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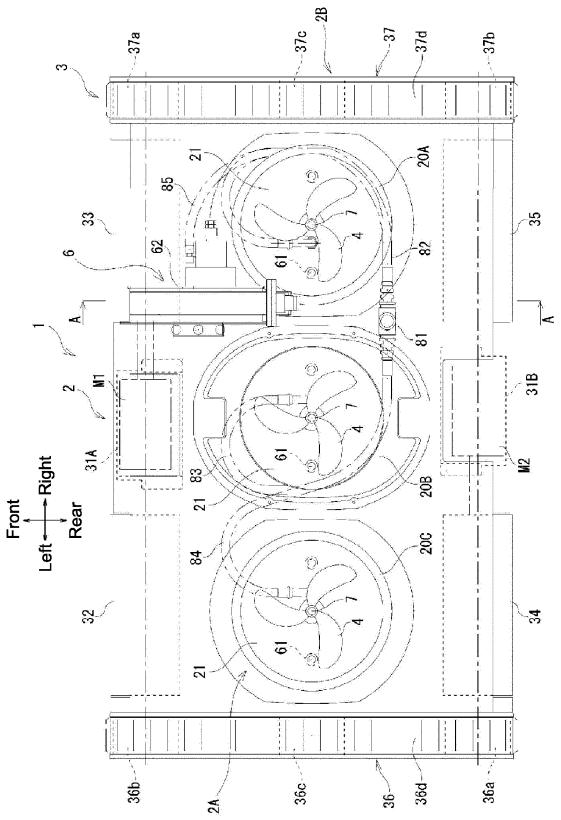
(54) UNDERWATER CLEANING MACHINE

(57) The underwater cleaning machine 1 for cleaning an object to be cleaned while moving along the surface of the object to be cleaned which is present in water is equipped with a cleaning nozzle unit 5 for cleaning by spraying high-pressure water toward the object to be cleaned and a suction device 6 for suctioning dirty water after cleaning by the cleaning nozzle unit 5, and the cleaning nozzle unit 5 and the suction device 6 are driven by high-pressure water supplied from an external high-pressure water pump.

Fig.1



EP 3 912 738 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to an underwater cleaning machine.

BACKGROUND ART

[0002] Patent Literature 1 discloses an underwater sweeper that removes shellfish, algae, and the like adhering to the seawater-immersed surface of a ship. Such an underwater sweeper includes multiple drive apparatuses, such as a brush rotation pump for rotating the brush used for cleaning, a motor for rotating the screw for crimping the sweeper toward the hull, and a dirty water pump that suctions and discharges dirty water generated during cleaning. Thus, the machine itself is a heavy object, which causes problems in handleability and operability.

CITATION LIST

Patent Literature

[0003] Patent Literature 1: Japanese Unexamined Utility Model Application Publication No. 54-59764

DISCLOSURE OF INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0004] Therefore, in view of the above problems, an object of the present invention is to provide an underwater cleaning machine for cleaning underwater that is lighter in weight and capable of reliably preventing seawater contamination.

MEANS FOR SOLVING THE PROBLEMS

EFFECT OF THE INVENTION

[0005] An underwater cleaning machine according to the present invention cleans an object to be cleaned while moving along the surface of the object to be cleaned residing in the water, the underwater cleaning machine including

> a cleaning device that ejects high-pressure water toward the object to be cleaned for cleaning, and a suction device that suctions dirty water after cleaning by the cleaning device,
> wherein, the cleaning device and the suction device are driven by high-pressure water supplied from an external high-pressure water pump.

[0006] Since the underwater cleaning machine according to the present invention includes a suction device for suctioning the dirty water after cleaning by the cleaning device, contamination of seawater can be reliably prevented. In the underwater cleaning machine according to the present invention, since the cleaning device and the suction device are driven by the high-pressure water supplied from the external high-pressure water pump, multiple drive devices for driving the cleaning device and the suction device need not to be mounted on the machine body, and thus the work equipment is lightweight.

BRIEF DESCRIPTION OF DRAWINGS

[0007]

> FIG. 1 is a plan view of an underwater cleaning machine according to an embodiment.
> FIG. 2 is a right side view of an underwater cleaning machine according to an embodiment.
> FIG. 3 is a bottom view of an underwater cleaning machine according to an embodiment.
> FIG. 4 is a cross-sectional view of the underwater cleaning machine in FIG. 1 taken along the line AA.
> FIG. 5 is a side view including a partial cross-section of a suction pump.
> FIG. 6 is a plan view of an impeller.

DESCRIPTION OF EMBODIMENTS

[0008] Embodiments of the present invention will now be described with reference to the drawings.

[0009] FIGS. 1 to 4 illustrate an underwater cleaning machine 1 according to an embodiment. The underwater cleaning machine 1 cleans an object to be cleaned while moving along the surface of the object to be cleaned (for example, a hull, a farmed fish net, etc.) residing in the water. The underwater cleaning machine 1 includes a work machine body 2, a traveling device 3, propulsive-force generating propellers 4, a cleaning nozzle unit 5 (corresponding to a cleaning device), and a suction device 6.

[0010] The work machine body 2 includes a propeller-side body 2A in which the propulsive-force generating propellers 4 are disposed, a nozzle-side body 2B in which the cleaning nozzle unit 5 is disposed, and a coupling body 2C that couples the propeller-side body 2A and the nozzle-side body 2B. The coupling body 2C is composed of a plurality of pipes extending in the vertical direction.

[0011] The propeller-side body 2A includes a plurality of (three in this embodiment) tubular ducts 20A, 20B, and 20C having openings 21. The ducts 20A, 20B, and 20C are disposed in the left-right direction of the work machine body 2, and the propulsive-force generating propellers 4 are housed inside the respective openings 21.

[0012] A traveling device 3 is disposed on the nozzle-side body 2B. The traveling device 3 includes motor cases 31A and 31B that house underwater motors M1 and M2, respectively, four wheels 32, 33, 34, 35 in the front, rear, left and right, and a pair of left and right crawler

devices 36, 37.

[0013] The underwater motor M1 housed in the front motor case 31A rotationally drives the right front wheel 33. The underwater motor M2 housed in the front motor case 31B rotationally drives the left rear wheel 34. The underwater motors M1 and M2 are composed of DC motors.

[0014] A left crawler device 36 includes a drive wheel 36a, a first driven wheel 36b, a second driven wheel 36c, and an annular crawler 36d. The drive wheel 36a is fixed to the rotary shaft of the left rear wheel 34 and rotationally driven by the underwater motor M2. The first driven wheel 36b is fixed to the rotary shaft of the left front wheel 32. The second driven wheel 36c is rotatably supported above the drive wheel 36a and the first driven wheel 36b, between the drive wheel 36a and the first driven wheel 36b. The annular crawler 36d is wound around the drive wheel 36a, the first driven wheel 36b, and the second driven wheel 36c. In this way, in the crawler device 36, as the crawler 36d is rotated by the rotation of the underwater motor M2, the left front wheel 32 also rotates. That is, the underwater motor M2 simultaneously rotates the left rear wheel 34, the left front wheel 32, and the left crawler device 36 in the same direction.

[0015] A right crawler device 37 includes a drive wheel 37a, a first driven wheel 37b, a second driven wheel 37c, and an annular crawler 37d. The drive wheel 37a is fixed to the rotary shaft of the right front wheel 33 and rotationally driven by the underwater motor M1. The first driven wheel 37b is fixed to the rotary shaft of the right rear wheel 35. The second driven wheel 37c is rotatably supported above the drive wheel 37a and the first driven wheel 37b, between the drive wheel 37a and the first driven wheel 37b. The annular crawler 37d is wound around the drive wheel 37a, the first driven wheel 37b, and the second driven wheel 37c. In this way, in the crawler device 37, as the crawler 37d is rotated by the rotation of the underwater motor M1, the right rear wheel 35 also rotates. That is, the underwater motor M1 simultaneously rotates the right front wheel 33, the right rear wheel 35, and the right crawler device 37 in the same direction.

[0016] A power supply cable (not illustrated) is connected to each of the underwater motors M1 and M2, and power is supplied to each of the underwater motors M1 and M2 from a power supply device on board or on land through the power supply cable.

[0017] The cleaning nozzle unit 5 ejects high-pressure water supplied from a high-pressure hose (not illustrated) toward the object to be cleaned, and cleans the object to be cleaned by a jet stream. The cleaning nozzle unit 5 is fixed to the lower portions of rotary shafts 7 rotatably supported by the nozzle-side body 2B. Rotary joints 71 are disposed in the middle portions of the rotary shafts 7. The rotary joints 71 are for transporting high-pressure water to the rotating cleaning nozzle unit 5. Since the rotary joints 71 each have substantially the same configuration as that of a rotary joint 624 described below, detailed description thereof will be omitted. The rotary joints 71 are supplied with high-pressure water pumped from a high-pressure water pump (not illustrated) on board or on land through a high-pressure hose. The high-pressure hose is connected to a branch joint 81, and the high-pressure water branched by the branch joint 81 is supplied to the respective rotary joints 71 via connection hoses 82, 83, and 84 extending from the branch joint 81. The high-pressure water supplied to the rotary joints 71 is supplied to the cleaning nozzle unit 5 through flow paths inside the rotary shafts 7.

[0018] The cleaning nozzle unit 5 includes discoid cleaning bodies 51 fixed to the lower ends of the rotary shafts 7, and multiple cleaning nozzles 52 respectively disposed on the outer peripheral portion of the cleaning bodies 51.

[0019] The cleaning bodies 51 are each composed of, for example, stainless steel, and can rotate and come into contact with shellfish or the like attached to the object to be cleaned to remove the shellfish or the like. A diffusion prevention cover 53 is disposed on the outer peripheral sides of the cleaning bodies 51 so as to protrude from the lower surface of the nozzle-side body 2B. By providing the diffusion prevention cover 53, the diffusion of dirty water can be prevented during cleaning. The diffusion prevention cover 53 includes a first cover portion 53a that surrounds the front and back of the three cleaning bodies 51, and a second cover portion 53b that is disposed along the outer peripheries of the respective cleaning bodies 51 between the adjacent cleaning bodies 51. A rubber packing (not illustrated) is disposed at the tip of the first cover portion 53a. In the present embodiment, since the wheels 32, 33, 34, and 35 and the crawler devices 36 and 37 that come into contact with the surface of the object to be cleaned are arranged on the outer periphery of the nozzle-side body 2B, the diffusion of dirty water during cleaning can be further prevented.

[0020] In the present embodiment, the two cleaning nozzles 52 are arranged so as to face each other across the axial center of each of the cleaning bodies 51. The cleaning nozzles 52 eject high-pressure water pumped from the high-pressure water pump. Each cleaning nozzle 52 tilts downward by a predetermined angle so that the ejection direction of the high-pressure water faces the object to be cleaned (see FIG. 2). In this way, when high-pressure water is ejected from the cleaning nozzles 52, the cleaning nozzle unit 5 rotates together with the rotary shafts 7 by the reaction force of the ejection generated by the high-pressure water being sprayed onto the surface of the object to be cleaned.

[0021] The propulsive-force generating propellers 4 are fixed to the upper end of the rotary shafts 7. Therefore, when high-pressure water is ejected from the cleaning nozzles 52 and the rotary shaft 7 rotates together with the cleaning nozzle unit 5 by the ejection reaction force, the propulsive-force generating propellers 4 also rotate integrally.

[0022] The rotation of the propulsive-force generating propellers 4, causes water between the propeller-side

body 2A and the nozzle-side body 2B to be introduced into the ducts 20A, 20B, and 20C, and a water flow ejected from the openings 21 to be generated. This provides a propulsive force for the underwater cleaning machine 1, and thereby the underwater cleaning machine 1 is pressed against the object to be cleaned. Therefore, the wheels 32, 33, 34, and 35 and the crawler devices 36 and 37 do not float from the object to be cleaned, and the underwater cleaning machine 1 can clean the object to be cleaned while stably running along the surface of the object to be cleaned.

[0023] The suction device 6 suctions dirty water (residual water) after cleaning by the cleaning nozzle unit 5. The suction device 6 includes water suction ports 61 for suctioning dirty water and a suction pump 62 for suctioning dirty water.

[0024] The water suction ports 61 are formed on the lower surface of the nozzle-side body 2B. The water suction ports 61 are disposed on the inner side of the cleaning bodies 51, that is, above the cleaning bodies 51. In the present embodiment, two water suction ports 61 are provided for each cleaning body 51, and the two water suction ports 61 are arranged so as to face each other across the axial center of the rotary shaft 7.

[0025] The dirty water after the cleaning by the cleaning nozzle unit 5 is suctioned from the water suction ports 61 through the voids on the outer peripheral sides and the inner sides of the cleaning bodies 51 as indicated by the dashed-dotted line in FIG. 4. At this time, the diffusion prevention cover 53 disposed around the cleaning bodies 51 causes the dirty water to be effectively suctioned from the water suction ports 61.

[0026] The suction pump 62 is fixed on the upper surface of the nozzle-side body 2B. FIG. 5 is a side view of the suction pump 62. For illustrative purposes, the vertical direction in FIG. 5 is referred to as the vertical direction of the suction pump 62.

[0027] The suction pump 62 includes a hollow cylindrical casing 621, an impeller 622 disposed inside the casing 621, and a plurality of suction ports 623 formed in the casing 621.

[0028] A lower bearing 621c is fixed to the upper end surface 621a of the casing 621. A suction portion 621d projecting in a columnar shape is formed on the lower end surface (bottom surface) 621b of the casing 621, and the suction ports 623 are arranged on the outer peripheral portion of the suction portion 621d. In the present embodiment, six suction ports 623 are arranged at equal intervals along the circumferential direction of the suction portion 621d. Each suction port 623 opens toward a tangential direction of the casing 621, specifically, in the tangential direction of the suction portion 621d (see FIG. 4). Each suction port 623 is connected to the corresponding water suction port 61 by a suction hose (not illustrated) (see FIG. 4). In this way, the dirty water suctioned from the water suction ports 61 is suctioned into the casing 621 through the suction hose and the suction ports 623.

[0029] A discharge portion 621e for discharging the suctioned dirty water is disposed on the outer peripheral portion of the casing 621. A dirty water transfer hose (not illustrated) is connected to the end of the discharge portion 621e, and the dirty water discharged from the suction pump 62 is transferred to the ship or land through the dirty water transfer hose.

[0030] A middle case cover 621f is fixed to the upper end surface 621a of the casing 621, and an upper case cover 621g is fixed to the upper surface of the middle cover 621f. The middle case cover 621f covers the lower bearing 621c. A rotary joint 624, which will be described below, is housed inside the upper case cover 621g. An upper bearing 621h is fixed on the upper surface of the upper case cover 621g.

[0031] The impeller 622 includes a discoid impeller body 622a, a plurality of ejection nozzles 622b disposed on the outer peripheral portion of the impeller body 622a, a plurality of blade portions 622c disposed on the lower surface of the impeller body 622a, and a rotary shaft 622d fixed to the upper surface of the impeller body 622a.

[0032] A pair of ejection nozzles 622b are disposed across the rotary shaft of the impeller 622. In other words, the two ejection nozzles 622b are arranged so as to face each other across the axial center of the impeller body 622a. The ejection nozzles 622b eject high-pressure water pumped from the high-pressure water pump (not illustrated) described above. Each ejection nozzle 622b is disposed so that the ejection direction of the high-pressure water faces the tangential direction of the impeller body 622a. Therefore, when high-pressure water is ejected from the ejection nozzles 622b, the impeller body 622a rotates by the reaction force of the ejection of the high-pressure water. That is, the impeller 622 is driven by the reaction force of the ejection of high-pressure water from the ejection nozzles 622b.

[0033] The blade portions 622c rotate together with the impeller body 622a to apply a centrifugal force to the liquid in the casing 621. In the present embodiment, six blade portions 622c are arranged at equal intervals along the circumferential direction of the impeller body 622a.

[0034] The lower end of the rotary shaft 622d is fixed to the impeller body 622a. The rotary shaft 622d is rotatably supported by the lower bearing 621c and the upper bearing 621h. A flow path 622e for transporting high-pressure water in the axial direction is formed on the rotary shaft 622d. The upper end of the flow path 622e is positioned at the central area of the rotary shaft 622d. The lower end of the flow path 622e extends to the impeller body 622a and communicates with the ejection nozzles 622b via connection pipes 622f.

[0035] The rotary joint 624 is for transporting high-pressure water to the rotating impeller 622. The rotary joint 624 includes the rotary shaft 622d of the impeller 622 and a fixed housing 624a surrounding the rotary shaft 622d.

[0036] A receiving hole 624b that communicates with the flow path 622e is formed in the rotary shaft 622d. A supply hole 624c is formed in the fixed housing 624a at

a height corresponding to the receiving hole 624b.

[0037] The fixed housing 624a is fixed to the upper surface of the middle case cover 621f. A crank joint 625 is connected to the supply hole 624c in the fixed housing 624a. A connecting hose 85 (see FIG. 1) extending from the branch joint 81 is connected to the crank joint 625.

[0038] In this way, high-pressure water pumped from a high-pressure water pump (not illustrated) on board or on land is supplied to the rotary joint 624 through the high-pressure hose, the branch joint 81, the connecting hose 85, and the crank joint 625. The high-pressure water supplied to the rotary joint 624 is supplied to the ejection nozzles 622b through the flow path 622e of the rotary shaft 622d and the connection pipe 622f, and is ejected from the ejection nozzles 622b.

[0039] The impeller 622 is rotationally driven by the reaction force of the ejection of high-pressure water from the ejection nozzles 622b. Since a centrifugal force is applied to the liquid inside the casing 621 by the rotation of the impeller 622, the suction pump 62 discharges the dirty water from the discharge portion 621e and suctions dirty water from the suction ports 623. That is, since the suction pump 62 is driven by the high-pressure water supplied from an external high-pressure water pump, it is not necessary to mount a drive device such as a motor for driving the suction device 6 on the machine body.

[0040] As described above, the underwater cleaning machine 1 of the present embodiment is an underwater cleaning machine 1 that cleans an object to be cleaned while moving along the surface of the object to be cleaned residing underwater, and includes a cleaning nozzle unit 5 that cleans the object to be cleaned by ejecting high-pressure water toward the object to be cleaned, a suction device 6 that suctions dirty water after cleaning by the cleaning nozzle unit 5. The cleaning nozzle unit 5 and the suction device 6 are driven by high-pressure water supplied from an external high-pressure water pump.

[0041] In this way, since the suction device 6 for suctioning the dirty water after cleaning by the cleaning nozzle unit 5 is provided, contamination of seawater can be reliably prevented. Since the cleaning nozzle unit 5 and the suction device 6 are driven by the high-pressure water supplied from the external high-pressure water pump, multiple drive devices for driving the cleaning nozzle unit 5 and the suction device 6 need not to be mounted on the machine body, and thus the work equipment is lightweight.

[0042] In the present embodiment, the high-pressure water pumped from the high-pressure water pump through one high-pressure hose is distributed between the cleaning nozzle unit 5 and the suction device 6. However, the cleaning nozzle unit 5 and the suction device 6 may be supplied with high-pressure water pumped from a plurality of high-pressure water pumps through high-pressure hoses.

[0043] In the present embodiment, the cleaning nozzle unit 5 includes the discoid cleaning bodies 51 that rotate by the reaction force of ejection of high-pressure water on the object to be cleaned; the suction device 6 has the water suction ports 61 on the inner side of the cleaning bodies 51; and dirty water is suctioned from the water suction ports 61 through the voids on the outer peripheral side and the inner side of the cleaning bodies 51.

[0044] In the present embodiment, the diffusion prevention cover 53 for preventing the diffusion of dirty water disposed on the outer peripheral sides of the cleaning bodies 51.

[0045] In the present embodiment, the suction device 6 includes the suction pump 62 for suctioning dirty water; the suction pump 62 includes the hollow cylindrical casing 621, the impeller 622 disposed inside the casing 621, and the plurality of suction ports 623 formed in the casing 621; and the impeller 622 is driven by the reaction force of the ejection of high-pressure water from the ejection nozzles 622b disposed on the impeller 622.

[0046] In the present embodiment, the plurality of suction ports 623 are disposed on the bottom surface of the casing 621 along the circumferential direction, and the suction ports 623 are opened toward a tangential direction of the casing 621.

[0047] In the present embodiment, the ejection nozzles 622b are disposed across the rotary shaft 622d of the impeller 622.

[0048] Although the embodiment of the present invention has been described with reference to the drawings, the specific configuration is not limited to the embodiment. The present invention is shown by the claims as well as the description of the embodiments described above, and includes all modifications within the meaning and scope equivalent to scope of the claims.

DESCRIPTION OF REFERENCE NUMERALS

[0049]

1	underwater cleaning machine
2	work machine body
3	traveling device
4	propulsive-force generating propeller
5	cleaning nozzle unit
51	cleaning body
52	cleaning nozzle
53	diffusion prevention cover
6	suction device
61	water suction port
62	suction pump
621	casing
622	impeller
622b	ejection nozzle
623	suction port
624	rotary joint

Claims

1. An underwater cleaning machine that cleans an ob-

ject to be cleaned while moving along a surface of the object to be cleaned residing underwater, the underwater cleaning machine comprising:

a cleaning device that cleans the object to be cleaned by ejecting high-pressure water toward the object to be cleaned; and
a suction device that suctions dirty water after cleaning by the cleaning device,
wherein the cleaning device and the suction device are driven by high-pressure water supplied from an external high-pressure water pump.

2. The underwater cleaning machine according to claim 1, wherein the cleaning device and the suction device are distributed with the high-pressure water pumped from the high-pressure water pump through one high-pressure hose.

3. The underwater cleaning machine according to claim 1 or 2, wherein,

the cleaning device comprises a discoid cleaning body that rotates by a reaction force of ejection of high-pressure water on the object to be cleaned,
the suction device has a water suction port on an inner side of the cleaning body, and
the dirty water is suctioned from the water suction port through voids on the outer peripheral side and the inner side of the cleaning body.

4. The underwater cleaning machine according to claim 3, wherein the outer peripheral side of the cleaning body is provided with a diffusion prevention cover to prevent the diffusion of the dirty water.

5. The underwater cleaning machine according to any one of claims 1 to 4, wherein,

the suction device comprises a suction pump that suctions the dirty water, and
the suction pump comprises:

a hollow cylindrical casing;
an impeller disposed inside the casing; and
a plurality of suction ports formed in the casing,

the impeller being driven by a reaction force of ejection of high-pressure water from ejection nozzles disposed on the impeller.

6. The underwater cleaning machine according to claim 5, wherein

the plurality of suction ports is disposed on the bottom surface of the casing along the circumferential direction, and
the suction ports are open toward a tangential direction of the casing.

7. The underwater cleaning machine according to claim 5, wherein the ejection nozzles are disposed in pairs across the rotary shaft of the impeller.

Fig.1

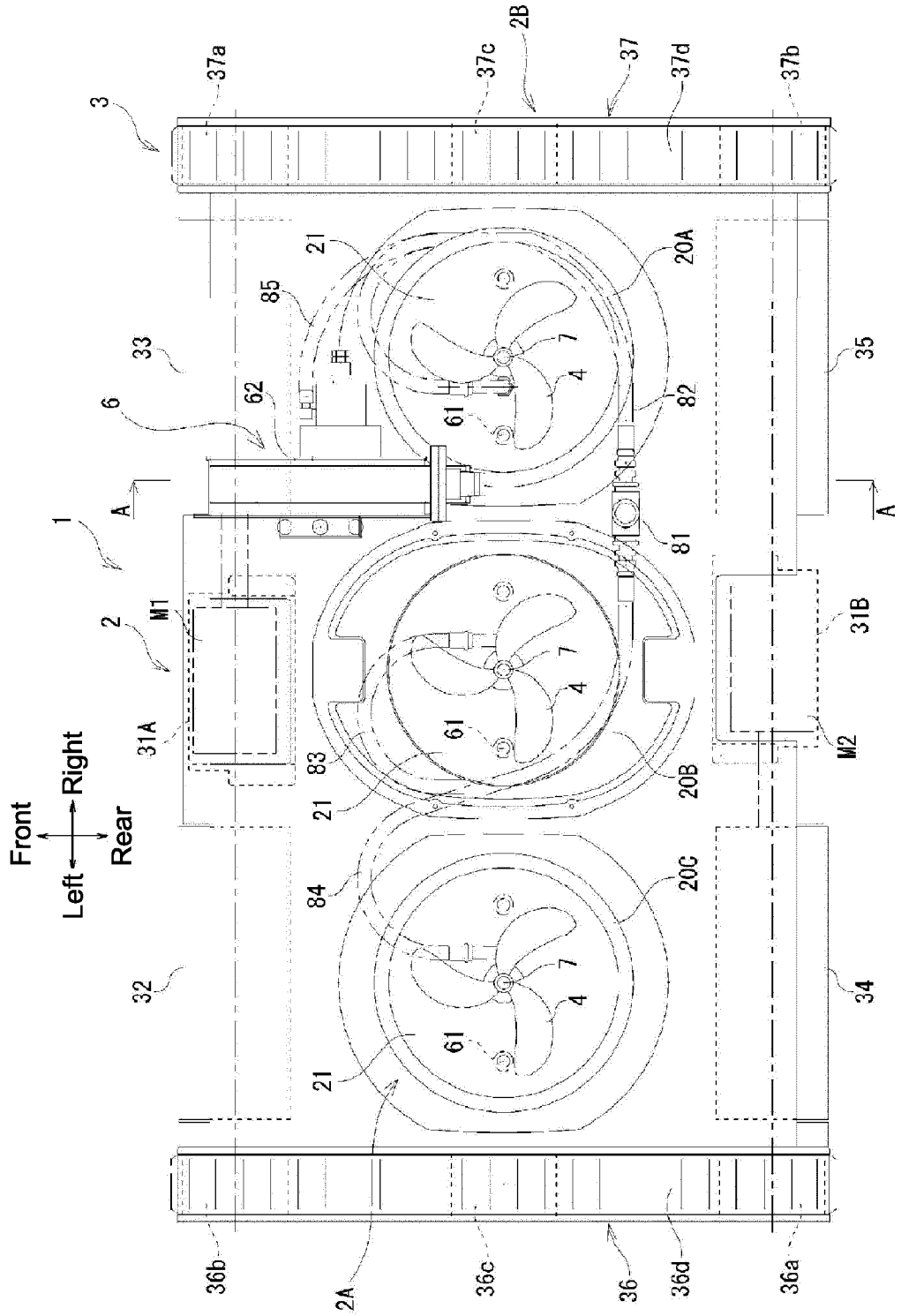

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Fig.2

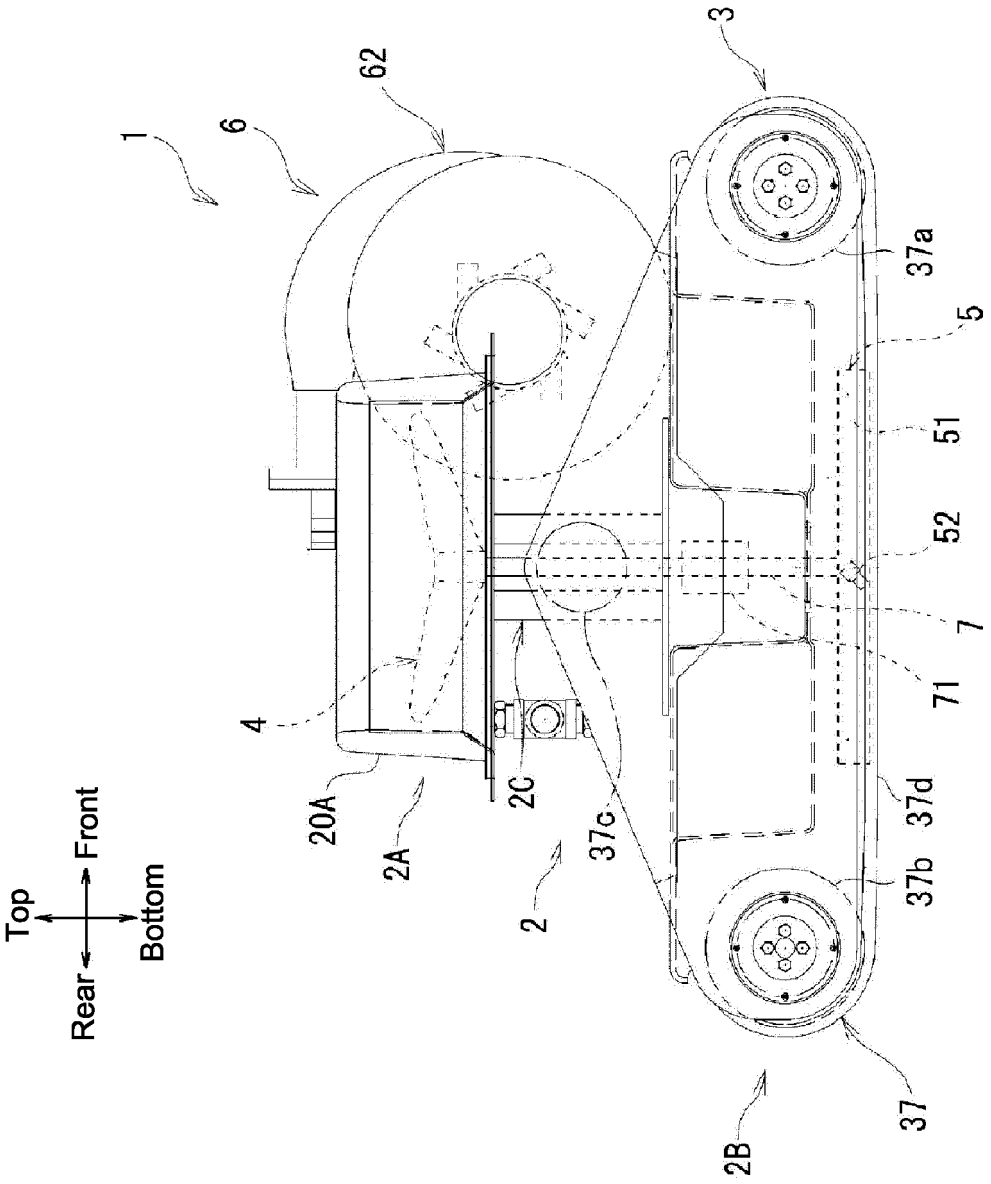
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Fig.3

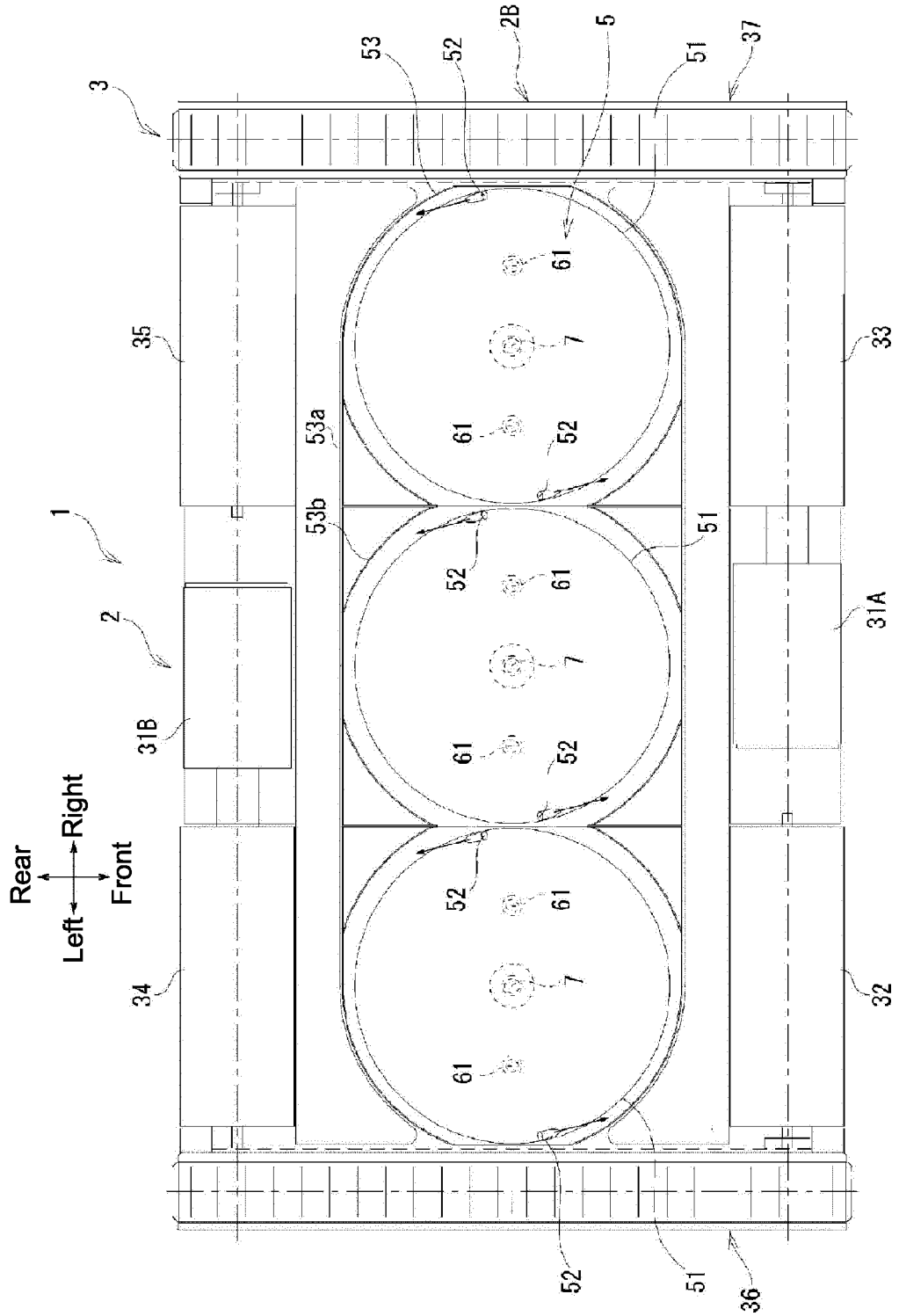
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Fig.4

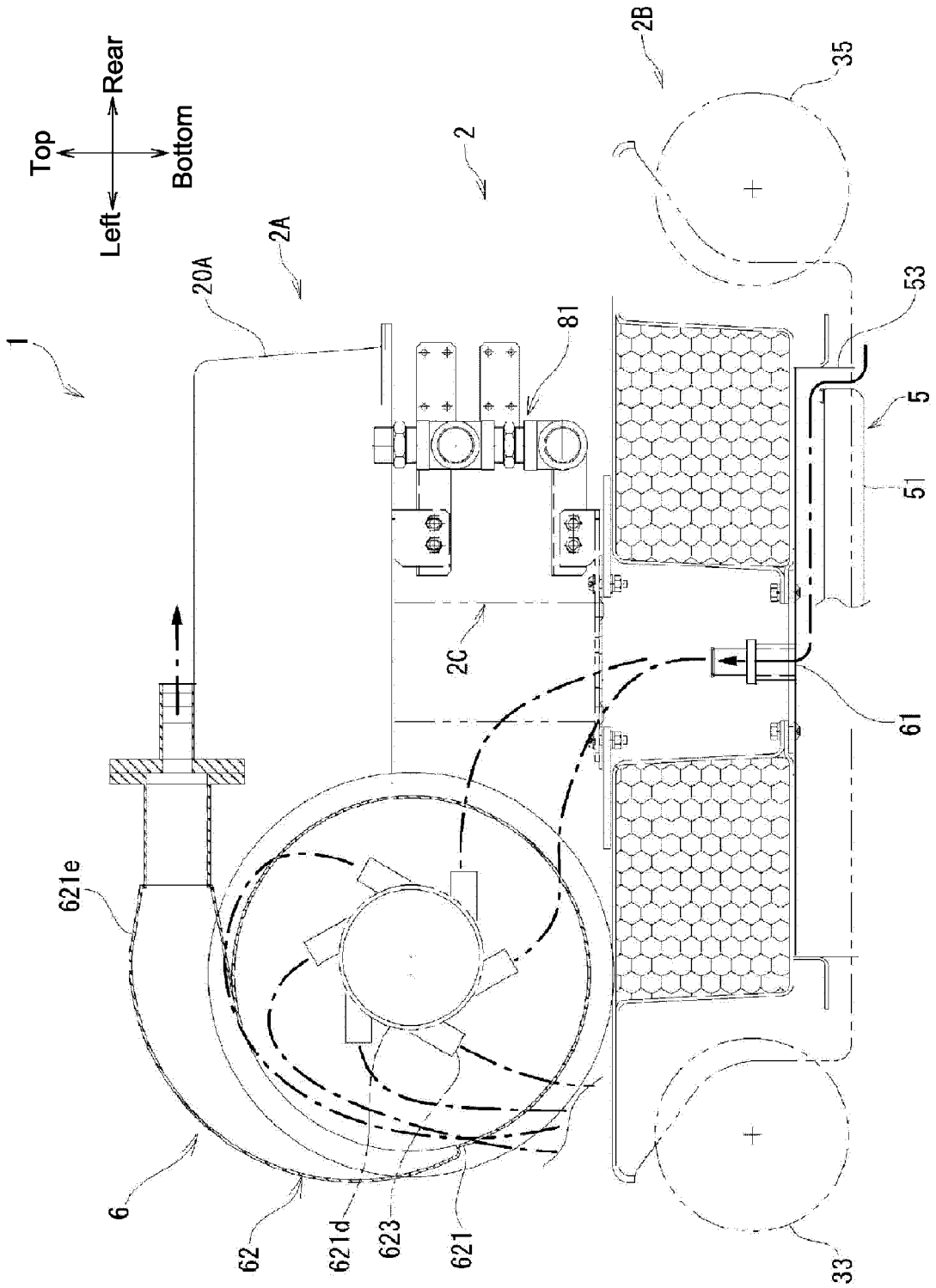
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Fig.5

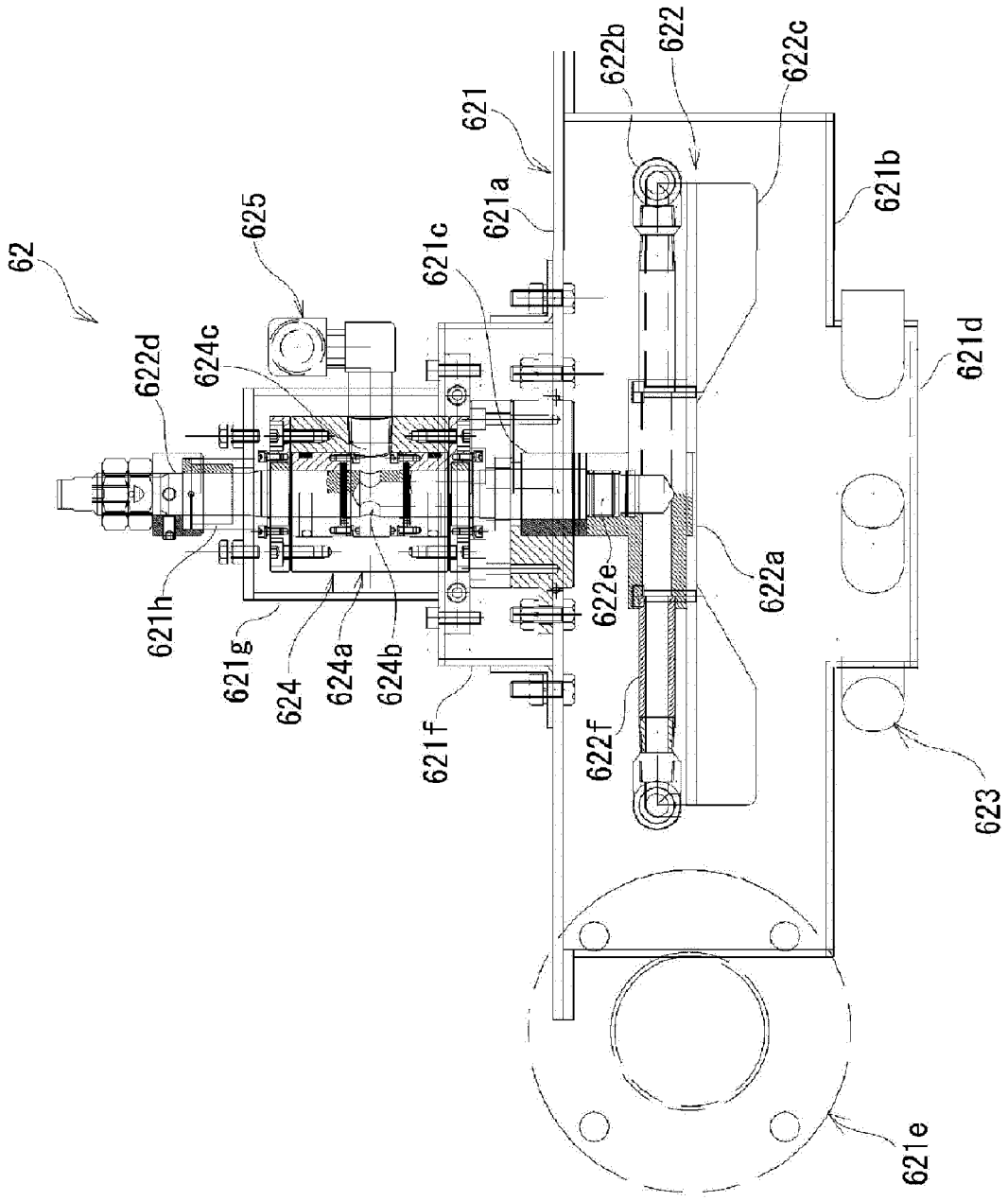
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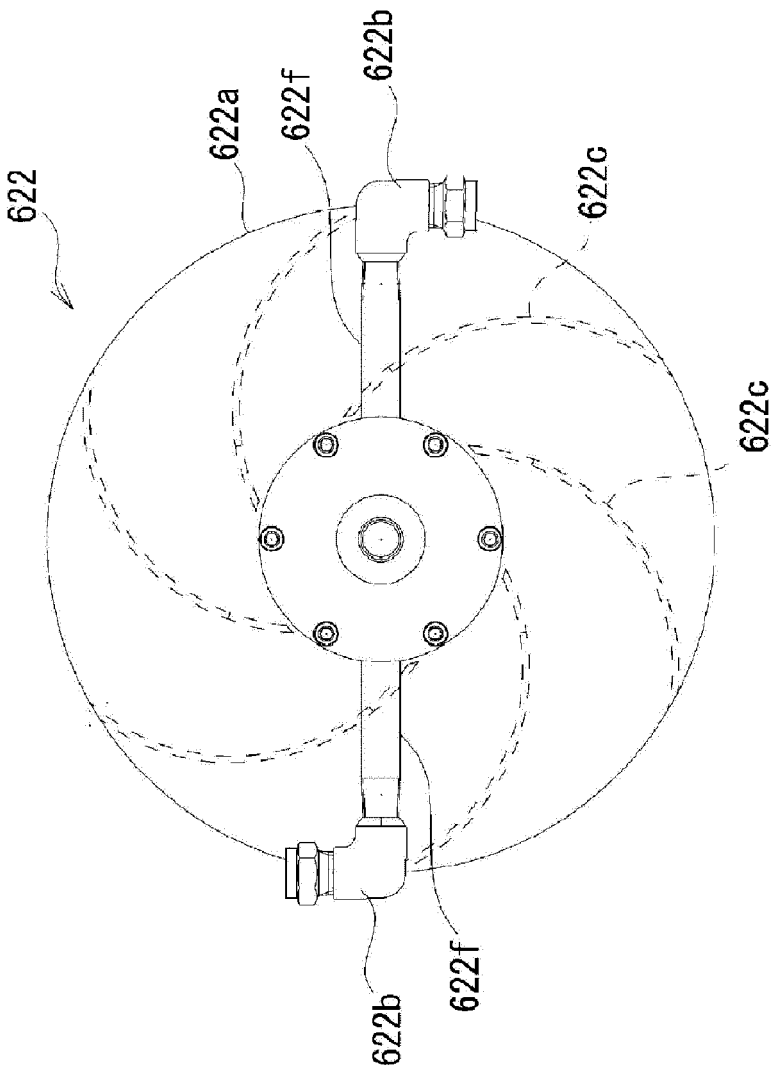
Fig.6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/000284

A. CLASSIFICATION OF SUBJECT MATTER
B08B 3/02(2006.01)i
FI: B08B3/02 F
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)
B08B3/02; B63B59/06-59/10; F04D1/00-35/00

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 133238/1977 (Laid-open No. 059764/1979) (MAGSTAR SERVICE) 25 April 1979 (1979-04-25) specification, page 1, line 16 to page 4, line 1, lines 1-2	1-7
Y	JP 5-503049 A (DEUTSCHE LUFTHANSA AG) 27.05.1993 (1993-05-27) page 3, upper left column, line 19 to page 4, upper right column, line 21, fig. 1-2	1-7
Y	JP 2001-276754 A (YANMAR DIESEL CO., LTD.) 09.10.2001 (2001-10-09) paragraphs [0029]-[0072], fig. 1-10	1-7

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

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/000284

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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REFERENCES CITED IN THE DESCRIPTION

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