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(71) Applicant: **Kawasaki Jukogyo Kabushiki Kaisha**
Kobe-shi Hyogo 650-91 (JP)

(72) Inventor: **Hino, Michinobu**
Hyogo, 673 (JP)

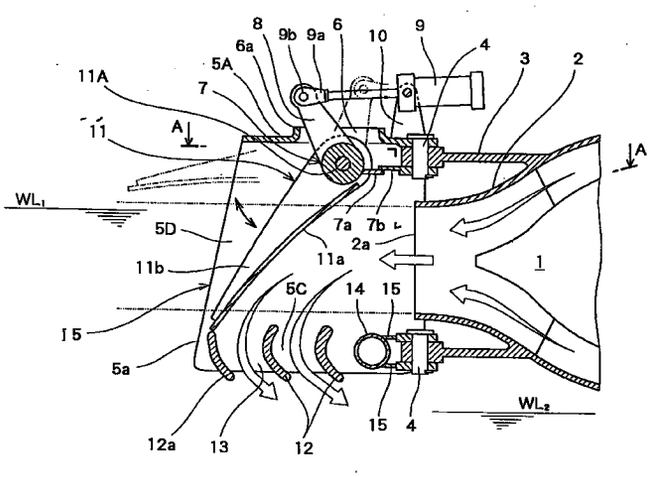
(74) Representative: **Knoblauch, Ulrich, Dr.-Ing. et al**
Patentanwälte Dr. Knoblauch,
Kühhornshofweg 10
60320 Frankfurt (DE)

(54) Reverse apparatus for water-jet propulsor

(57) [OBJECT] To provide a reverse apparatus for a water-jet propulsor, that is designed with reduced size and weight while retaining the reliability of the apparatus.

[CONSTITUTION] A steering nozzle 5 swingable from side to side is mounted rearwardly of an outlet nozzle 2 of a water-jet propulsor, and a flap 11 is provided which is tilted downward to close a rear opening 5D of the steering nozzle 5, forming astern flow passages by working together with curved guide vanes arranged in a row in a steering nozzle bottom, and is lifted upward and held in a substantially horizontal position to open the steering nozzle rear opening 5D. A hydraulic cylinder 9 is disposed upwardly of a steering nozzle upper wall 5A, directly below which is mounted an driving shaft to which the flap 11 is attached. Further, an opening window 6 is formed in the steering nozzle upper wall 5A, and a lever 8 is made to protrude through the opening window 6, an upper end of the lever 8 being connected to the hydraulic cylinder 9 and a lower end thereof connected to the driving shaft 7.

Fig. 1



EP 0 800 991 A1

Description

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Field of Industrial Utilization]

The present invention relates to a reverse apparatus for a water-jet propulsor, wherein a lever is mounted protruding through an opening window formed in an upper wall of a steering nozzle and the upper and lower ends of the lever are connected to a hydraulic unit and an driving shaft, respectively, to form a flap driving mechanism, thereby improving the reliability of the apparatus while achieving a reduction in component count as well as the reduction of the size and weight of the apparatus.

[0002]

[Prior Art]

In recent years, with increasing needs for higher-speed ocean transportation, attention has been being focused on water-jet propelled watercraft that speeds through the water by expelling water jets, pressurized by a water-jet propulsor pump mounted at the stern, through outlet nozzles at fluid speeds of 30 to 50 m/s and by using its reaction as propulsive power.

In such water-jet propelled watercraft, reducing the size and weight of the water-jet propulsor is strongly demanded to attain higher vessel speeds.

[0003]

An example of a reverse apparatus for a water-jet propulsor is shown in Figure 3, which is disclosed in Japanese Patent Unexamined Publication No. 5-278683. According to the disclosed construction, a steering nozzle 33 swingable about a vertical shaft 32 is mounted rearwardly of an outlet nozzle 31 of a water-jet propulsor mounted at the stern; a water jet from the outlet nozzle 31 is introduced into the steering nozzle 33. On the other hand, a horizontally extending driving shaft 36, whose rotation is controlled by a hydraulic unit 34 via a lever 35, is mounted at the rear end of the bottom of the steering nozzle 33. Further, a plurality of deflecting plates capable of deflecting the water jet in a forward direction are provided in a steering nozzle bottom opening 37 formed in a section between the driving shaft 36 and the front end of the bottom of the steering nozzle 33. To the driving shaft 36 is attached a flap 40 that can be held down in a substantially horizontal position to close the flow passages alternately formed between the deflecting plates 38, and that can be lifted up through a limited angle to close a rear opening 39 formed in the steering nozzle 33.

[0004]

[Problems that the Invention Aims to Solve]

In conventional water-jet propulsors, including the one disclosed in the above prior art, the lever 35 provided between the driving shaft 36 and the hydraulic unit 34 is located outside the steering nozzle 33, as shown in Figure 4 (showing the steering nozzle as viewed from the front); the hydraulic unit 34 also is disposed outside and near the center of a steering nozzle side 33a. The lower end portion of the lever 35 is fixed on the driving shaft in integral fashion. This construction therefore requires the provision of a transmitting means, such as a key 41 or a spline, for transmitting the movement of the lever 35a to the flap 40 via the driving shaft 36. This is because if the flap 40 were constructed integral with the driving shaft 36, the flap 40 could not be mounted on or removed from the steering nozzle 33. Furthermore, the driving shaft 36 is not only subjected to a radial force acting on the flap 40, but its size is necessarily increased because of the key 41 or a keyway or spline provided to transmit a torque for operating the flap 40. This constitutes a factor contributing to increased weight.

[0005]

Moreover, since the conventional structure usually requires the provision of the lever 35 and hydraulic unit 34 on each side of the steering nozzle 33, two sets of such components need to be provided. This entails an increase in component count and further increases the weight.

[0006]

Furthermore, if the hydraulic unit 34, etc. are located outside and near the center of the steering nozzle 33, the hydraulic unit 34, the driving shaft 36, the lever 35, and a joint 35a on the hydraulic unit 35 will be submerged under the sea or exposed to the seawater when the vessel is moving at slow speeds or is at anchor, since the draft deepens (at this time, the water surface WL is usually above the steering nozzle 33). The resulting problem is that the hydraulic unit 34, etc. will be damaged because of corrosion, deposition of marine products, etc., impairing the performance and degrading the reliability of the apparatus.

[0007]

In the construction in which the driving shaft 36 is installed at the rear end of the bottom of the steering nozzle 33, the steering nozzle 33 necessarily becomes long, and the weight of the steering nozzle 33 increases accordingly.

[0008]

Further, the water jet discharged from the outlet nozzle 31 tends to disperse more or less as it flows rearward. Therefore, as the steering nozzle 33 becomes longer, the need increases, when the vessel is moving ahead, to hold the flap 40 down onto the deflecting plates 38, as shown in Figure 3, to close the astern flow passages 38 in order to prevent the dispersion at the rearmost position. Moreover, since the driving shaft 36 is located on the bottom of the steering nozzle 33, it is difficult to provide a sufficiently long deflecting plate 38 at that position. In order to smoothly redirect the water jet flow in a forward direction when the vessel is going astern, the flap plate 40a must be provided on its underside with a curved plate 40b having a shape continuing to the curved surface of the deflecting plate 38 (with the driving shaft interposed therebetween).

[0009]

Furthermore, since the flap plate 40a is provided on its upper surface with a reinforcing rib 40c for increased rigidity, when the flap 40 is held down on the deflecting plates 38 the water jet hits the reinforcing rib 40c, perturbing the water flow and thus adversely affecting the thrust.

[0010]

In view of the above-outlined problems of the prior art, it is an object of the present invention to provide a reverse apparatus for a water-jet propulsor, that is designed with reduced size and weight while retaining the reliability of the apparatus.

[0011]

[Means to Solve the Problems]

To accomplish the above object, the means described in claim 1 is a reverse apparatus for use with a water-jet propulsor in which a steering nozzle swingable from side to side is mounted rearwardly of an outlet nozzle of the water-jet propulsor, and a flap is provided which is tilted downward to close a rear opening of the steering nozzle, forming astern flow passages by working together with curved guide vanes arranged in a row in a steering nozzle bottom, and is lifted upward and held in a substantially horizontal position to open the steering nozzle rear opening, the reverse apparatus for use with the water-jet propulsor, characterized in that: a hydraulic unit is disposed upwardly of a steering nozzle upper wall, directly below which is mounted an driving shaft to which the flap is attached, while an opening window is formed in the steering nozzle upper wall and a lever is made to protrude through the opening window, an upper end of the lever being connected to the hydraulic unit and a lower end thereof connected to the driving shaft.

[0012]

The means described in claim 2 is a reverse apparatus for use with the water-jet propulsor, having the construction described in claim 1, and characterized in that the opening window is formed in one position in the center of the steering nozzle upper wall.

[0013]

The means described in claim 3 is a reverse apparatus for use with the water-jet propulsor, having the construction described in claim 1 or 2, and characterized in that, when the flap is lifted up and held in a substantially horizontal position, the flap plate is positioned higher than a bore of the outlet nozzle.

[0014]

The means described in claim 4 is a reverse apparatus for use with the water-jet propulsor, having the construction described claim 1, 2 or 3, and characterized in that the flap plate is formed in a mildly curving shape, and when the flap is tilted downward, the flap plate engages on a curved guide vane located in a rearmost position, forming an astern flow passage of a continuously curved shape.

[0015]

The means described in claim 5 is a reverse apparatus for use with the water-jet propulsor, having the construction described in claim 1, 2, 3, or 4, and characterized in that a shield plate extending full width of the steering nozzle is attached to the driving shaft.

[0016]

[Mode of Operation]

According to the means described in claims 1 to 5, since the hydraulic unit, the lever, the driving shaft, and the joint between the hydraulic unit and lever, which together constitute a flap driving mechanism, are located in the upper part of the apparatus, even when the vessel is at anchor or is moving at slow speeds the mechanism will not be submerged under the sea surface or exposed to the seawater. This construction serves to prevent corrosion, deposition of marine products, etc.

[0017]

Specifically, according to the means described in claim 2, since the lever and the hydraulic unit, forming part of the flap driving mechanism, are disposed in one position in the center of the steering nozzle (in the prior

art, such components were disposed on both sides of the steering nozzle), the number of component parts of the flap driving mechanism is reduced, simplifying the construction of the apparatus.

[0018]

According to the means described in claim 3, neither the flap itself nor the reinforcing rib of the flap interferes with the straight rearward expulsion of the water jet, so that no adverse effects are caused to ahead thrust.

[0019]

According to the means described in claim 4, the curved flap plate (having a warped shape) and the curved guide vane together form a continuously curved flow passage, so that the jet flow is smoothly discharged in a forward direction.

[0020]

Further, according to the means described in claim 5, jet water is prevented from escaping upwardly through the opening window when the vessel is moving astern.

[0021]

[Embodiment]

An embodiment of the present invention will now be described below with reference to the accompanying drawings.

Figure 1 is a longitudinal sectional view of a water-jet propulsor, showing a condition in which the hydraulic unit is operated to tilt the flap downward (indicated by solid lines) to deflect the water jet flow vertically downward and to redirect the jet flow toward the stem (forward) through a plurality of curved guide vanes arranged in the bottom of the steering nozzle, thereby moving the vessel astern. Figure 2(a) shows a top plan view of the same, and (b) shows a cross-sectional view taken along line A-A in Figure 1.

[0022]

As shown in Figures 1 and 2, a pump 1 forming part of the water-jet propulsor installed at the stern is provided at its rear end with a circular outlet nozzle 2 to which a rectangular steering nozzle 5 is connected. More specifically, the front end of the steering nozzle 5 is mounted pivotably by means of upper and lower vertical pins 4 provided on a bracket 3 protruding rearwardly of the outlet nozzle 2, so that the steering nozzle 5 is swingable in horizontal directions about the vertical pins 4, thereby moving the bow in a desired direction.

[0023]

A rectangular opening window 6 is formed in an upper wall 5A of the steering nozzle 5, preferably in one position in the center thereof. A flange 6a is formed on the periphery of the opening window 6, to reinforce the opening periphery. Near the opening window 6 and exposed therethrough, that is, directly below the steering nozzle upper wall 5A, there is disposed an driving shaft 7 extending horizontally in a crosswise direction of the steering nozzle 5. Inserted through the core of the driving shaft 7 is a flap shaft 11A whose ends are supported in respective steering nozzle side walls 5B. On the other hand, bearings 11B are installed inside the driving shaft 7 to support the flap shaft 11A therein, the driving shaft 7 thus being made free to rotate. Further, liners 11C are provided between the driving shaft 7 and the respective steering nozzle side walls 5B, to prevent the driving shaft 7 from moving sideways. The lower end of a lever 8 is attached to a center portion of the driving shaft 7 in integral fashion, the lever 8 protruding upwardly through the opening window 6 and extending upwardly of the steering nozzle upper wall 5A. The size of the opening window 6 is made larger than the moving range of the lever 8. A rod end 9a of a hydraulic cylinder 9 forming part of the hydraulic unit is pivotably connected to the upper end of the lever 8. The hydraulic cylinder 9 is mounted pivotably on amounting base 10 installed at a front end portion of the steering nozzle 5.

[0024]

In the above construction, the driving shaft 7, the flap shaft 11A, the bearings 11B, the liners 11C, the hydraulic cylinder 9, and the joint 9b between the lever 8 and the hydraulic cylinder rod end 9a are located in the upper part or upwardly of the steering nozzle upper wall 5A so that they will not be submerged under the sea surface or exposed to the seawater even when the vessel is at anchor or is moving at slow speeds (at this time, the water surface WL1 is approximately in the upper part of the steering nozzle 5). WL2 indicates the sea surface when the vessel is moving at high speed.

[0025]

Furthermore, since the shaft 7 is disposed in the upper part of the steering nozzle, not on the bottom thereof, the overall length of the steering nozzle 5, that is, the distance from an outlet nozzle end 2a to a steering nozzle rear end 5a, can be shortened, which contributes to reducing the size of the steering nozzle 5 and hence, a reduction in weight.

[0026]

A shield plate 7a extending full width of the steering nozzle 5 is attached to the driving shaft 7. The shield plate 7a engages on a receive plate 7b pivotably

attached to the vertical pin 4 and thus acts as a stopper for the lever 8, while acting at the same time to prevent upwardly splashing water from escaping through the opening window 6 when the water jet hits and bounces off the flap 11 held in the closed position shown in Figure 1.

[0027]

The flap 11 is fixed on the driving shaft in integral fashion. The flap 11 consists of a flap plate 11a and a reinforcing rib 11b mounted vertically thereon. The driving shaft 7 is inserted through the reinforcing rib 11b. The flap plate 11a is formed in a mildly curving shape. In other words, the flap plate 11a has a mildly warped shape.

[0028]

On the other hand, in the bottom opening 5C of the steering nozzle 5, there are formed a plurality of curved guide vanes 12 arranged in a row, as shown in Figure 1; astern flow passages 13 for redirecting the water jet flow in a forward direction are formed alternately between them. The curved guide vanes 12 each have a length sufficient to redirect and straighten the jet flow. Reference numeral 14 indicates a round pipe, installed between the steering nozzle side walls 5B, for forming a flow passage between it and the curved guide vane 12 at the front end of the steering nozzle bottom. Attached to the round pipe 14 are a pair of upper and lower supporting members 15 which are supported on the vertical pin 4. The round pipe 14 also acts as a rigid member for preventing the steering nozzle side walls from deflecting sideways by the jet flow hitting against them when the steering nozzle 5 is swung horizontally to steer the vessel.

[0029]

When the vessel is moving ahead, with the hydraulic cylinder 9 retracted as shown by imaginary lines in Figure 1, the flap 11 is held in a substantially horizontal position as shown by imaginary lines, and the rear end opening 5D is in a full open position, so that the water jet is expelled straight rearward, generating the ahead thrust. Since, at this time, the flap plate 11a is positioned higher than the bore of the outlet nozzle 2, the flap plate 11a does not interfere with the rearward expulsion of the water jet. In this forward moving condition, the flow passages formed between the curved guide vanes 12 are open, but since the distance from the outlet nozzle end 2a to the steering nozzle rear end 5a is short, as previously described, the dispersion of the water jet along this distance is minimal, virtually eliminating the possibility of the water jet escaping through the opened astern flow passages 13 (in other words, the length of the steering nozzle 5 is reduced to within a range where the water jet flows without dispersion). As a result, no adverse effects are caused to the thrust.

[0030]

When the vessel is moving astern, the hydraulic cylinder 9 is extended to move the lever 8 rearward, as shown in Figure 1, thereby holding down the flap 11 in a tilted position (shown by solid lines) to block the forward expulsion of the water jet and to redirect the water jet, hitting against the flap 11, in a downward direction so that the water jet is expelled toward the stem through the curved guide vanes 12, its reaction providing a stern thrust to the vessel. In this case, the curved flap plate 11a engages on the curved guide vane 12a located at the rear end, forming a continuously curved astern flow passage 13 and thus facilitating smooth redirection of the water jet in a forward direction.

[0031]

In the construction shown in Figure 1, the lower end of each curved guide vane 12 is protruding below the bottom of the steering nozzle 5, but these protruding ends are clear of the water and do not cause resistance to the water when the vessel is moving at high speed since the water surface WL2 at this time is below the protruding ends. Depending on the position of the water surface WL2, the curved guide vanes 12 may be made so that their lower ends do not protrude below the bottom of the steering nozzle 5 (that is, the lower ends are made flush with the underside surface of the steering nozzle).

[0032]

[Effect of the Invention]

In the claims 1 to 5, since the flap driving mechanism comprising the hydraulic unit, the driving shaft (flap shaft), and the joint between the hydraulic unit and lever, is located in the upper part of the apparatus, even when the vessel is at anchor or is moving at slow speeds the mechanism will not be submerged under the sea surface or exposed to the seawater. This prevents corrosion, deposition of marine products, etc., and thus improves the reliability of the apparatus.

[0033]

Specifically, in claim 2, an opening window is formed in the center of the steering nozzle upper wall so that the lever and the hydraulic unit, forming part of the flap driving mechanism, can be disposed in one position in the center of the steering nozzle (in the prior art, such components were disposed on both sides of the steering nozzle). This construction serves to reduce the number of components parts of the flap driving mechanism, simplifying the construction of the apparatus,

while achieving at the same time the reduction of the apparatus weight.

[0034]

In claim 3, since the flap does not interfere with the straight rearward expulsion of the water jet, and since the reinforcing rib of the flap does not disturb the jet flow, no adverse effects are caused to ahead thrust, and the ahead thrust can thus be increased.

[0035]

In claim 4, the curved flap plate has a shape that continues to the curved guide vane to form a smooth astern flow passage, which serves to increase the reverse thrust.

[0036]

Further, in claim 5, since the upward dispersion of the water jet, when the vessel is moving astern, can be prevented, adverse effects on the reverse thrust can be eliminated.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Figure 1]

Figure 1 is a longitudinal sectional view of a steering nozzle, including an outlet nozzle, in a water-jet propulsor according to the present invention.

[Figure 2]

Part (a) is a top plan view of the steering nozzle, and part (b) is a cross-sectional view taken along line A-A in Figure 1.

[Figure 3]

Figure 3 is a longitudinal sectional view of a steering nozzle, including a flap, an driving shaft, and a lever, in a water-jet propulsor according to the prior art.

[Figure 4]

Figure 4 is a front view of the prior art steering nozzle including the flap, driving shaft, and lever.

[DESCRIPTION OF THE REFERENCE NUMERALS]

1 ... Pump, 2 ... Outlet nozzle, 5 ... Steering nozzle, 5A ... Steering nozzle upper wall, 5B ... Steering nozzle side wall, 5C ... Steering nozzle bottom opening, 5D ... Steering nozzle rear opening, 6 ... Opening window, 7... Driving shaft, 8 ... Lever, 9 ... Hydraulic cylinder (Hydraulic unit), 11 ... Flap, 11a ... Flap plate, 11b ... Reinforcing rib, 12 ... Curved guide vane, 13 ... Astern flow passage

Claims

1. In a water-jet propulsor in which a steering nozzle swingable from side to side is mounted rearwardly of an outlet nozzle of the water-jet propulsor, and a flap is provided which is tilted downward to close a rear opening of the steering nozzle, forming astern flow passages by working together with curved guide vanes arranged in a row in a steering nozzle bottom, and is lifted upward and held in a substantially horizontal position to open the steering nozzle rear opening, a reverse apparatus for use with the water-jet propulsor, characterized in that:

   a hydraulic unit is disposed upwardly of a steering nozzle upper wall, directly below which is mounted an driving shaft to which the flap is attached, while an opening window is formed in the steering nozzle upper wall and a lever is made to protrude through the opening window, an upper end of the lever being connected to the hydraulic unit and a lower end thereof connected to the driving shaft.

2. A reverse apparatus for use with the water-jet propulsor, according to claim 1, wherein the opening window is formed in one position in the center of the steering nozzle upper wall.

3. A reverse apparatus for use with the water-jet propulsor, according to claim 1 or 2, wherein when the flap is lifted up and held in a substantially horizontal position, the flap plate is positioned higher than a bore of the outlet nozzle.

4. A reverse apparatus for use with the water-jet propulsor, according to claim 1, 2 or 3, wherein the flap plate is formed in a mildly curving shape, and when the flap is tilted downward, the flap plate engages on a curved guide vane located in a rearmost position, forming an astern flow passage of a continuously curved shape.

5. A reverse apparatus for use with the water-jet propulsor, according to claim 1, 2, 3, or 4, wherein a shield plate extending full width of the steering nozzle is attached to the driving shaft.

Fig 1

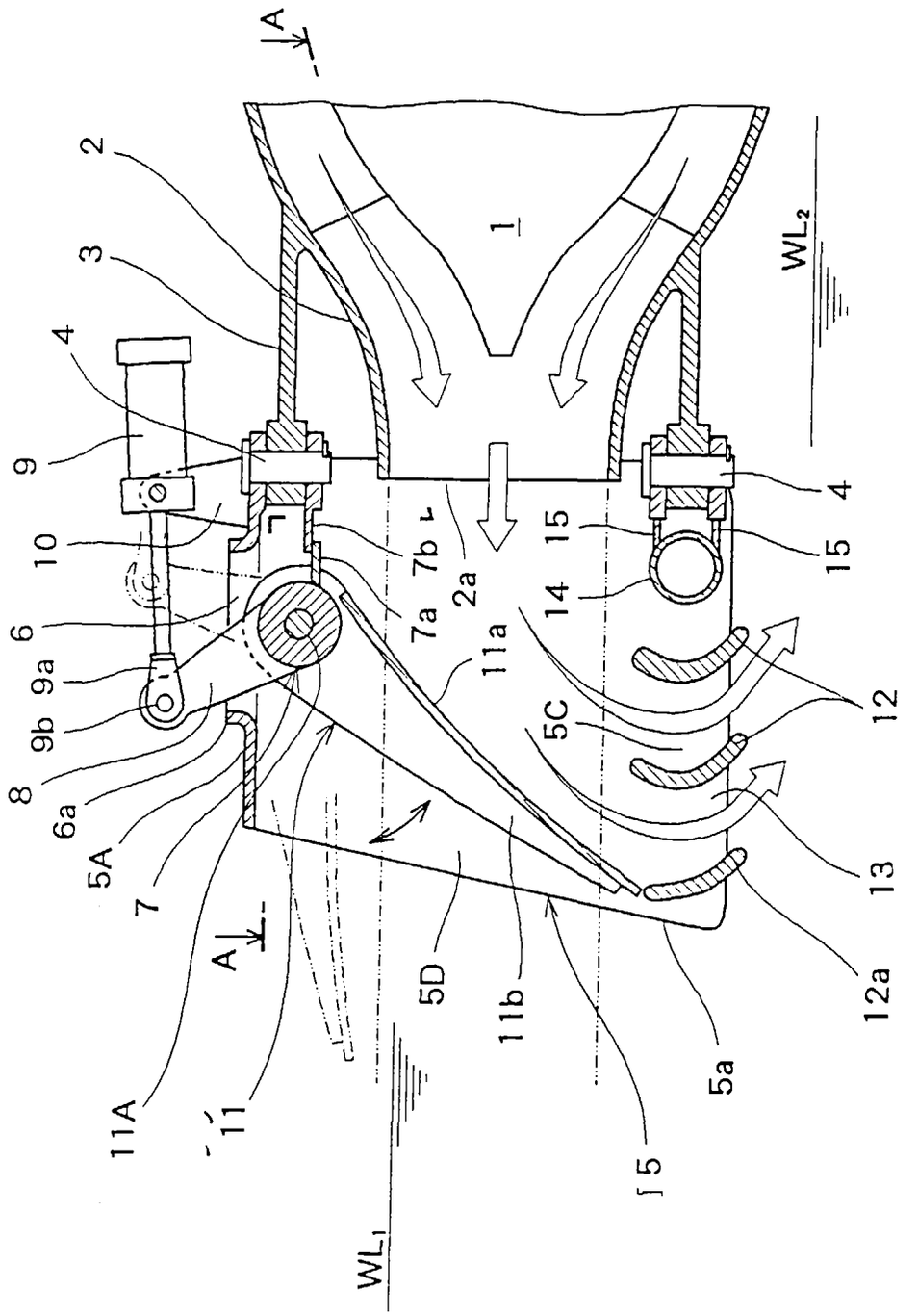
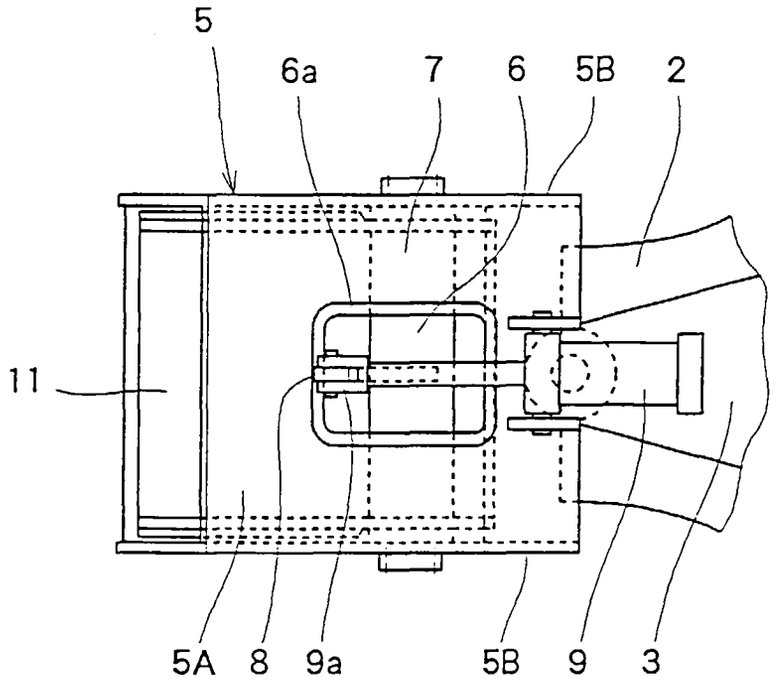
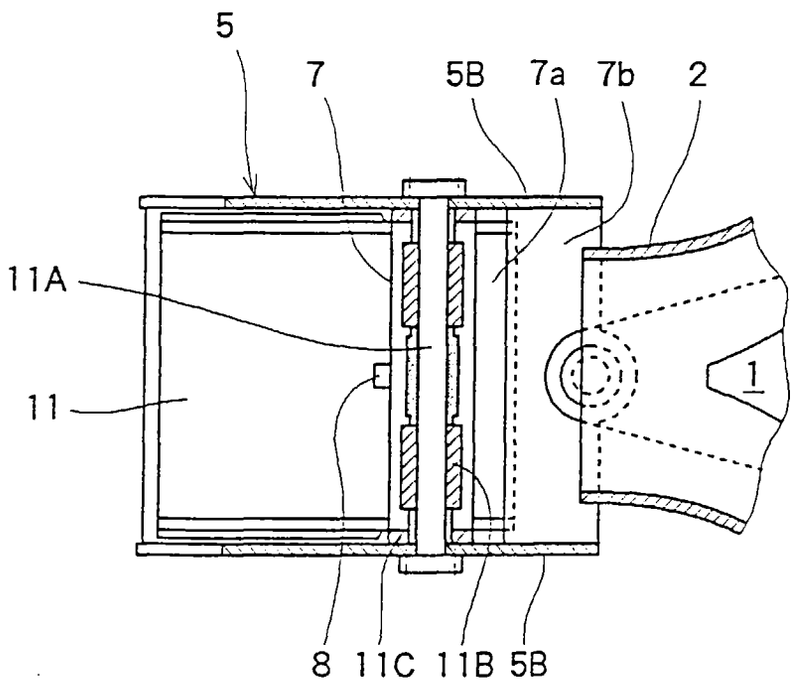

A
2
3
4
9
10
6
9a
9b
8
6a
5A
7
A
11A
11
WL1
5D
11b
5a
15
12a
13
12
5C
11a
14
15
4
7a
7b
2a
1
WL2

Fig 2.



(a)



(b)

Fig 3

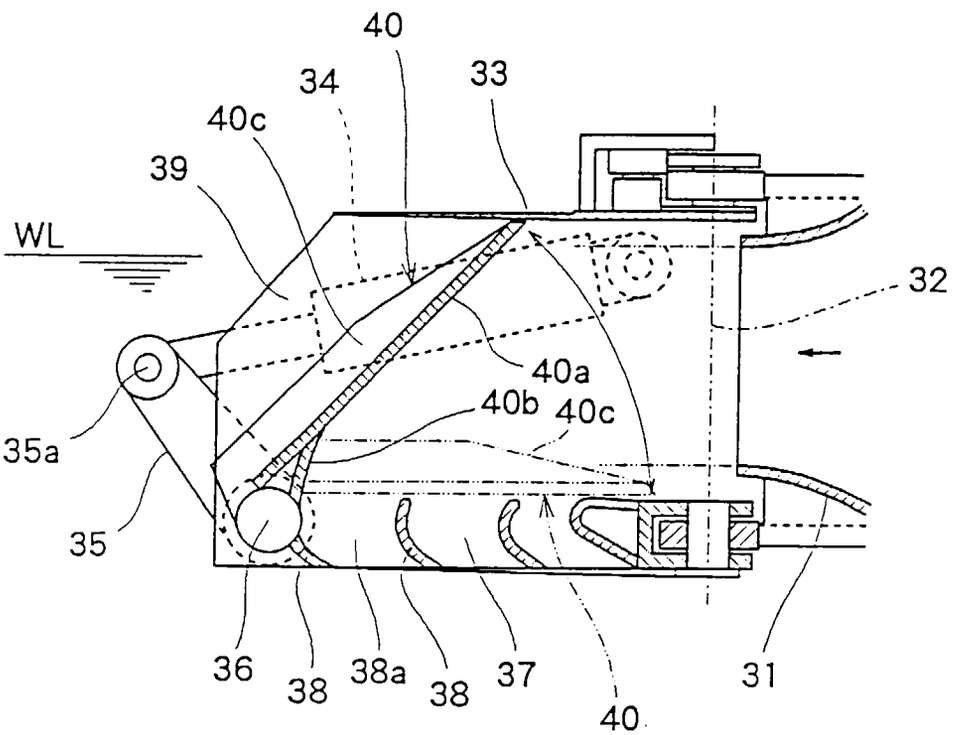
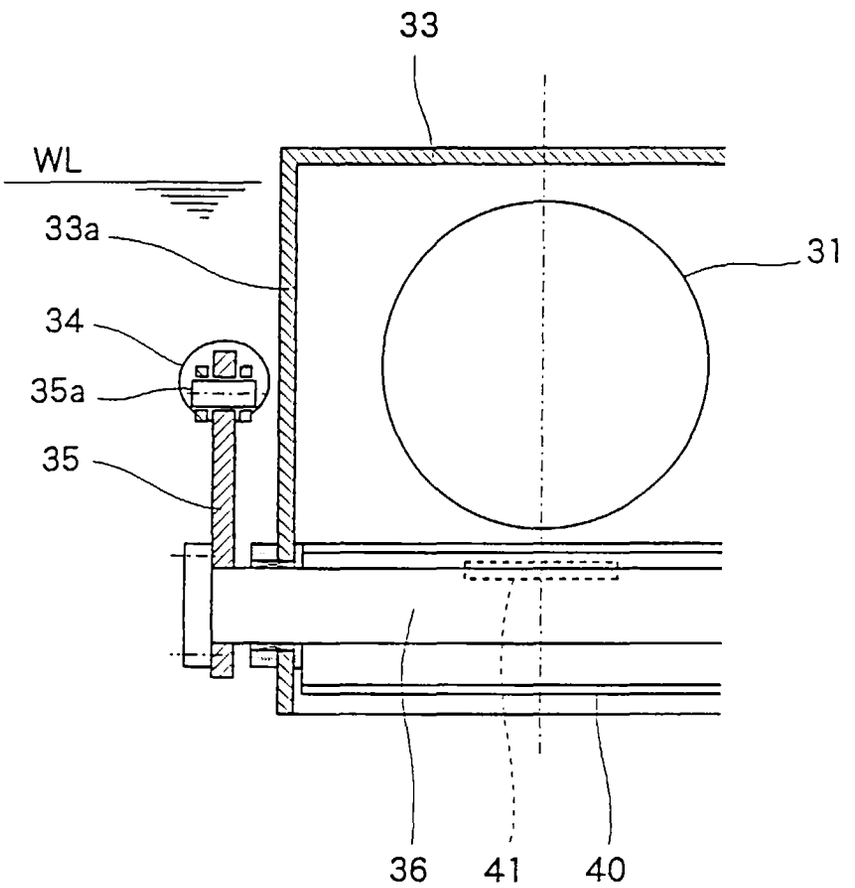


Fig 4



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EUROPEAN SEARCH REPORT

Application Number
EP 96 10 5431

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
D,A	JP-A-05 278 683 (MITSUBISHI HEAVY INDUSTRIES) * abstract; figures *	1	B63H11/107
A	US-A-3 127 741 (J.POTTHARST) * claim 1; figures *	1	
A	US-A-3 788 265 (C.MOORE) * abstract; figures *	1	
A	EP-A-0 085 035 (KAMEWA AB) * abstract; figures *	1,4	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B63H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 September 1996	Stierman, E

CATEGORY OF CITED DOCUMENTS

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