so as to: close the side of the second outlet 13 to form a first volute 61 around the central axis of the impeller 5 inside the switch valve 6 if a rotation direction of the impeller 5 is the first direction; and also close the side of the first outlet 12 to form a second volute 62 around the central axis of the impeller 5 inside the switch valve 6 if a rotation direction of the impeller 5 is the second direction. The first volute 61 becomes gradually wider from the second outlet 13 to the first outlet 12. The second volute 62 becomes gradually wider from the first outlet 12 to the second outlet 13.

[0024] Specifically, the pump is symmetry with respect to a line (see 'A' in FIG. 2, etc.). The center on the central axis of the impeller 5 and the pivot 60 of the switch valve 6 are located on the line (A). The impeller 5 and the casing 1 are equally divided by the line (A). The first and second exhaust channels 25 and 26 are located at both sides of the line (A). The first and second volutes 61 and 62 are symmetry with respect to the line (A). In an example, the pump is approximately symmetry with respect to the line (A).

[0025] The central axis of the impeller 5 and the pivot 60 of the switch valve 6 are arranged so that the central axis exists between the first and second outlets 12 and 13 and the pivot 60. The pivot 60 is a hole into which a pin (not shown) of the casing is inserted, and is formed at the center of the sides of the switch valve 6. The pin is formed on the base 20 of the front case 2 or the flange 32 of the rear case 3 so as to be located in the vicinity of the center of the side 21 of the front case 2.

[0026] The switch valve 6 is put in the casing 1 (the enclosed space 10) so that the whole of the outer circumference of the switch valve 6 faces the inner face of the casing 1 (i.e., the side 21 of the front case 2) and a part of the outer circumference makes contact with the inner face of the side 21 and also the switch valve 6 turns on the pivot 60 by force of the liquid generated when the impeller 5 is rotating. However, not limited to this, the switch valve of the present invention may be rotated with a motor driven based on a rotation direction of the impeller, or the like. The curvature radius of the outer circumference of the switch valve 6 is smaller than that of the inner circumference of the side 21. The length between both ends of the switch valve 6 is approximately equal to the length between the outer end of the first (or second)

outlet 12 (or 13) and the inner end of the second (or first) outlet 13 (or 12). The outer end 121 and the inner end 122 of the first outlet 12 exist outside and inside with respect to the central axis of the impeller 5, respectively. Similarly, the outer end 131 and the inner end 132 of the second outlet 13 exist outside and inside with respect to the central axis of the impeller 5, respectively.

[0027] In short, the switch valve 6 is configured to turn on the pivot 60 by force of the liquid in the enclosed space 10 generated with the impeller 5 rotating in the first direction so as to close the side of the second outlet 13 to form the first volute 61 around the central axis of the impeller 5 inside the switch valve 6 and to drain the liquid in the enclosed space 10 through the first volute 61, the first outlet 12 and the first exhaust channel 25. The switch valve 6 is also configured to turn on the pivot 60 by force of the liquid in the enclosed space 10 generated with the impeller 5 rotating in the second direction so as to close the side of the first outlet 12 to form the second volute 62 around the central axis of the impeller 5 inside the switch valve 6 and to drain the liquid in the enclosed space 10 through the second volute 62, the second outlet 13 and the second exhaust channel 26.

[0028] The operation of the embodiment is explained. As shown in FIG. 2, if receiving an input signal for the first direction (Rf), the controller 45 operates the electromagnets 44 to rotate the impeller 5 around the central axis in the first direction. Thereby, the liquid in the enclosed space 10 is rotated in the first direction with the impeller 5 to generate pressure (force), and a liquid from outside is sucked into the enclosed space 10 through the intake channel 24 and the inlet 11 by the pressure. The switch valve 6 also turns counterclockwise on the pivot 60 by the pressure and closes the side of the second outlet 13 to form the first volute 61 around the central axis of the impeller 5 inside the switch valve 6. In this instance, the side of the first end 6a of the switch valve 6 makes contact with the side of the outer end 121 of the first outlet 12 in the inner face of the side 21. The second end 6b of the switch valve 6 also makes contact with the inner end 132 of the second outlet 13. Thereby, the liquid sucked into the enclosed space 10 through the intake channel 24 is discharged through the first volute 61, the first outlet 12 and the first exhaust channel 25.

[0029] As shown in FIG. 3, if receiving an input signal for the second direction (Rs), the controller 45 operates the electromagnets 44 to rotate the impeller 5 around the central axis in the second direction. Thereby, the liquid in the enclosed space 10 is rotated in the second direction with the impeller 5 to generate pressure (force), and a liquid from outside is sucked into the enclosed space 10 through the intake channel 24 and the inlet 11 by the pressure. The switch valve 6 also turns clockwise on the pivot 60 by the pressure and closes the side of the first outlet 12 to form the second volute 62 around the central axis of the impeller 5 inside the switch valve 6. In this instance, the side of the second end 6b of the switch valve 6 makes contact with the side of the outer end 131 of the second outlet 13 in the inner face of the side 21. The first end 6a of the switch valve 6 also makes contact with the inner end 122 of the first outlet 12. Thereby, the liquid sucked into the enclosed space 10 through the intake channel 24 is discharged through the second volute 62, the second outlet 13 and the second exhaust channel 26.

[0030] Thus, the liquid in the enclosed space 10 is discharged through first or second volute 61 or 62 becoming gradually wider to first or second outlet 12 or 13, and accordingly the pump can have higher fluid (liquid)-carrying performance even if the impeller 5 rotates in any of the first and second directions. Especially, the pump is symmetry with respect to the line (A), and therefore can have the same performance as a one-way volute pump.

[0031] In an embodiment, as shown FIGS. 4, 5A and 5B, the switch valve 6 further includes a recess 64 formed on its own outer circumference. In the example of these figures, four recesses 64 are formed at both sides of two brims 63 which stick out between the center and both ends of the outer circumference of the switch valve 6, respectively and divide the outer circumference of the switch valve 6 in two in the circumferential direction. In each structure of FIGS. 1-3, if a foreign substance enters between the switch valve 6 and the side 21 of the front case 2, the switch valve 6 may be obstructed by the foreign substance and incompletely close the side of first or second outlet 12 or 13. In this embodiment, even if a foreign substance enters between the switch valve 6 and the side 21 of the front case 2, the foreign substance can be drawn into any space (S) of the four recesses 64. Therefore, it is possible to prevent a foreign substance from obstructing the operation of the switch valve 6. In an example, the switch valve 6 does not have all or part of the two brims 63.

[0032] In an example, as shown in FIG. 6, the switch valve 6 further includes a projection 65 formed on a side of the switch valve 6, and is put in the casing 1 so that the projection 65 slides on the inner face of the casing 1. (specifically, the base 20 of the front case 2 and the flange 32 of the rear case 3) when it turns on the pivot 60. In the example of FIG. 6, the switch valve 6 includes projections 65 formed on both sides of the switch valve 6. However, not limited to this, the switch valve of the present invention may have at least one projection only on one side of the switch valve. The projections 65 include, but not limited to, raised strips (ridges) 66 formed on both sides of the switch valve 6, and two circular rims 67 which are formed at centers of both sides of the switch valve 6 and enclose both ends of the pivot 60. Each raised strip 66 is formed along circumference of a circle of which center is located on the central axis of the switch valve 6. In this embodiment, when the switch valve 6 turns on the pivot 60, the projections 65 formed on both sides of the switch valve 6 slide on the inner faces of the casing 1. Accordingly, dynamic friction between the switch valve 6 and the casing 1 can be reduced. The switch valve 6 can smoothly turn on the pivot 60 by force of the liquid

in the enclosed space 10 generated when the impeller 5 is rotating. In addition, even if a foreign substance enters a place between the switch valve 6 and the base 20 of the front case 2 or the flange 32 of the rear case 3, the foreign substance can be let out from the place. Therefore, it is possible to prevent a foreign substance from obstructing the operation of the switch valve 6.

[0033] In an example, instead of the projection 65 formed on a side of the switch valve 6, at least one projection may be formed on an inner face of the casing 1 (the base 20 of the front case 2 and the flange 32 of the rear case 3). The projection may be a projection for point contact (e-.g., a nib).

[0034] Although the present invention has been described with reference to certain preferred embodiments, numerous modifications and variations can be made by those skilled in the art without departing from the true spirit and scope of this invention.

Claims

1. A pump, comprising:

a casing comprising an enclosed space, an inlet and first and second outlets, the casing being configured so that a fluid can enter the enclosed space through the inlet and the fluid in the enclosed space can flow out through the first and second outlets;
a rotating device including an impeller which has a central axis and is put in the enclosed space, the rotating device being configured to rotate the impeller around the central axis in first and second directions; and
a switch valve which has a pivot and is put in the casing,
wherein the switch valve is configured to turn on the pivot so that the fluid in the enclosed space can: flow out through the first outlet if a rotation direction of the impeller is the first direction; and also flow out through the second outlet if a rotation direction of the impeller is the second direction,
wherein the switch valve is in the shape of a circular arc as seen from a side of the switch valve, and
wherein the switch valve is further configured to turn on the pivot so as to:

close the side of the second outlet to form a first volute around the central axis of the impeller inside the switch valve if a rotation direction of the impeller is the first direction, the first volute becoming gradually wider from the second outlet to the first outlet; and also
close the side of the first outlet to form a second volute around the central axis of the impeller inside the switch valve if a rotation direction of the impeller is the second direction, the second volute becoming gradually wider from the first outlet to the second outlet.

2. The pump of claim 1, further comprising:

an intake channel extended from the inlet; and
first and second exhaust channels extended from the first and second outlets, respectively,
wherein the switch valve is put in the enclosed space,
wherein the switch valve is configured:

to turn on the pivot by force of the fluid in the enclosed space generated with the impeller rotating in the first direction so as to close the side of the second outlet to form the first volute around the central axis of the impeller inside the switch valve and to drain the fluid in the enclosed space through the first volute, the first outlet and the first exhaust channel and; and also
to turn on the pivot by force of the fluid in the enclosed space generated with the impeller rotating in the second direction so as to close the side of the first outlet to form the second volute around the central axis of the impeller inside the switch valve and to drain the fluid in the enclosed space through the second volute, the second outlet and the second exhaust channel.

3. The pump of claim 2, wherein the pump is symmetry with respect to a line, and configured so that:

the center on the central axis of the impeller and the pivot of the switch valve are located on said line;
the impeller and the casing are equally divided by said line;
the first and second exhaust channels are located at both sides of said line; and
the first and second volutes are symmetry with respect to said line.

4. The pump of claim 2, wherein the central axis of the impeller and the pivot of the switch valve are arranged so that the central axis exists between the first and second outlets and the pivot.

5. The pump of any one of claims 1-4,
wherein the switch valve is put in the casing so that a part of outer circumference of the switch valve makes contact with the inner face of the casing, and
wherein the switch valve further comprises a recess

formed on the outer circumference of the switch valve.

6. The pump of any one of claims 1-4, wherein the switch valve further comprises a projection formed on a side of the switch valve, and is put in the casing so that the projection slides on an inner face of the casing when it turns on the pivot.

FIG. 1

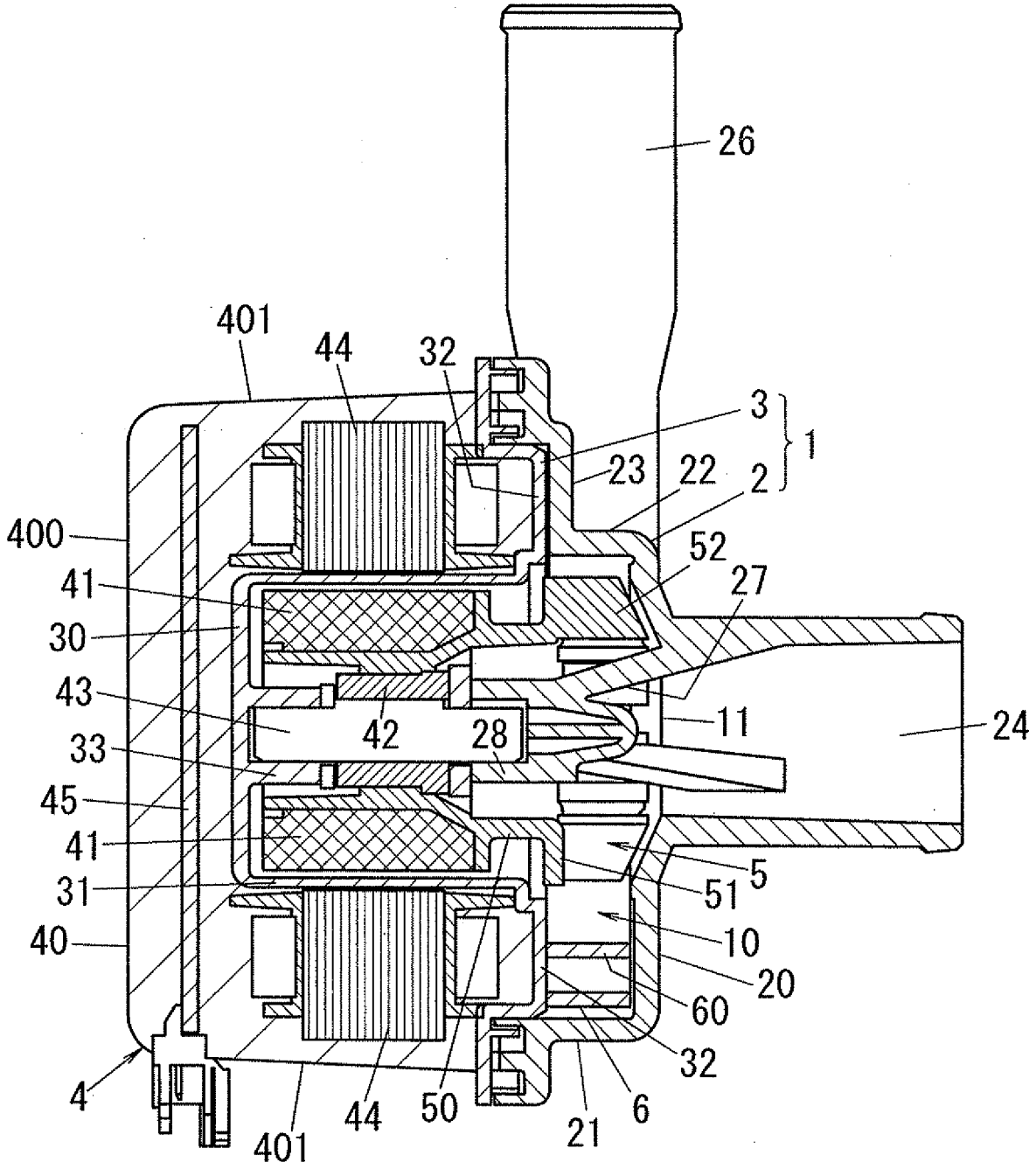

26
401
44
32
3
1
23
22
2
400
52
41
27
30
43
42
28
11
24
33
45
41
5
31
51
40
10
20
60
32
4
401
44
50
21
6

FIG. 2

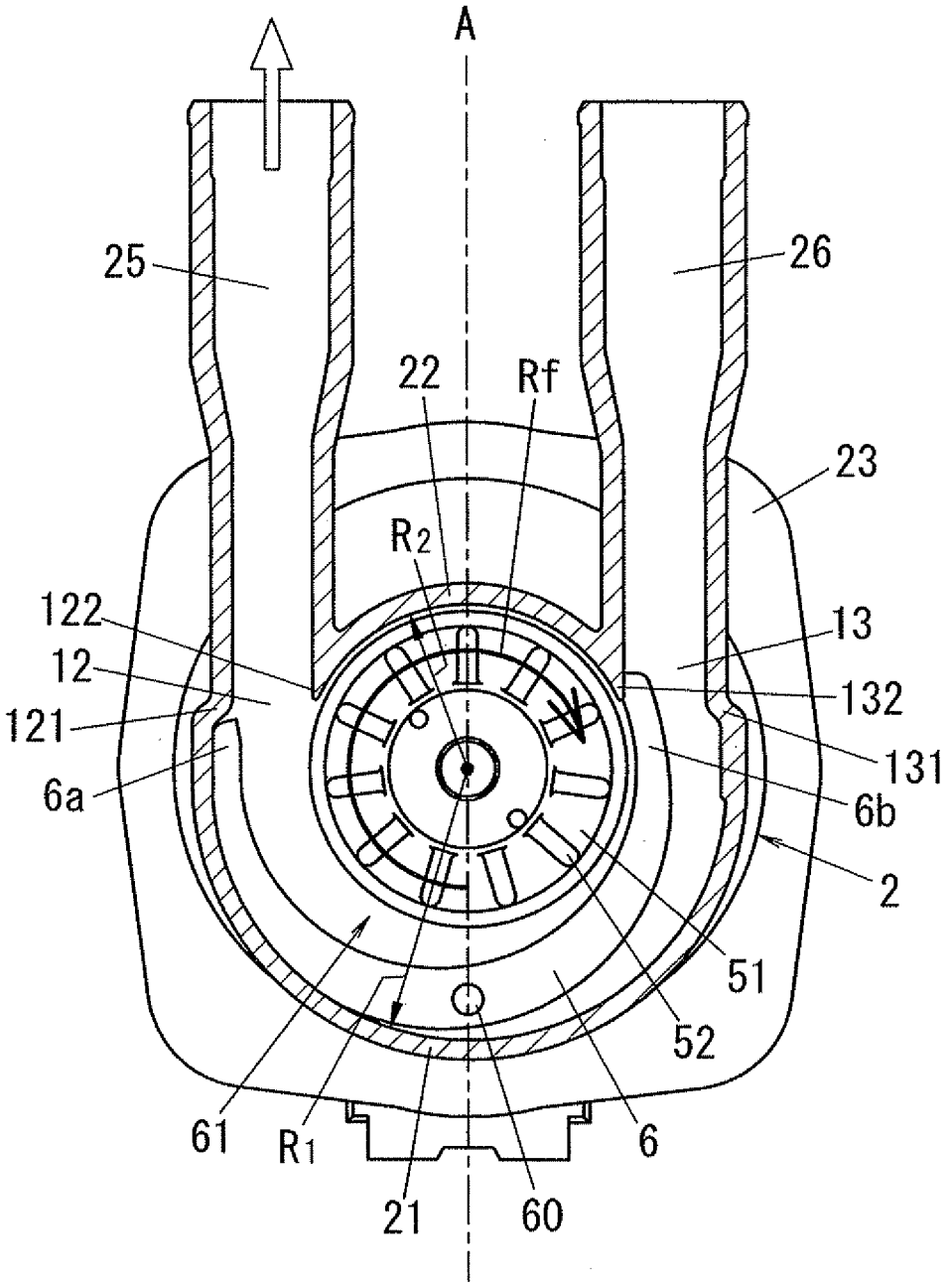


FIG. 3

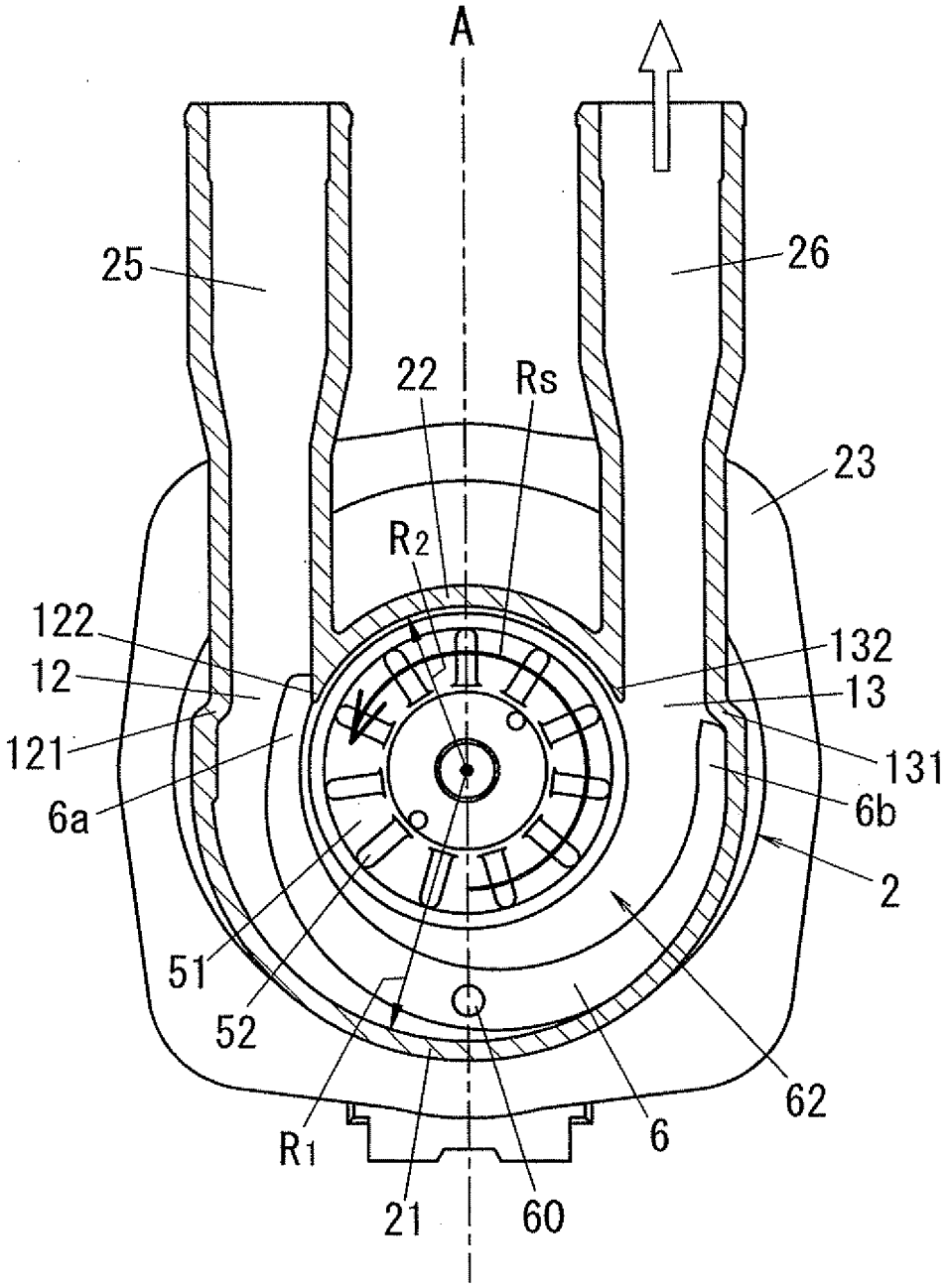


FIG. 4

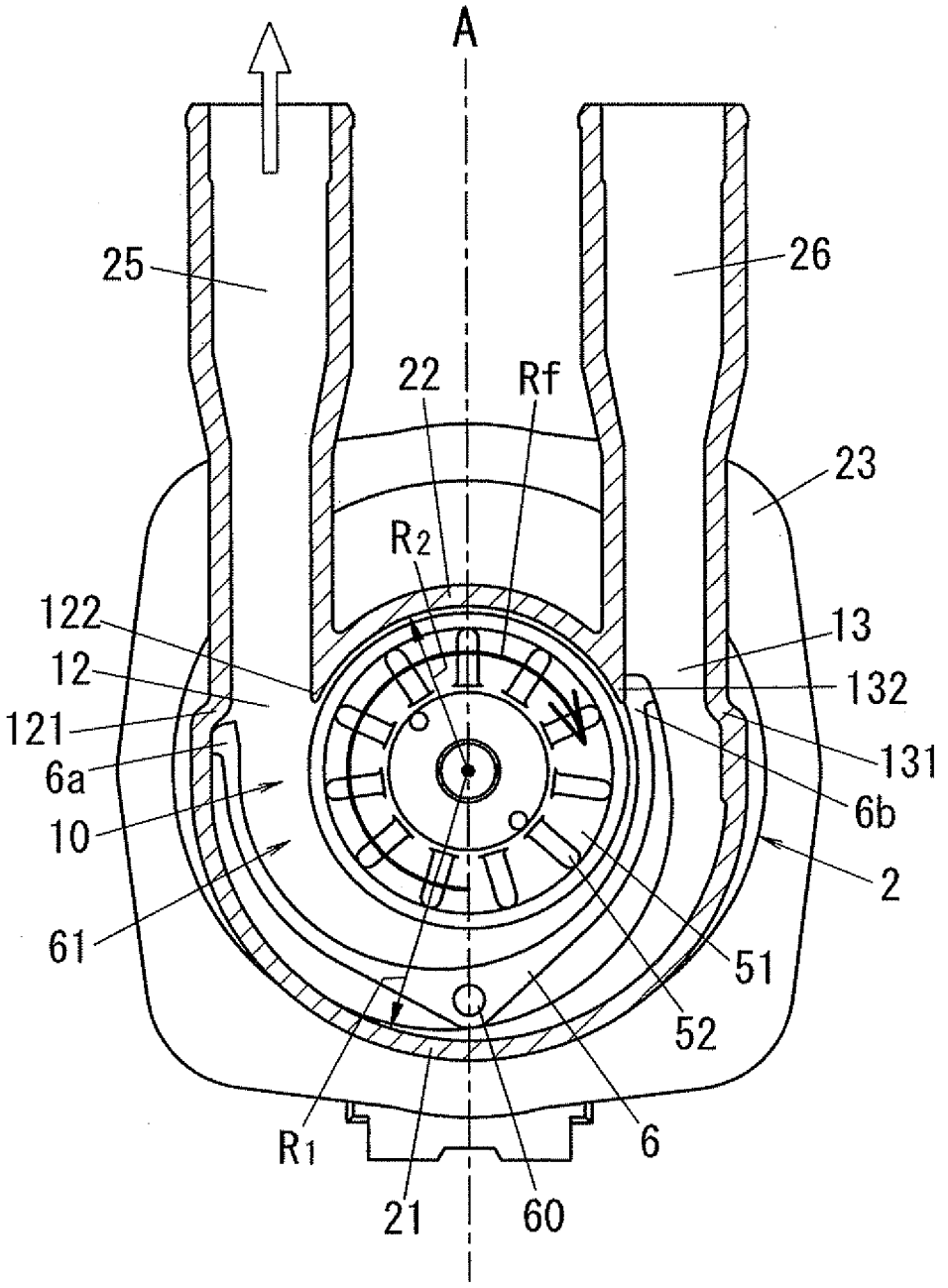


FIG. 5A

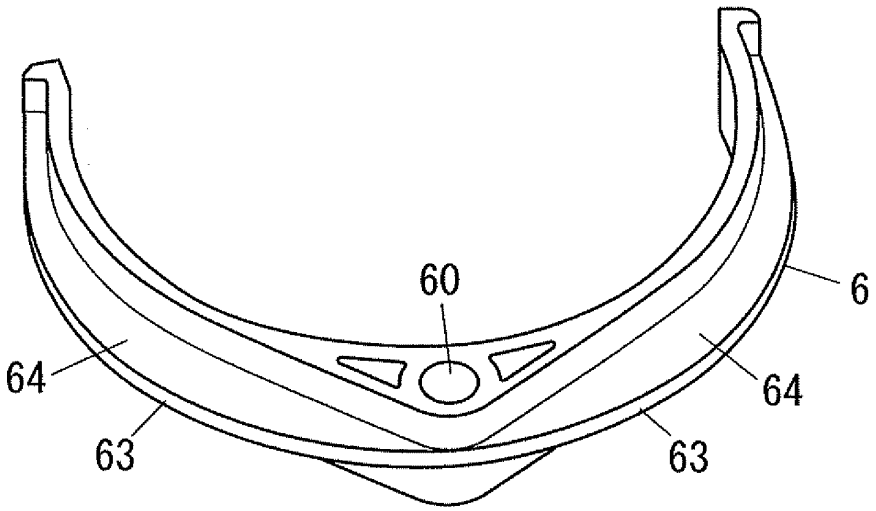


FIG. 5B

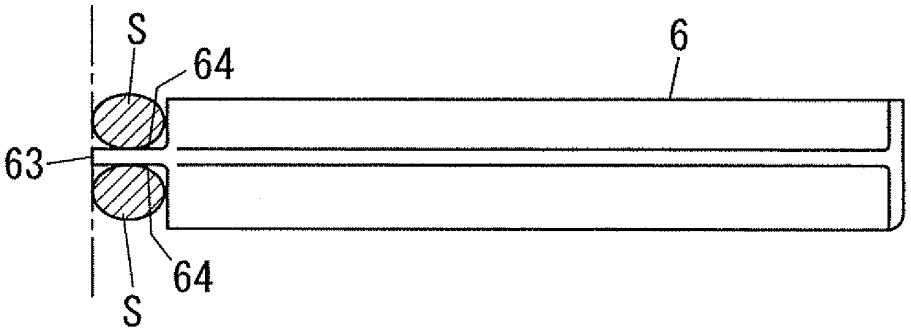
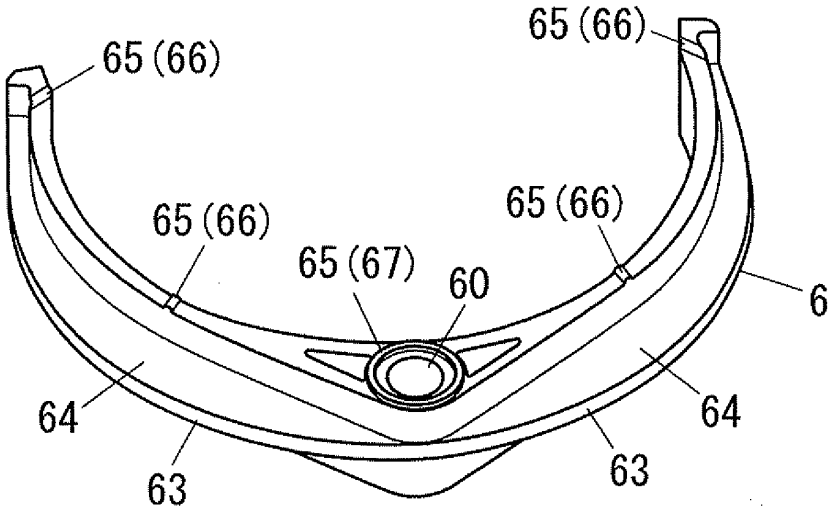


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/060990

A. CLASSIFICATION OF SUBJECT MATTER
F04D29/48(2006.01)i, *F04D13/06*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F04D29/48, F04D13/06

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 1996-2009
Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	US 2205902 A (GENERAL ELECTRIC CO.), 25 June, 1940 (25.06.40), Full text; all drawings (Family: none)	1 2-4,6 5
Y	JP 10-141287 A (Daewoo Electronics Co., Ltd.), 26 May, 1998 (26.05.98), Par. No. [0012]; Fig. 6 & GB 2320061 A & DE 19745737 A1 & KR 10-0220407 B1	2-4,6
Y	JP 2003-172286 A (Matsushita Electric Industrial Co., Ltd.), 20 June, 2003 (20.06.03), Par. No. [0035] & US 2003/0072656 A1 & WO 2003/027504 A1	6

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 July, 2009 (16.07.09)	28 July, 2009 (28.07.09)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/060990

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 52-41468 A (Hitachi, Ltd.), 31 March, 1977 (31.03.77), Page 2, upper right column, line 12 to lower left column, line 3; Figs. 5 to 6 (Family: none)	5

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

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 H10141287 B **[0002]**
- JP 2003003995 A **[0004]**