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Matsunaga et al.

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(54) **OUTBOARD MOTOR AND MARINE VESSEL**

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B63H 20/00	(2006.01)
B63H 25/02	(2006.01)

(52) **U.S. Cl.**

CPC ***B63H 20/12*** (2013.01); *B63H 2020/003* (2013.01); *B63H 2025/022* (2013.01)

(58) **Field of Classification Search**

CPC B63H 20/12; B63H 2020/003; B63H 2025/022

See application file for complete search history.

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(57) **ABSTRACT**

An outboard motor includes an oil chamber, an oil passage connected to the oil chamber via an oil passage connection port, and an air guide, located in a vicinity of or adjacent to the oil passage connection port in a right-left direction of an outboard motor body, to guide air remaining in the oil chamber to the oil passage connection port when hydraulic oil is discharged from the oil chamber via the oil passage.

20 Claims, 9 Drawing Sheets

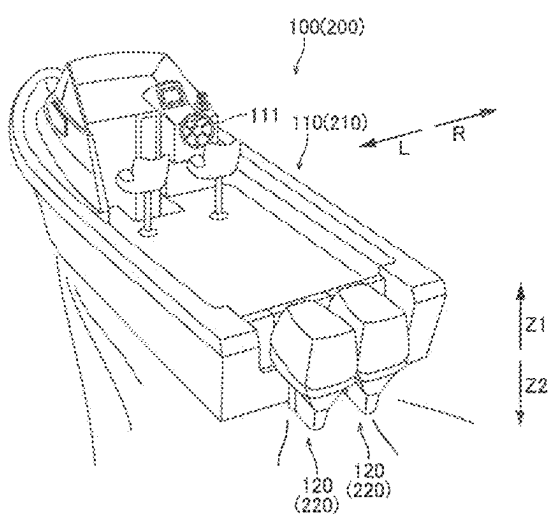
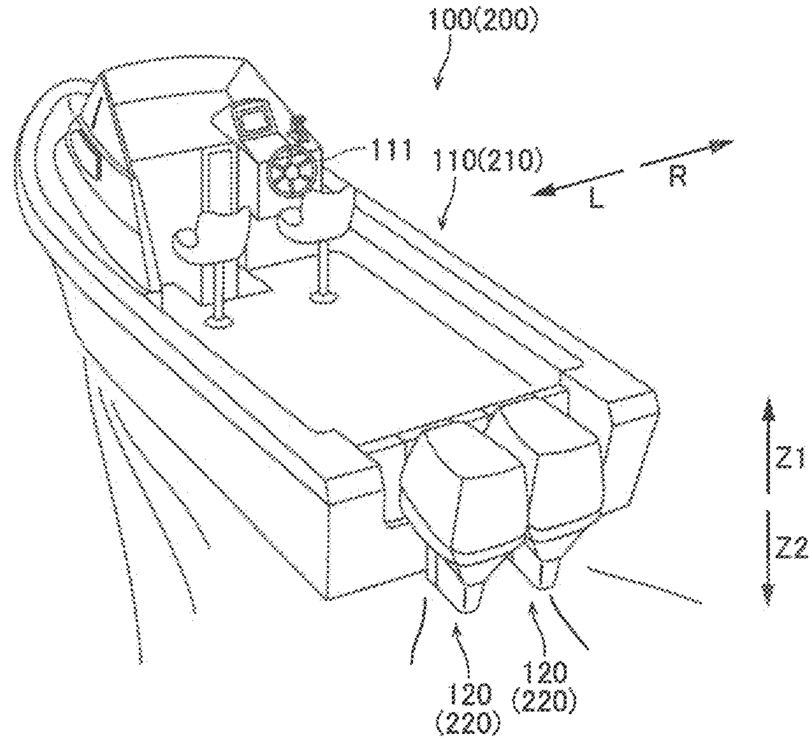


FIG.1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111
110(210)
L
R
Z1
Z2
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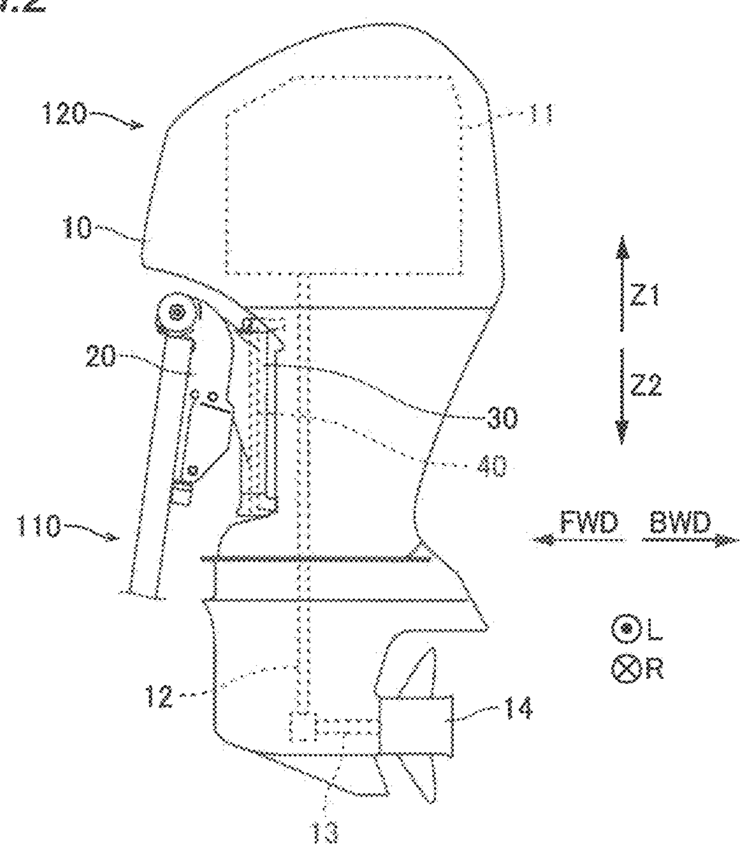
(220)
120
(220)

FIG.2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Z1
Z2
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30
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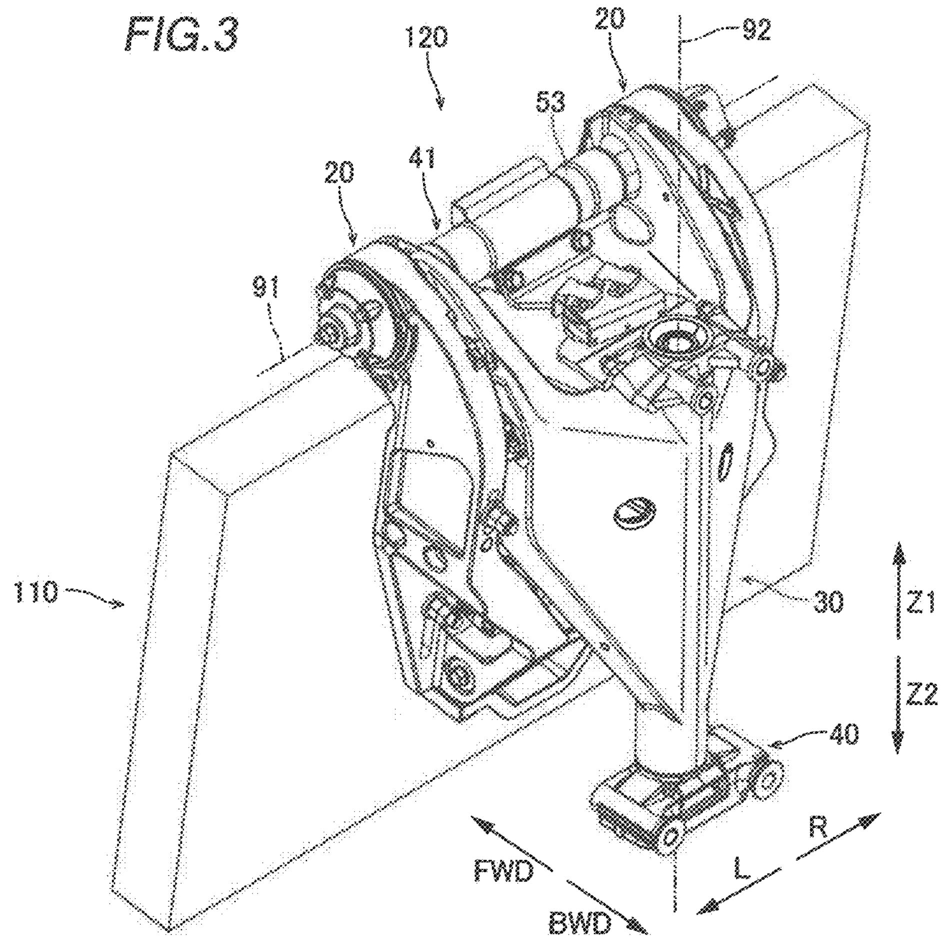
110
FWD
BWD
L
R
12
14
13

FIG.3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30
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Z2
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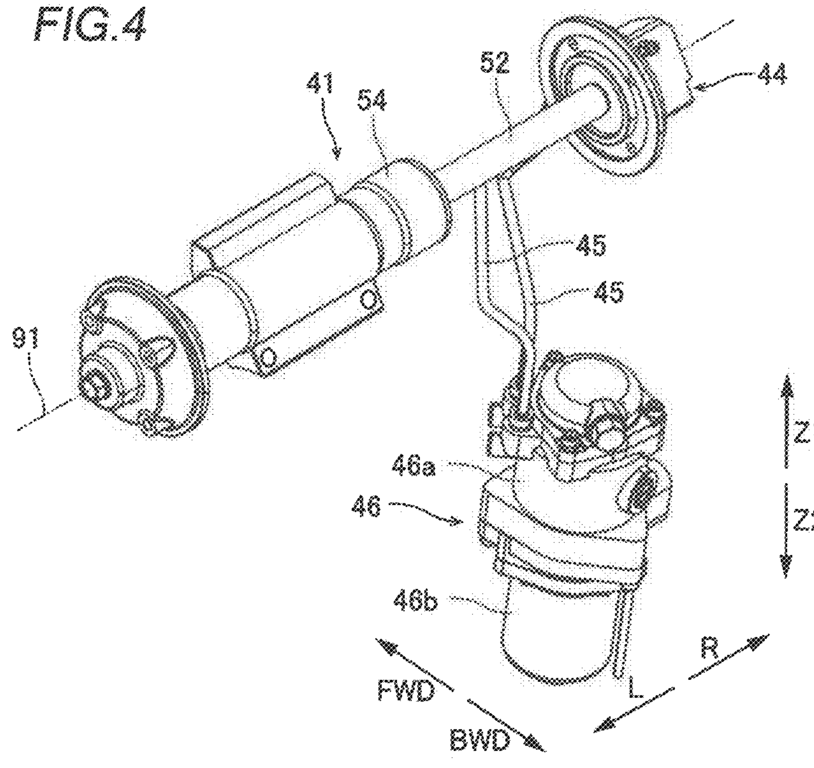
FWD
BWD

FIG.4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Z1
46a
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Z2
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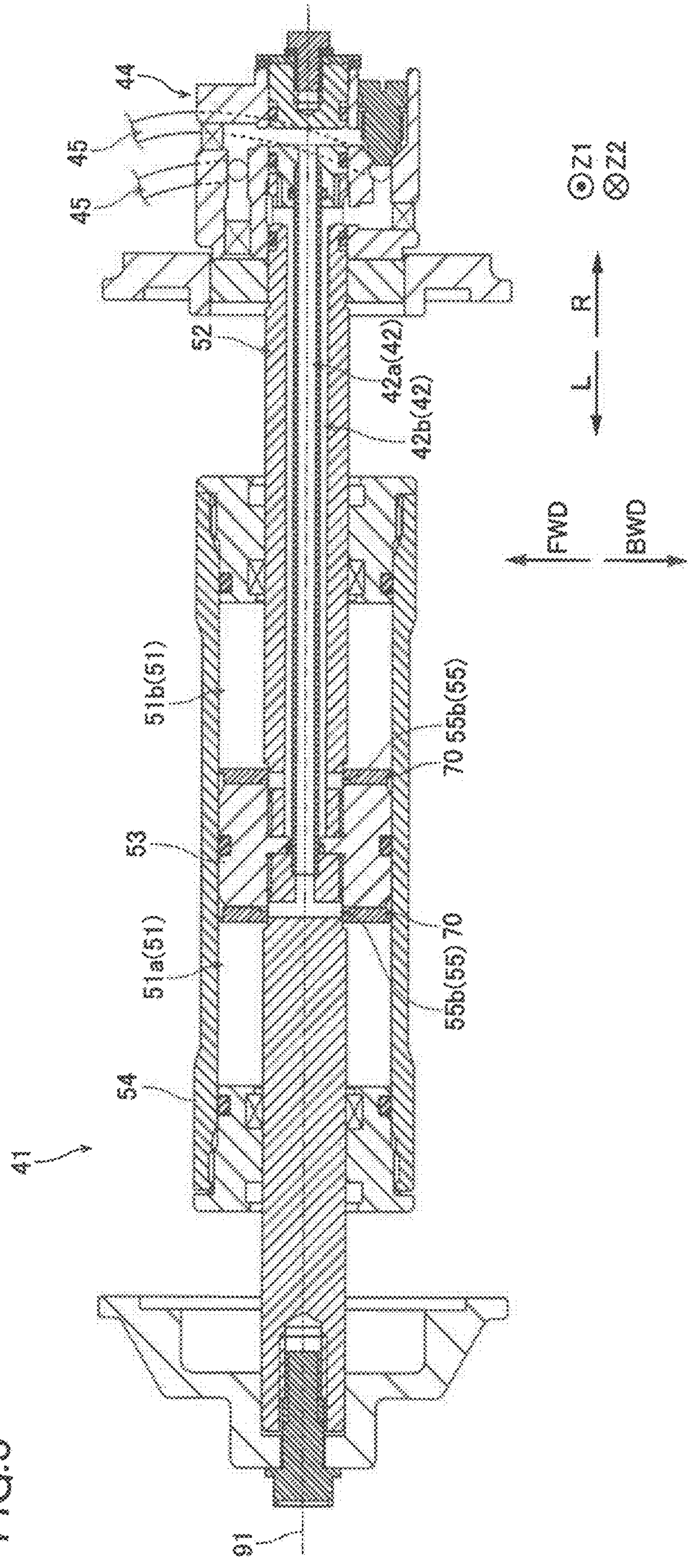
BWD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45
45
52
42a(42)
42b(42)
Z1
Z2
R
L
FWD
BWD
51b(51)
70 55b(55)
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51a(51)
55b(55) 70
54
41
91

FIG.5

FIG.6

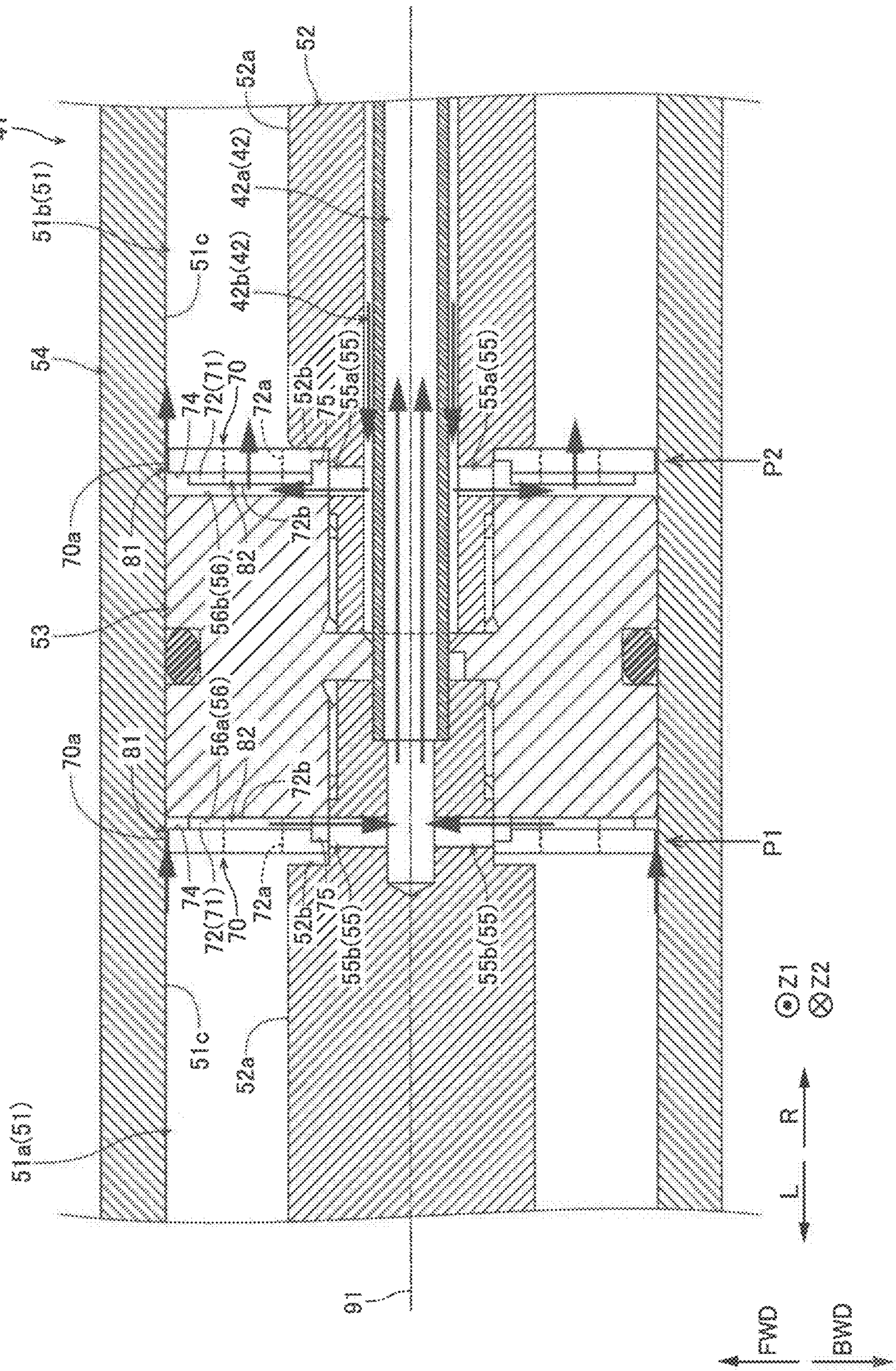
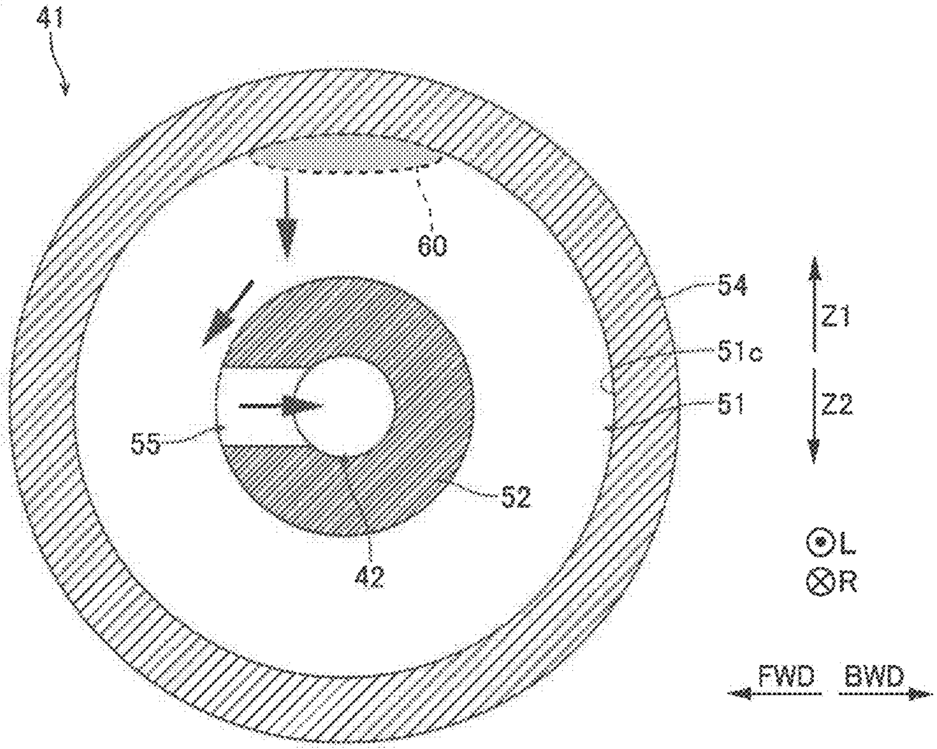

41
52
52a
42a(42)
42b(42)
51b(51)
51c
54
74
72(71)
70
72a
52b
75
55a(55)
P2
70a
81
82
72b
56b(56)
53
56a(56)
P1
55b(55)
Z1
Z2
R
L
51a(51)
91
FWD
BWD

FIG.7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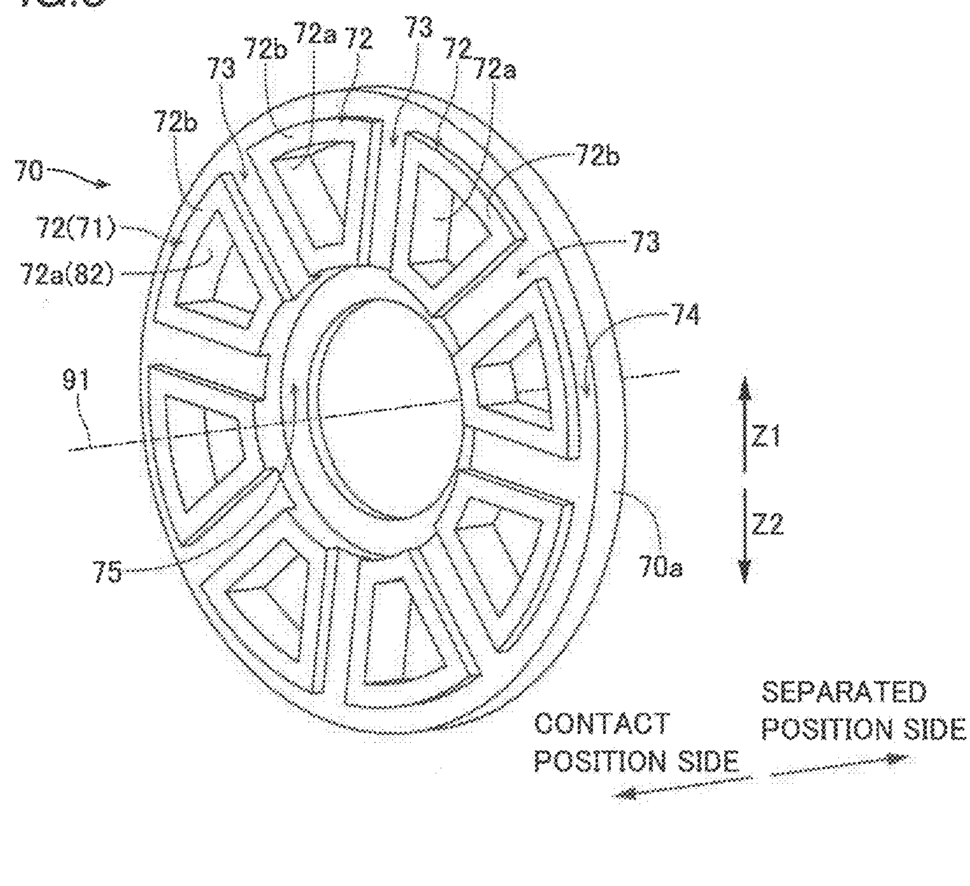
60
54
51c
51
55
52
42
Z1
Z2
L
R
FWD
BWD

FIG.8


73
72b
72a
72
73
72
72a
72b
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72b
72(71)
72a(82)
73
74
91
Z1
Z2
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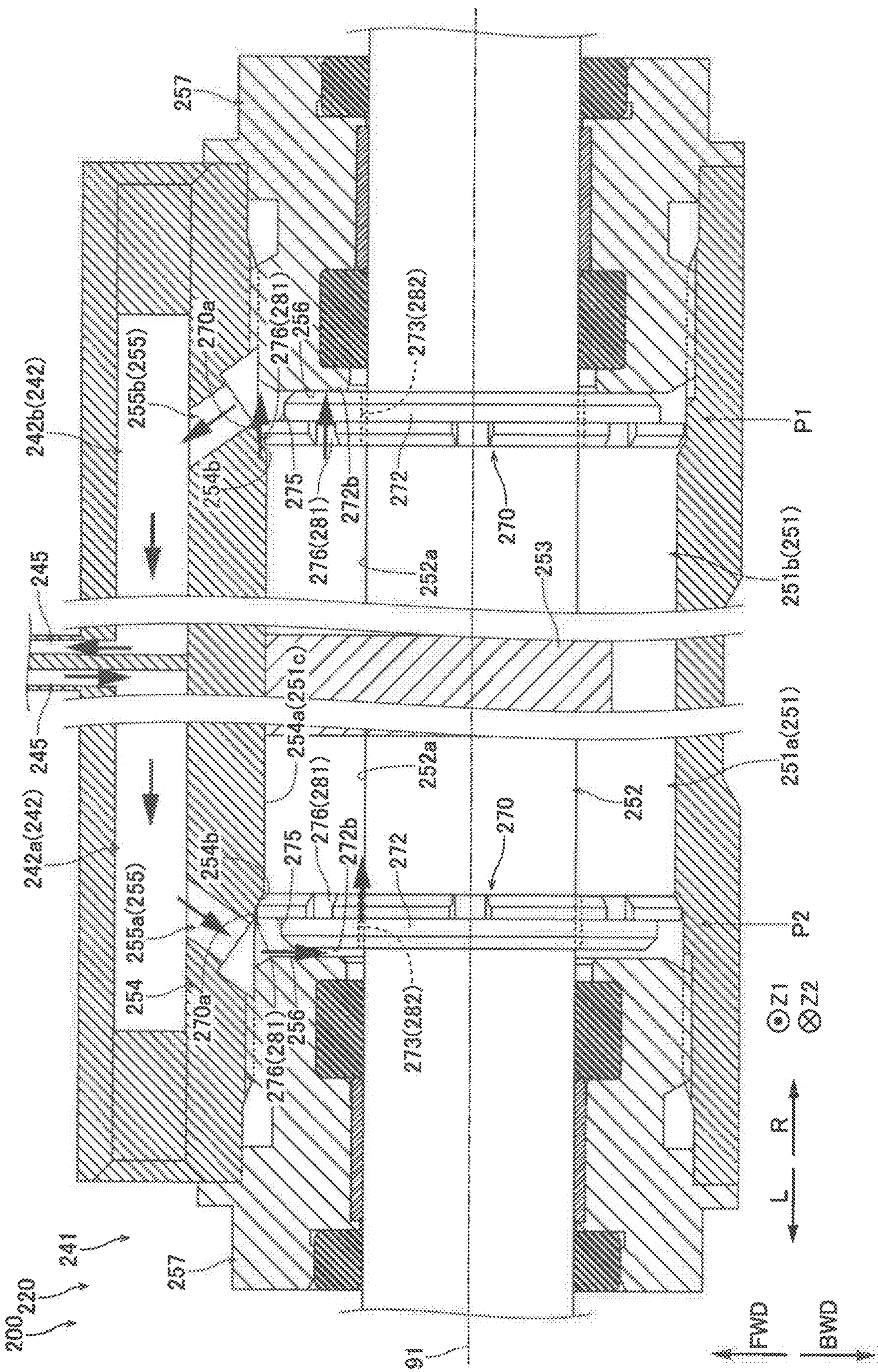
70a
CONTACT POSITION SIDE
SEPARATED POSITION SIDE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256
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275
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272
270
252a
253
251b(251)
P1
245
254a(251c)
251a(251)
242a(242)
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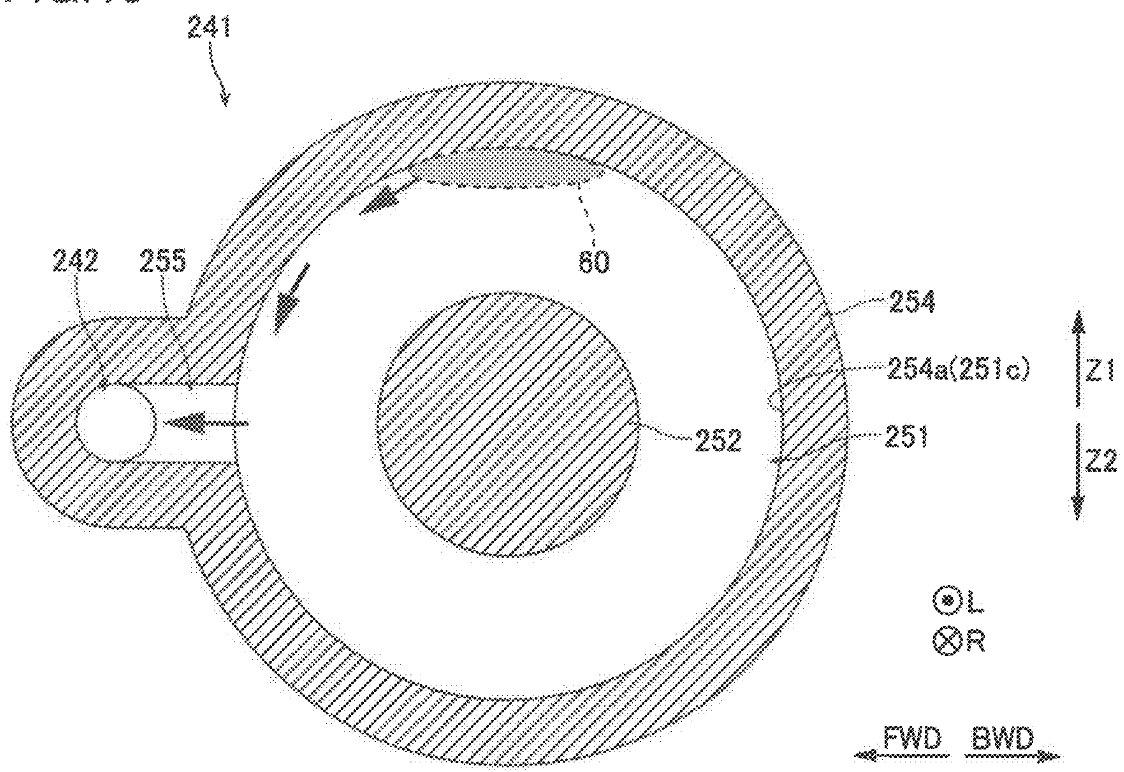
254
252
P2
Z1
Z2
R
L
FWD
BWD
91
FIG. 9

FIG.10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Z1
Z2
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FWD
BWD

FIG.11

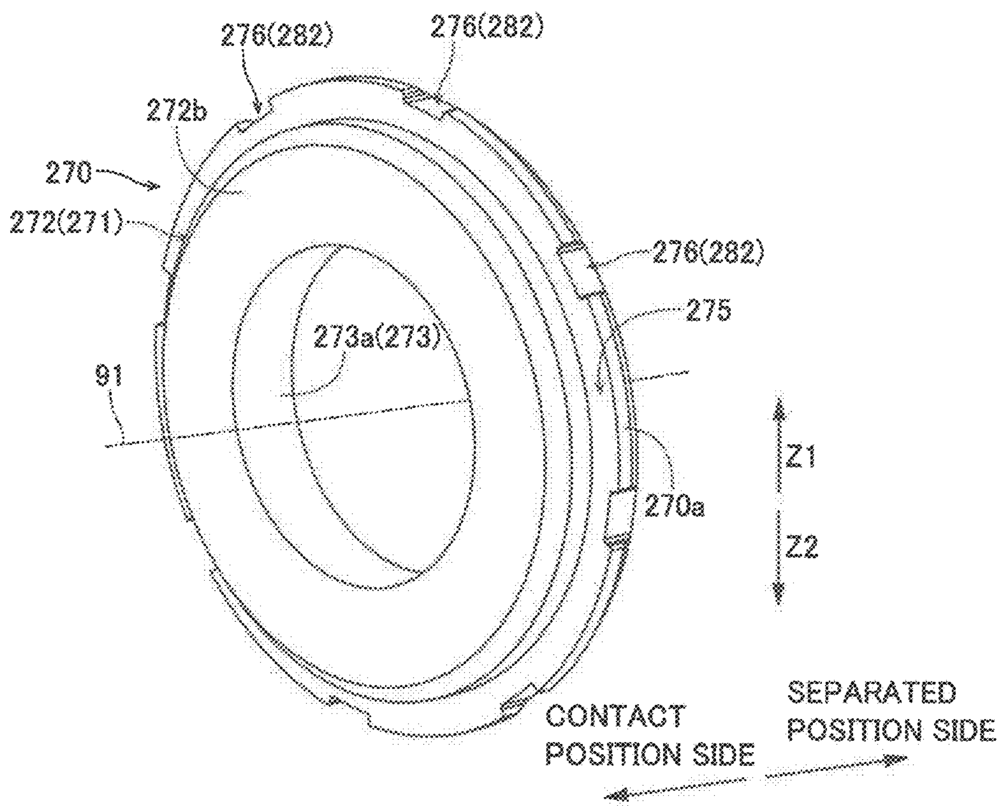

276(282)
276(282)
272b
270
272(271)
276(282)
275
273a(273)
91
Z1
270a
Z2
CONTACT
POSITION SIDE
SEPARATED
POSITION SIDE

FIG.12

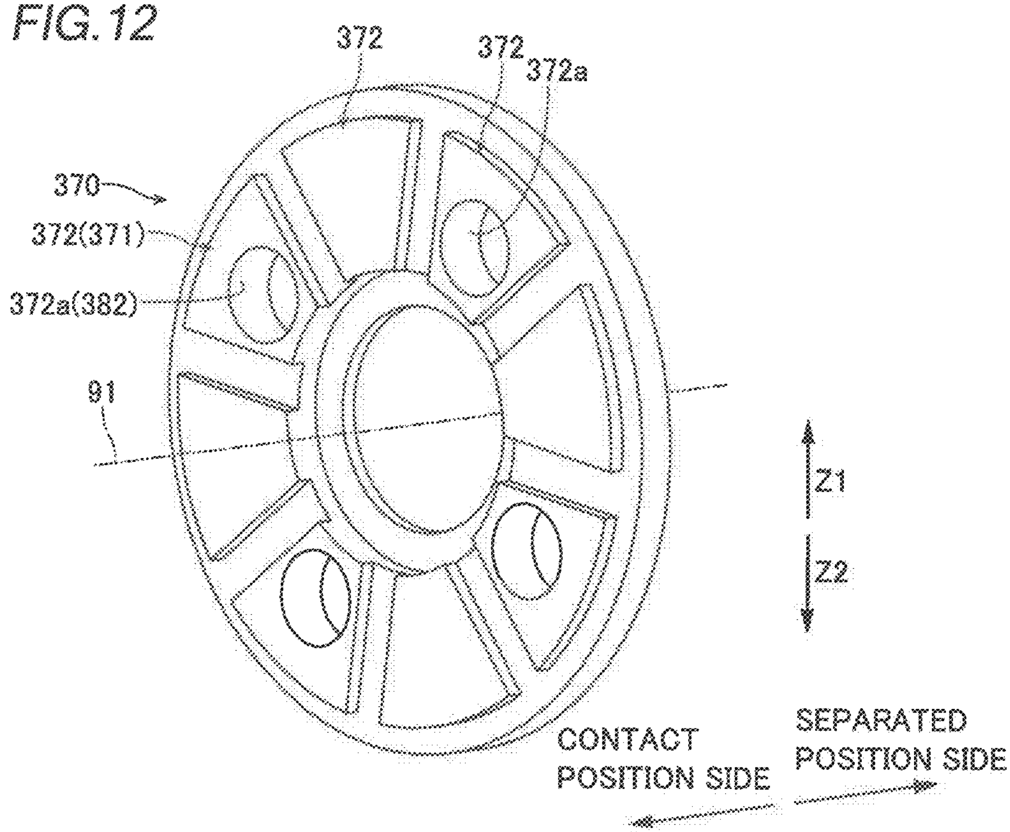
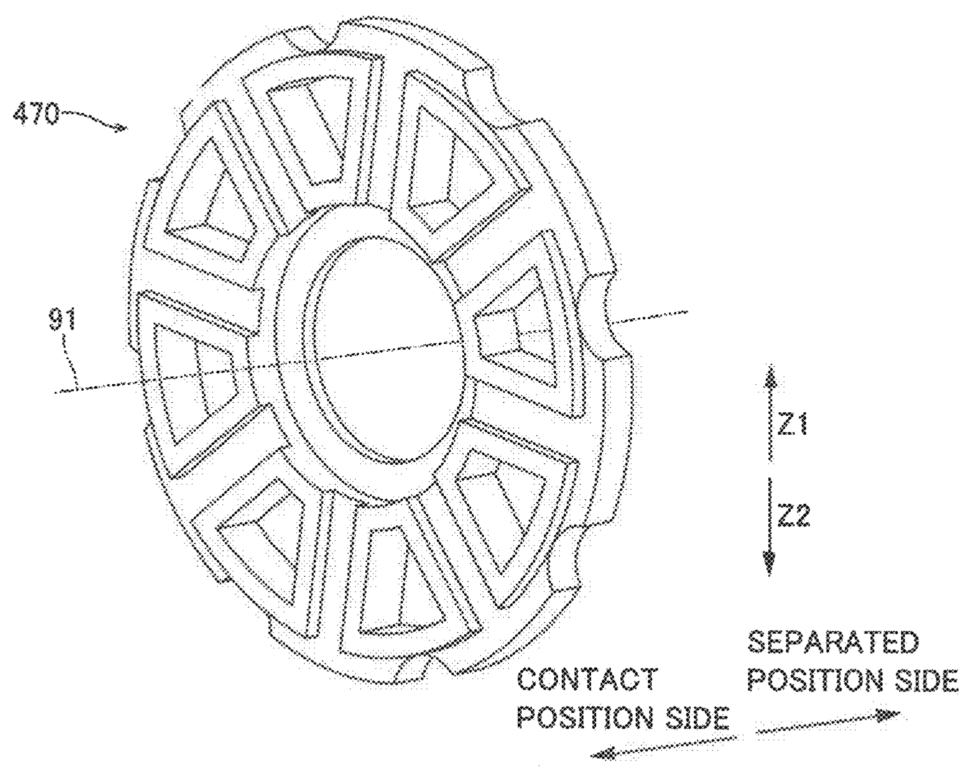

372
372
372a
370
372(371)
372a(382)
91
Z1
Z2
CONTACT
POSITION SIDE
SEPARATED
POSITION SIDE

FIG.13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91
Z1
Z2
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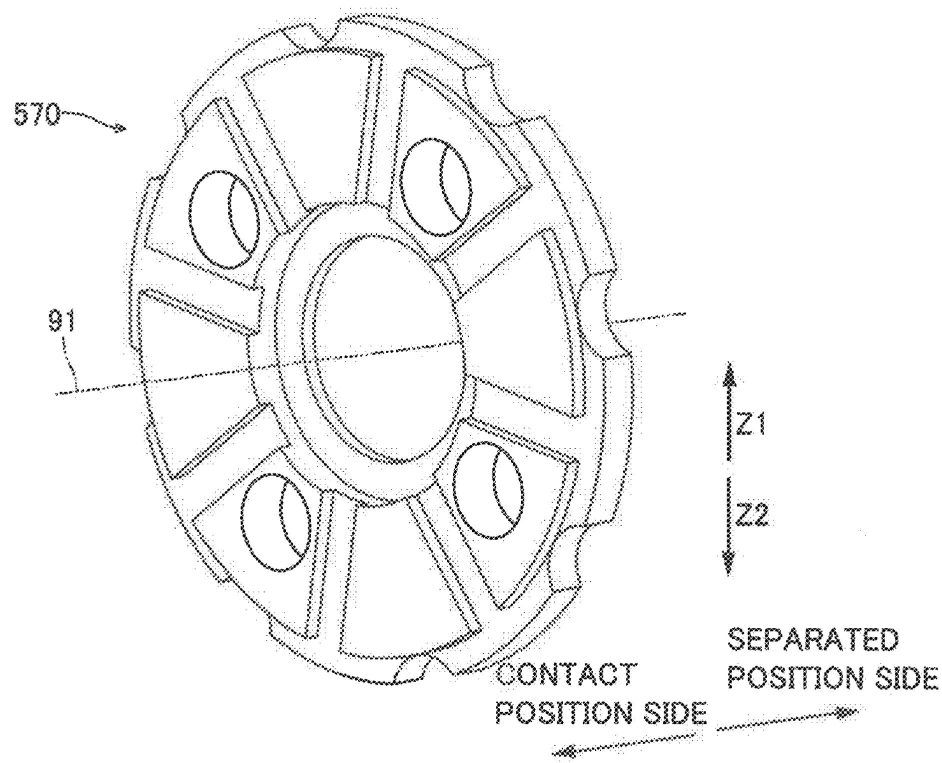
POSITION SIDE
SEPARATED
POSITION SIDE

FIG. 14



OUTBOARD MOTOR AND MARINE VESSEL

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of priority to Japanese Patent Application No. 2021-071161 filed on Apr. 20, 2021. The entire contents of this application are hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an outboard motor and a marine vessel, and more particularly, it relates to an outboard motor and a marine vessel each including a steering cylinder that rotates a steering shaft to rotate an outboard motor body in a right-left direction.

2. Description of the Related Art

An outboard motor including a steering cylinder that rotates a steering shaft to rotate an outboard motor body in a right-left direction is known in general. Such an outboard motor is disclosed in Japanese Patent Laid-Open No. 2020-168889, for example.

Japanese Patent Laid-Open No. 2020-168889 discloses an outboard motor including a steering cylinder that exerts a steering force on an outboard motor body. In the outboard motor disclosed in Japanese Patent Laid-Open No. 2020-168889, the steering cylinder extends in a right-left direction. The steering cylinder is connected to a steering shaft via a link mechanism. An oil chamber in the steering cylinder is connected to a steering pump via an oil passage, and hydraulic oil is supplied to and discharged from the oil chamber. The steering cylinder is driven (is moved in the right-left direction) by the hydraulic oil to generate a steering force so as to rotate the outboard motor body about the steering shaft. In the outboard motor disclosed in Japanese Patent Laid-Open No. 2020-168889, a connection port of the oil chamber in the steering cylinder to the oil passage is provided on the side of (lateral to) the steering cylinder that extends in the right-left direction.

In the outboard motor disclosed in Japanese Patent Laid-Open No. 2020-168889, as described above, the connection port of the oil chamber in the steering cylinder to the oil passage is provided on the side of (lateral to) the steering cylinder, and thus when air enters the oil chamber, the air stays in the oil chamber without escaping. When the air stays in the oil chamber, the operation of the steering cylinder may become unstable. Therefore, although not clearly described in Japanese Patent Laid-Open No. 2020-168889, an operator performs an operation to discharge air from the oil chamber to the outside (an air bleeding operation for the oil chamber) when air enters the oil chamber in a conventional outboard motor as disclosed in Japanese Patent Laid-Open No. 2020-168889. The air bleeding operation for the oil chamber includes a complex operation such as tilting a steering cylinder such that a connection port to an oil passage is located on the upper side of the steering cylinder after removing the steering cylinder from an outboard motor body, for example. Therefore, it is desired to easily bleed air from the oil chamber in the steering cylinder.

SUMMARY OF THE INVENTION

Preferred embodiments of the present invention provide outboard motors and marine vessels that each facilitate air bleeding from oil chambers in steering cylinders.

An outboard motor according to a preferred embodiment of the present invention includes an outboard motor body, a steering shaft, a steering cylinder including a piston rod extending in a right-left direction of the outboard motor body, a piston fixed to the piston rod, and a cylinder body including therein the piston and an oil chamber to store hydraulic oil, an oil passage connected to the oil chamber via an oil passage connection port to supply the hydraulic oil to the oil chamber and discharge the hydraulic oil from the oil chamber, and an air guide, located in a vicinity of or adjacent to the oil passage connection port in the right-left direction, to guide air remaining in the oil chamber to the oil passage connection port when the hydraulic oil is discharged from the oil chamber via the oil passage, wherein the steering cylinder is operable to rotate the steering shaft and the outboard motor body in the right-left direction by adjusting an amount of the hydraulic oil in the oil chamber and moving the cylinder body in the right-left direction.

An outboard motor according to a preferred embodiment of the present invention includes the air guide located in the right-left direction in the vicinity of or adjacent to the oil passage connection port to guide the air remaining in the oil chamber to the oil passage connection port when the hydraulic oil is discharged from the oil chamber via the oil passage. Accordingly, when the hydraulic oil is discharged from the oil chamber via the oil passage, the air guide guides the air remaining in the oil chamber to the oil passage connection port. That is, the air remaining in the oil chamber is guided to the oil passage connection port by the normal operation of the steering cylinder that discharges the hydraulic oil from the oil chamber via the oil passage, and thus the air is automatically discharged from the oil chamber to the outside without an operator performing a complex operation such as tilting the steering cylinder. Consequently, the air in the oil chamber of the steering cylinder is easily bled therefrom. Furthermore, the air is bled at any time only by a user of a marine vessel performing a steering operation (to change the propulsion direction of the marine vessel) while maneuvering the marine vessel, without the operator performing an air bleeding operation.

In an outboard motor according to a preferred embodiment of the present invention, the air guide preferably guides air remaining in an upper portion of the oil chamber to the oil passage connection port via an outer peripheral side flow passage provided on an outer peripheral side of the air guide when the hydraulic oil is discharged from the oil chamber. Accordingly, the upper portion (outer peripheral side) of the oil chamber is closer to the outer peripheral side flow passage than the inner peripheral side of the oil chamber, and the air is lower in viscosity than the hydraulic oil, and thus when the hydraulic oil is discharged from the oil chamber via the oil passage, the air remaining in the upper portion (outer peripheral side) of the oil chamber is preferentially discharged to the outside from the oil chamber via the outer peripheral side flow passage. Consequently, when the hydraulic oil is discharged from the oil chamber via the oil passage, the air guide reliably guides the air remaining in the upper portion of the oil chamber to the oil passage connection port.

In such a case, the air guide preferably has a disk shape, and the outer peripheral side flow passage is preferably defined by an outer peripheral surface of the air guide and an inner peripheral surface of the oil chamber. Accordingly, with the air guide, the outer peripheral side flow passage that guides the air remaining in the upper portion (outer peripheral side) of the oil chamber to the oil passage connection port is easily provided on the outer peripheral side of the air guide.

In an outboard motor in which the air remaining in the upper portion of the oil chamber is guided to the oil passage connection port via the outer peripheral side flow passage provided on the outer peripheral side of the air guide, the air guide preferably supplies the hydraulic oil to the oil chamber via an inner peripheral side flow passage provided on an inner peripheral side of the outer peripheral side flow passage in addition to the outer peripheral side flow passage when the hydraulic oil is supplied to the oil chamber. Accordingly, when the hydraulic oil is supplied to the oil chamber, the sectional area of a flow passage through which the hydraulic oil is supplied is increased as compared with a case in which the flow passage through which the hydraulic oil is supplied is limited to the outer peripheral side flow passage. Consequently, the pressure loss of the hydraulic oil is decreased when the hydraulic oil is supplied to the oil chamber.

In such a case, the air guide preferably moves in the right-left direction in the oil chamber to close the inner peripheral side flow passage when the hydraulic oil is discharged from the oil chamber and to open the inner peripheral side flow passage when the hydraulic oil is supplied to the oil chamber. Accordingly, the air guide is moved in the right-left direction in the oil chamber such that the outer peripheral side flow passage is easily provided when the hydraulic oil is discharged from the oil chamber, and the outer peripheral side flow passage and the inner peripheral side flow passage are easily provided when the hydraulic oil is supplied to the oil chamber.

In an outboard motor including the air guide that moves in the right-left direction in the oil chamber, the air guide preferably includes a contact portion to contact an end surface of the oil chamber in the right-left direction, and the air guide preferably moves in the right-left direction to a contact position at which the contact portion contacts the end surface to close the inner peripheral side flow passage when the hydraulic oil is discharged from the oil chamber, and moves in the right-left direction to a separated position at which the contact portion is spaced apart from the end surface to open the inner peripheral side flow passage when the hydraulic oil is supplied to the oil chamber. Accordingly, the air guide is moved in the right-left direction between the contact position and the separated position in the oil chamber such that the inner peripheral side flow passage is easily closed when the hydraulic oil is discharged from the oil chamber, and the inner peripheral side flow passage is easily opened when the hydraulic oil is supplied to the oil chamber.

In such a case, the air guide preferably moves to the contact position in the right-left direction due to a flow of the hydraulic oil discharged from the oil chamber to the oil passage connection port when the hydraulic oil is discharged from the oil chamber, and moves to the separated position in the right-left direction due to a flow of the hydraulic oil supplied from the oil passage connection port to the oil chamber when the hydraulic oil is supplied to the oil chamber. Accordingly, the air guide is moved to the contact position in the right-left direction through the normal operation of the steering cylinder that discharges the hydraulic oil from the oil chamber, and the air guide is moved to the separated position in the right-left direction through the normal operation of the steering cylinder that supplies the hydraulic oil to the oil passage, and thus the air guide is moved in the right-left direction to the contact position and the separated position in the oil chamber without separately providing a dedicated movement mechanism to move the air guide.

An outboard motor including the air guide that moves in the right-left direction to the contact position when the hydraulic oil is discharged from the oil chamber, and moves in the right-left direction to the separated position when the hydraulic oil is supplied to the oil chamber preferably further includes a restrictor to restrict the air guide from moving to a side opposite to the contact position relative to the separated position in the right-left direction. Accordingly, the moving range of the air guide is limited between the contact position and the separated position in the right-left direction by the restrictor, and thus an excessive increase in the moving range of the air guide is significantly reduced or prevented.

In an outboard motor including the air guide that moves in the right-left direction to the contact position when the hydraulic oil is discharged from the oil chamber, and moves in the right-left direction to the separated position when the hydraulic oil is supplied to the oil chamber, the oil passage connection port is preferably located in a vicinity of or adjacent to the end surface in the right-left direction. Accordingly, the separated position is located relatively close to the end surface in the right-left direction, and thus an excessive increase in the moving range of the air guide is significantly reduced or prevented.

In an outboard motor including the air guide that moves in the right-left direction to the contact position when the hydraulic oil is discharged from the oil chamber, and moves in the right-left direction to the separated position when the hydraulic oil is supplied to the oil chamber, the oil passage is preferably provided in the piston rod, the oil passage connection port is preferably provided on an outer peripheral surface of the piston rod, the piston rod is preferably provided on an inner peripheral side of the oil chamber, and the air guide preferably further includes, as the contact portion, a plurality of first protrusions that protrude toward the end surface in the right-left direction, and an inside-outside connection recess located between the plurality of first protrusions to connect an outer peripheral side of the oil chamber to the inner peripheral side. Accordingly, the plurality of first protrusions corresponding to the contact portion easily close the inner peripheral side flow passage when the hydraulic oil is discharged from the oil chamber, and easily open the inner peripheral side flow passage when the hydraulic oil is supplied to the oil chamber. Furthermore, the inside-outside connection recess easily connects, on the end surface side of the air guide, the outer peripheral side flow passage to the oil passage connection port provided on the outer peripheral surface of the piston rod on the inner peripheral side when the hydraulic oil is discharged from the oil chamber, and easily connects, on the end surface side of the air guide, the outer peripheral side flow passage and the inner peripheral side flow passage to the oil passage connection port when the hydraulic oil is supplied to the oil chamber.

In such a case, the air guide preferably further includes, as the inner peripheral side flow passage, a through-hole provided on at least one of the plurality of first protrusions extending therethrough in the right-left direction. Accordingly, with the through-hole, the inner peripheral side flow passage, which is closed due to contact of the plurality of first protrusions with the end surface in the right-left direction when the hydraulic oil is discharged from the oil chamber, and is opened due to being spaced apart from the plurality of first protrusions from the end surface in the right-left direction when the hydraulic oil is supplied to the oil chamber, is easily provided.

In an outboard motor including the air guide that includes the through-hole as the inner peripheral side flow passage, the through-hole is preferably provided on each of the plurality of first protrusions. Accordingly, the sectional area of the inner peripheral side flow passage is easily increased as compared with a case in which the through-hole is provided on one or more but not all of the plurality of first protrusions. Consequently, the pressure loss of the hydraulic oil is effectively decreased when the hydraulic oil is supplied to the oil chamber.

In an outboard motor including the air guide that includes the through-hole as the inner peripheral side flow passage, the plurality of first protrusions each preferably have a sectoral shape as viewed in the right-left direction, and the through-hole preferably has a sectoral shape smaller than the sectoral shape of each of the plurality of first protrusions as viewed in the right-left direction. Accordingly, the sectional area of the inner peripheral side flow passage is easily increased as compared with a case in which the through-hole does not have the same sectoral shape as the plurality of first protrusions. Consequently, the pressure loss of the hydraulic oil is effectively decreased when the hydraulic oil is supplied to the oil chamber.

In an outboard motor in which the oil passage connection port is provided on the outer peripheral surface of the piston provided in the cylinder body, the oil passage connection port is preferably provided on a portion of the outer peripheral surface in a circumferential direction of the piston rod, and the air guide preferably further includes a first annular recess recessed away from the end surface with respect to the plurality of first protrusions on the inner peripheral side to connect the inside-outside connection recess to the oil passage connection port. Accordingly, the inside-outside connection recess that connects the outer peripheral side to the inner peripheral side is easily connected to the oil passage connection port provided on a portion of the outer peripheral surface of the piston rod in the circumferential direction by the first annular recess.

In an outboard motor including the air guide that moves in the right-left direction to the contact position when the hydraulic oil is discharged from the oil chamber, and moves in the right-left direction to the separated position when the hydraulic oil is supplied to the oil chamber, the oil passage is preferably located in front of, behind, or below the steering cylinder, the oil passage connection port is preferably provided on an inner peripheral surface of the cylinder body, and the air guide preferably further includes, as the contact portion, a second protrusion that protrudes toward the end surface in the oil chamber. Accordingly, the second protrusion corresponding to the contact portion easily closes the inner peripheral side flow passage when the hydraulic oil is discharged from the oil chamber, and easily opens the inner peripheral side flow passage when the hydraulic oil is supplied to the oil chamber.

In such a case, the air guide preferably further includes, as the outer peripheral side flow passage, a notch provided on the outer peripheral side of the air guide extending therethrough in the right-left direction. Accordingly, with the notch, the outer peripheral side flow passage is easily provided in the oil chamber when the hydraulic oil is discharged from the oil chamber.

In an outboard motor in which the oil passage connection port is provided on the inner peripheral surface of the cylinder body, the oil passage connection port is preferably provided on a portion of the inner peripheral surface in a circumferential direction of the cylinder body, and the air guide preferably further includes a second annular recess recessed away from the end surface with respect to the second protrusion on the outer peripheral side of the air guide and connected to the oil passage connection port. Accordingly, the outer peripheral side flow passage is easily connected to the oil passage connection port provided on a portion of the inner peripheral surface of the cylinder body in the circumferential direction by the second annular recess.

A marine vessel according to a preferred embodiment of the present invention includes a hull including a steering wheel, and an outboard motor attached to the hull. The outboard motor includes an outboard motor body, a steering shaft, a steering cylinder including a piston rod extending in a right-left direction of the outboard motor body, a piston fixed to the piston rod, and a cylinder body including therein the piston and an oil chamber to store hydraulic oil, an oil passage connected to the oil chamber via an oil passage connection portion to supply the hydraulic oil to the oil chamber and discharge the hydraulic oil from the oil chamber, and an air guide, located in a vicinity of or adjacent to the oil passage connection port in the right-left direction, to guide air remaining in the oil chamber to the oil passage connection port when the hydraulic oil is discharged from the oil chamber via the oil passage, wherein the steering cylinder is operable to rotate the steering shaft and the outboard motor body in the right-left direction by adjusting an amount of the hydraulic oil in the oil chamber and moving the cylinder body in the right-left direction based on an operation of the steering wheel.

A marine vessel according to a preferred embodiment of the present invention includes the air guide, located in the right-left direction in the vicinity of or adjacent to the oil passage connection port connecting the oil chamber to the oil passage, to guide the air remaining in the oil chamber to the oil passage connection port when the hydraulic oil is discharged from the oil chamber via the oil passage. Accordingly, similarly to the outboard motors according to preferred embodiments of the present invention described above, the air remaining in the oil chamber is guided to the oil passage connection port by the normal operation of the steering cylinder that discharges the hydraulic oil from the oil chamber via the oil passage, and thus the air is automatically discharged from the oil chamber to the outside without an operator performing a complex operation such as tilting the steering cylinder. Consequently, similarly to the outboard motors according to preferred embodiments of the present invention described above, the air in the oil chamber of the steering cylinder is easily bled.

In a marine vessel according to a preferred embodiment of the present invention, the air guide preferably guides air remaining in an upper portion of the oil chamber to the oil passage connection port via an outer peripheral side flow passage provided on an outer peripheral side of the air guide when the hydraulic oil is discharged from the oil chamber. Accordingly, similarly to the outboard motors according to preferred embodiments of the present invention described above, when the hydraulic oil is discharged from the oil chamber via the oil passage, the air remaining in the upper portion (outer peripheral side) of the oil chamber is preferentially discharged to the outside from the oil chamber via the outer peripheral side flow passage. Consequently, similarly to the outboard motors according to preferred embodiments of the present invention described above, when the hydraulic oil is discharged from the oil chamber via the oil passage, the air guide reliably guides the air remaining in the upper portion of the oil chamber to the oil passage connection port.

In such a case, the air guide preferably has a disk shape, and the outer peripheral side flow passage is preferably defined by an outer peripheral surface of the air guide and an inner peripheral surface of the oil chamber. Accordingly, similarly to the outboard motors according to preferred embodiments of the present invention described above, with the disk-shaped air guide, the outer peripheral side flow passage that guides the air remaining in the upper portion (outer peripheral side) of the oil chamber to the oil passage connection port is easily provided on the outer peripheral side of the air guide.

The above and other elements, features, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view showing a marine vessel including outboard motors according to first and second preferred embodiments of the present invention.

FIG. **2** is a left side view showing the overall structure of one of the outboard motors according to the first preferred embodiment of the present invention.

FIG. **3** is a perspective view showing clamp brackets, a swivel bracket, a steering cylinder, a steering device, etc. of the outboard motor according to the first preferred embodiment of the present invention.

FIG. **4** is a perspective view showing the steering cylinder, oil pipes, a steering pump, etc. of the outboard motor according to the first preferred embodiment of the present invention.

FIG. **5** is a plan sectional view showing the overall structure of the steering cylinder of the outboard motor according to the first preferred embodiment of the present invention.

FIG. **6** is an enlarged plan sectional view of the vicinity of a piston of the steering cylinder of the outboard motor according to the first preferred embodiment of the present invention.

FIG. **7** is a schematic sectional view illustrating air discharge from an oil chamber of the steering cylinder of the outboard motor according to the first preferred embodiment of the present invention.

FIG. **8** is a perspective view showing an air guide of the steering cylinder of the outboard motor according to the first preferred embodiment of the present invention.

FIG. **9** is an enlarged plan sectional view of the vicinity of a piston of a steering cylinder of an outboard motor according to a second preferred embodiment of the present invention.

FIG. **10** is a schematic sectional view illustrating air discharge from an oil chamber of the steering cylinder of the outboard motor according to the second preferred embodiment of the present invention.

FIG. **11** is a perspective view showing an air guide of the steering cylinder of the outboard motor according to the second preferred embodiment of the present invention.

FIG. **12** is a perspective view showing an air guide of a steering cylinder of an outboard motor according to a first modified example of the first preferred embodiment of the present invention.

FIG. **13** is a perspective view showing an air guide of a steering cylinder of an outboard motor according to a second modified example of the first preferred embodiment of the present invention.

FIG. **14** is a perspective view showing an air guide of a steering cylinder of an outboard motor according to a third modified example of the first preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention are hereinafter described with reference to the drawings.

First Preferred Embodiment

The structure of a marine vessel **100** including outboard motors **120** (two outboard motors, for example) according to a first preferred embodiment of the present invention is now described with reference to FIGS. **1** to **8**.

As shown in FIG. **1**, the marine vessel **100** includes a hull **110** and the outboard motors **120**. The outboard motors **120** are attached to a rear transom of the hull **110**. The outboard motors **120** are marine propulsion devices that propel the hull **110**. The marine vessel **100** may be used for sightseeing in a canal and a lake, for example. The marine vessel **100** may be a relatively small marine vessel.

In the figures, arrow FWD and arrow BWD represent the front side and the rear side of the marine vessel **100**, respectively. In the figures, arrow L and arrow R represent the left side and the right side of the marine vessel **100**, respectively. In the figures, arrow Z**1** and arrow Z**2** represent the upper side and the lower side of the marine vessel **100**, respectively.

The hull **110** includes a steering wheel **111**. The steering wheel **111** receives a user's operation to cause the outboard motors **120** to change the propulsion direction of the hull **110**. As a user operates the steering wheel **111**, an electric signal is transmitted from the steering wheel **111** to a steering control unit (not shown) provided in each of the outboard motors **120**. The steering control unit controls a steering motor **46***b* (see FIG. **4**) of a steering device **40** (see FIG. **2**) provided in each of the outboard motors **120** to change the propulsion direction of the hull **110** based on the electric signal transmitted from the steering wheel **111**.

As shown in FIG. **2**, the outboard motors **120** each include an outboard motor body **10**, a pair of clamp brackets **20** to attach the outboard motor body **10** to the transom of the hull **110**, and a swivel bracket **30** to support the outboard motor body **10**. Furthermore, the outboard motors **120** each include a hydraulic power trim-tilt device (not shown) to rotate the outboard motor body **10** in an upward-downward direction and the hydraulic steering device **40** to rotate the outboard motor body **10** in a right-left direction.

The outboard motor body **10** includes an engine **11**, a drive shaft **12**, a propeller shaft **13**, and a propeller **14**. The engine **11** is, for example, an internal combustion engine that generates a driving force. The drive shaft **12** and the propeller shaft **13** transmit a driving force from the engine **11** to the propeller **14**. The propeller **14** generates a thrust force (a propulsive force to propel the hull **110**) by rotating in the water with the driving force transmitted from the engine **11**.

The outboard motor body **10** is rotated in the upward-downward direction together with the swivel bracket **30** with respect to the clamp brackets **20** by the power trim-tilt device. Thus, when the hull **110** is propelled, the upward-downward orientation of the propeller **14** positioned in the water is adjusted, and when the hull **110** is stopped or starts to be propelled, the position of the propeller **14** is changed between underwater and above water. Furthermore, the outboard motor body **10** is rotated in the right-left direction with respect to the swivel bracket **30** (clamp brackets **20**) by the steering device **40**. Thus, when the hull **110** is propelled, the right-left orientation of the propeller **14** positioned in the water is adjusted.

As shown in FIG. **3**, the clamp brackets **20** are attached to the transom of the hull **110**. A pair of clamp brackets **20** are spaced apart from each other in the right-left direction. The swivel bracket **30** is attached to the clamp brackets **20** so as to be rotatable about a tilt shaft (not shown) that extends in the right-left direction. The outboard motor body **10** is attached to the swivel bracket **30** via a steering shaft (not shown) that extends in the upward-downward direction. That is, the clamp brackets **20** rotatably support the swivel bracket **30** and the outboard motor body **10**.

The swivel bracket **30** is located between the pair of clamp brackets **20** in the right-left direction. The swivel bracket **30** is attached to the pair of clamp brackets **20** via the tilt shaft. The swivel bracket **30** rotates in the upward-downward direction by rotating about the tilt shaft.

The power trim-tilt device is attached to the clamp brackets **20**. The power trim-tilt device is located between the pair of clamp brackets **20**. The power trim-tilt device rotates the swivel bracket **30** and the outboard motor body **10** in the upward-downward direction about the central axis **91** of the tilt shaft.

As shown in FIG. **4**, the steering device **40** includes a steering cylinder **41**, an oil passage **42** (see FIG. **5**), an adapter **44**, oil pipes **45**, and a steering oil supply/discharge device **46**. As shown in FIG. **5**, the steering cylinder **41** includes an oil chamber **51** to store hydraulic oil. As shown in FIG. **4**, the steering oil supply/discharge device **46** includes a steering pump **46***a* and a steering motor **46***b*. The oil chamber **51** (see FIG. **5**) is connected to the steering pump **46***a* via the oil passage **42**, the adapter **44**, and the oil pipes **45**. The steering motor **46***b* drives the steering pump **46***a* under the control of the steering control unit to supply the hydraulic oil from the steering pump **46***a* to the oil chamber **51** and discharge the hydraulic oil from the oil chamber **51** to the outside. That is, the oil passage **42** is provided to supply the hydraulic oil to the oil chamber **51** and discharge the hydraulic oil from the oil chamber **51**.

As shown in FIG. **5**, the steering cylinder **41** includes a piston rod **52** that extends in the right-left direction of the outboard motor body **10**, a piston **53** fixed to the piston rod **52**, and a cylinder body **54** with the piston **53** therein and the oil chamber **51** therein to store hydraulic oil. Specifically, a left end and a right end of the piston rod **52** that extends in the right-left direction are supported by the pair of clamp brackets **20**, respectively, while being rotatable with respect to the pair of clamp brackets **20**. The piston **53** is fixed to the piston rod **52** in a central portion between the pair of clamp brackets **20** in the right-left direction. The piston **53** divides the internal space of the cylinder body **54** into a space on the left side of the piston **53** and a space on the right side of the piston **53**. Thus, a left oil chamber **51***a* on the left side of the piston **53** and a right oil chamber **51***b* on the right side of the piston **53** are provided in the cylinder body **54** as the oil chamber **51** that stores hydraulic oil.

The steering cylinder **41** adjusts the amount of hydraulic oil in the oil chamber **51** to move the cylinder body **54** in the right-left direction so as to rotate the steering shaft and the outboard motor body **10** (see FIG. **3**) in the right-left direction. Specifically, the steering cylinder **41** is rotatably attached to the clamp brackets **20** (see FIG. **3**) via the piston rod **52**. The steering oil supply/discharge device **46** (see FIG. **4**) supplies hydraulic oil to one of the left oil chamber **51***a* and the right oil chamber **51***b*, and discharges hydraulic oil from the other of the left oil chamber **51***a* and the right oil chamber **51***b*. Thus, with an increase in the hydraulic oil stored in one of the left oil chamber **51***a* and the right oil chamber **51***b* and a decrease in the hydraulic oil stored in the other of the left oil chamber **51***a* and the right oil chamber **51***b*, the cylinder body **54** moves in the right-left direction. The movement of the cylinder body **54** in the right-left direction is transmitted to the steering shaft, and the steering shaft rotates in the right-left direction. Thus, the outboard motor body **10** attached to the steering shaft rotates about the central axis **92** of the steering shaft in the right-left direction, and the propulsion direction of the hull **110** is changed.

In the first preferred embodiment, the oil passage **42** is provided in the piston rod **52**. Specifically, the oil passage **42** including a first end connected to the oil pipes **45** (see FIG. **4**) and a second end connected to the oil chamber **51** is provided inside the piston rod **52**. The oil passage **42** includes an oil passage **42***a* connected to the left oil chamber **51***a* and an oil passage **42***b* connected to the right oil chamber **51***b*. The piston rod **52** has a double pipe structure. The oil passage **42***a* is an inner pipe of the double pipe. The oil passage **42***b* is a region between the inner pipe and an outer pipe of the double pipe.

In the first preferred embodiment, an oil passage connection port **55**, which is a connection port of the oil chamber **51** to the oil passage **42**, is provided on a portion of the outer peripheral surface **52***a* of the piston rod **52** provided in the cylinder body **54** in the circumferential direction. Specifically, an oil passage connection port **55***a* of the oil passage **42***a* connected to the left oil chamber **51***a* extends from the inner pipe of the double pipe to an end (outer peripheral surface **52***a*) of the left oil chamber **51***a* on the piston rod **52** side toward the outer peripheral side of the piston rod **52** inside the piston rod **52**. An oil passage connection port **55***b* of the oil passage **42***b* connected to the right oil chamber **51***b* extends from the outer pipe of the double pipe to an end (outer peripheral surface **52***a*) of the right oil chamber **51***b* on the piston rod **52** side toward the outer peripheral side of the piston rod **52** inside the piston rod **52**. A plurality of (four, for example) oil passage connection ports **55***a* and a plurality of (four, for example) oil passage connection ports **55***b* are provided at equal or substantially equal intervals in the circumferential direction as viewed in the axial direction (right-left direction) of the piston rod **52**.

In the first preferred embodiment, the oil passage connection port **55** is located in the vicinity of or adjacent to an end surface **56** of the oil chamber **51** in the right-left direction. Specifically, the oil passage connection port **55***a* of the oil passage **42***a* connected to the left oil chamber **51***a* is located such that the position of the oil passage connection port **55***a* on the piston **53** side (right side) in the right-left direction and the location of the end surface **56***a* of the left oil chamber **51***a* on the piston **53** side are the same or substantially the same as each other in the right-left direction. Similarly, the oil passage connection port **55***b* of the oil passage **42***b* connected to the right oil chamber **51***b* is positioned such that the location of the oil passage connection port **55***b* on the piston **53** side (left side) in the right-left direction and the location of the end surface **56***b* of the right oil chamber **51***b* on the piston **53** side are the same or substantially the same as each other in the right-left direction.

As shown in FIG. **6**, in the first preferred embodiment, the outboard motor **120** (see FIG. **2**) includes an air guide **70** located in the vicinity of or adjacent to the oil passage connection port **55** to guide air **60** remaining in the oil chamber **51** to the oil passage connection port **55** when the hydraulic oil is discharged from the oil chamber **51** via the oil passage **42**. The air **60** (see FIG. **7**) remaining in the oil chamber **51** includes air that remains in the oil chamber **51** without being discharged from the oil passage connection port **55** after the air **60** enters the oil chamber **51** when the steering cylinder **41** is assembled, for example. FIG. **6** shows a state in which the hydraulic oil is discharged from the left oil chamber **51***a* to the oil passage **42***a* via the oil passage connection port **55***a*, and the hydraulic oil is supplied from the oil passage **42***b* to the right oil chamber **51***b* via the oil passage connection port **55***b*. In FIG. **6**, the hatching of the air guide **70** indicating a cross-section is omitted in order to clearly show the shape of the air guide **70**.

In the first preferred embodiment, when the hydraulic oil is discharged from the oil chamber **51**, the air guide **70** guides the air **60** remaining in an upper portion of the oil chamber **51** to the oil passage connection port **55** via an outer peripheral side flow passage **81** provided on the outer peripheral side of the air guide **70**. Specifically, as shown in FIG. **7**, the air **60** is lighter than the hydraulic oil, and thus the air **60** that has entered the oil chamber **51** remains in the upper portion of the oil chamber **51**. The oil chamber **51** has a circular shape as viewed in the axial direction of the piston rod **52**, and thus the upper portion of the oil chamber **51** includes a portion of the oil chamber **51** on the outer peripheral side. Furthermore, the air **60** is lower in viscosity than the hydraulic oil. Therefore, as shown in FIG. **6**, when the hydraulic oil is discharged from the oil chamber **51** to the oil passage **42** via the outer peripheral side flow passage **81**, the air **60** remaining in the upper portion (outer peripheral side) of the oil chamber **51** is preferentially discharged. In FIG. **7**, the piston rod **52** having a double pipe structure is simplified and drawn as a single pipe structure, and a plurality of oil passage connection ports **55** are simplified and drawn as only one.

As shown in FIG. **8**, in the first preferred embodiment, the air guide **70** has a disk shape. As shown in FIG. **6**, the outer peripheral side flow passage **81** is defined by the outer peripheral surface **70***a* of the disk-shaped air guide **70** and the inner peripheral surface **51***c* of the oil chamber **51**. Specifically, the outer peripheral side flow passage **81** is an annular gap between the outer peripheral surface **70***a* of the disk-shaped air guide **70** and the inner peripheral surface **51***c* of the oil chamber **51**. The width of the annular gap between the outer peripheral surface **70***a* and the inner peripheral surface **51***c* is set to several millimeters, for example. A hole through which the piston rod **52** on the inner peripheral side of the air guide **70** penetrates is slightly larger than the diameter of the piston rod **52** (is much smaller than the width of the annular gap between the outer peripheral surface **70***a* and the inner peripheral surface **51***c*). Thus, the air guide **70** moves within a predetermined range described below in the oil chamber **51** while being guided by the outer peripheral surface **52***a* of the piston rod **52**.

In the first preferred embodiment, the air guide **70** supplies hydraulic oil to the oil chamber **51** via an inner peripheral side flow passage **82** provided on the inner peripheral side of the outer peripheral side flow passage **81** in addition to the outer peripheral side flow passage **81** when the hydraulic oil is supplied to the oil chamber **51**. Specifically, as shown in FIG. **8**, the inner peripheral side flow passage **82** provided on the inner peripheral side of the outer peripheral side flow passage **81** is provided in the air guide **70**. As shown in FIG. **6**, the air guide **70** allows the hydraulic oil to pass through the outer peripheral side flow passage **81** and the inner peripheral side flow passage **82** when the hydraulic oil is supplied from the oil chamber **51** to the oil passage **42** via the oil passage connection port **55**.

In the first preferred embodiment, the air guide **70** moves in the right-left direction in the oil chamber **51** to close the inner peripheral side flow passage **82** when the hydraulic oil is discharged from the oil chamber **51** and to open the inner peripheral side flow passage **82** when the hydraulic oil is supplied to the oil chamber **51**. Specifically, the air guide **70** includes a contact portion **71** that contacts the end surface **56** in right-left direction in the oil chamber **51**. The air guide **70** moves in the right-left direction to a contact position P**1** at which the contact portion **71** contacts the end surface **56** to close the inner peripheral side flow passage **82** when the hydraulic oil is discharged from the oil chamber **51**, and moves in the right-left direction to a separated position P**2** at which the contact portion **71** is spaced apart from the end surface **56** to open the inner peripheral side flow passage **82** when the hydraulic oil is supplied to the oil chamber **51**.

Specifically, in the first preferred embodiment, as shown in FIG. **8**, the air guide **70** includes, as the contact portion **71**, a plurality of (eight) first protrusions **72** that protrude toward the end surface **56** (see FIG. **6**) in the right-left direction, and inside-outside connection recesses **73** located between the plurality of (eight) first protrusions **72** to connect the outer peripheral side of the oil chamber **51** to the inner peripheral side of the oil chamber **51** (see FIG. **6**). The piston rod **52** (see FIG. **6**) is provided on the inner peripheral side of the oil chamber **51**. Furthermore, the air guide **70** includes, as the inner peripheral side flow passage **82**, a through-hole **72***a* provided on at least one of the plurality of (eight) first protrusions **72** to penetrate or extend therethrough in the right-left direction. That is, as shown in FIG. **6**, when the hydraulic oil is discharged from the left oil chamber **51***a* (oil chamber **51**) to the oil passage **42***a* (oil passage **42**) via the oil passage connection port **55***a* (oil passage connection port **55**), the air guide **70** moves to the contact position P**1**, and surfaces **72***b* of the plurality of first protrusions **72** on the end surface **56** side in the right-left direction contact the end surface **56** in the right-left direction. In this state, the through-hole **72***a* corresponding to the inner peripheral side flow passage **82** is closed. The air **60** that has flowed from the left oil chamber **51***a* (oil chamber **51**) to the end surface **56** side in the right-left direction via the outer peripheral side flow passage **81** flows from the outer peripheral side to the inner peripheral side via the inside-outside connection recesses **73**. When the hydraulic oil is supplied from the oil passage **42***b* (oil passage **42**) to the right oil chamber **51***b* (oil chamber **51**) via the oil passage connection port **55***b* (oil passage connection port **55**), the air guide **70** moves to the separated position P**2**, and the surfaces **72***b* of the plurality of first protrusions **72** on the end surface **56** side in the right-left direction are spaced apart from the end surface **56** in the right-left direction. In this state, the through-hole **72***a* corresponding to the inner peripheral side flow passage **82** is opened.

As shown in FIG. **8**, in the first preferred embodiment, each of the plurality of (eight) first protrusions **72** has a sectoral shape as viewed in the right-left direction. The through-hole **72***a* has a sectoral shape smaller than the sectoral shape of each of the plurality of first protrusions **72** as viewed in the right-left direction. That is, the surfaces **72***b* of the plurality of first protrusions **72** on the end surface **56** side in the right-left direction that contact the end surface **56** in the right-left direction each have a sectoral frame shape. In the first preferred embodiment, the through-hole **72***a* is provided on each of the plurality of (eight) first protrusions **72**.

The air guide **70** includes an annular recess **74** recessed away from the end surface **56** with respect to the plurality of first protrusions **72** on the outer peripheral side of the plurality of first protrusions **72**. The annular recess **74** is connected to the outer peripheral side flow passage **81**. The annular recess **74** is recessed away from the end surface **56** by the same amount as the inside-outside connection recesses **73**.

The air guide **70** includes a first annular recess **75** recessed away from the end surface **56** with respect to the plurality of first protrusions **72** on the inner peripheral side on which the piston rod **52** is provided. The first annular recess **75** connects the inside-outside connection recesses **73** to the oil passage connection port **55**. The first annular recess **75** is largely recessed away from the end surface **56** relative to the inside-outside connection recesses **73**.

As shown in FIG. **6**, in the first preferred embodiment, the air guide **70** moves to the contact position P**1** in the right-left direction due to the flow of the hydraulic oil discharged from the oil chamber **51** to the oil passage connection port **55** when the hydraulic oil is discharged from the oil chamber **51**, and moves to the separated position P**2** in the right-left direction due to the flow of the hydraulic oil supplied from the oil passage connection port **55** to the oil chamber **51** when the hydraulic oil is supplied to the oil chamber **51**. Specifically, the air guide **70** is moved toward the contact position P**1** due to the flow of the hydraulic oil discharged from the left oil chamber **51***a* (oil chamber **51**) to move in the right-left direction from the separated position P**2** to the contact position P**1** when the hydraulic oil is discharged from the left oil chamber **51***a* (oil chamber **51**) to the oil passage **42***a* (oil passage **42**) via the oil passage connection port **55***a* (oil passage connection port **55**). Furthermore, the air guide **70** is moved toward the separated position P**2** due to the flow of the hydraulic oil supplied to the right oil chamber **51***b* (oil chamber **51**) to move in the right-left direction from the contact position P**1** to the separated position P**2** when the hydraulic oil is supplied from the oil passage **42***b* (oil passage **42**) to the right oil chamber **51***b* (oil chamber **51**) via the oil passage connection port **55***b* (oil passage connection port **55**).

In the first preferred embodiment, the outboard motors **120** each include a restrictor **52***b* to restrict the air guide **70** from moving to the side opposite to the contact position P**1** relative to the separated position P**2** in the right-left direction. Specifically, the restrictor **52***b* has a stepped shape that protrudes toward the outer peripheral side relative to the oil passage connection port **55** and is provided at the end of the piston rod **52** on the oil passage connection port **55** side. Thus, the moving range of the air guide **70** is limited between the contact position P**1** and the separated position P**2** in the right-left direction.

According to the first preferred embodiment of the present invention, the following advantageous effects are achieved.

According to the first preferred embodiment of the present invention, the outboard motors **120** (marine vessel **100**) each include the air guide **70** located in the vicinity of or adjacent to the oil passage connection port **55**, which is the connection port of the oil chamber **51** to the oil passage **42**, in the right-left direction to guide the air **60** remaining in the oil chamber **51** to the oil passage connection port **55** when the hydraulic oil is discharged from the oil chamber **51** via the oil passage **42**. Accordingly, when the hydraulic oil is discharged from the oil chamber **51** via the oil passage **42**, the air guide **70** guides the air **60** remaining in the oil chamber **51** to the oil passage connection port **55**. That is, the air **60** remaining in the oil chamber **51** is guided to the oil passage connection port **55** by the normal operation of the steering cylinder **41** that discharges the hydraulic oil from the oil chamber **51** via the oil passage **42**, and thus the air **60** is automatically discharged from the oil chamber **51** to the outside without an operator performing a complex operation such as tilting the steering cylinder **41**. Consequently, the air in the oil chamber **51** of the steering cylinder **41** is easily bled. Furthermore, the air is bled at any time only by the user of the marine vessel **100** performing a steering operation (to change the propulsion direction of the marine vessel **100**) while maneuvering the marine vessel **100**, without the operator performing an air bleeding operation.

According to the first preferred embodiment of the present invention, the air guide **70** guides the air **60** remaining in the upper portion of the oil chamber **51** to the oil passage connection port **55** via the outer peripheral side flow passage **81** provided on the outer peripheral side of the air guide **70** when the hydraulic oil is discharged from the oil chamber **51**. Accordingly, the upper portion (outer peripheral side) of the oil chamber **51** is closer to the outer peripheral side flow passage **81** than the inner peripheral side of the oil chamber **51**, and the air **60** is lower in viscosity than the hydraulic oil, and thus when the hydraulic oil is discharged from the oil chamber **51** via the oil passage **42**, the air **60** remaining in the upper portion (outer peripheral side) of the oil chamber **51** is preferentially discharged to the outside from the oil chamber **51** via the outer peripheral side flow passage **81**. Consequently, when the hydraulic oil is discharged from the oil chamber **51** via the oil passage **42**, the air guide **70** reliably guides the air **60** remaining in the upper portion of the oil chamber **51** to the oil passage connection port **55**.

According to the first preferred embodiment of the present invention, the air guide **70** has a disk shape. Furthermore, the outer peripheral side flow passage **81** is defined by the outer peripheral surface **70***a* of the disk-shaped air guide **70** and the inner peripheral surface **51***c* of the oil chamber **51**. Accordingly, with the disk-shaped air guide **70**, the outer peripheral side flow passage **81** that guides the air **60** remaining in the upper portion (outer peripheral side) of the oil chamber **51** to the oil passage connection port **55** is easily provided on the outer peripheral side of the air guide **70**.

According to the first preferred embodiment of the present invention, the air guide **70** supplies the hydraulic oil to the oil chamber **51** via the inner peripheral side flow passage **82** provided on the inner peripheral side of the outer peripheral side flow passage **81** in addition to the outer peripheral side flow passage **81** when the hydraulic oil is supplied to the oil chamber **51**. Accordingly, when the hydraulic oil is supplied to the oil chamber **51**, the sectional area of a flow passage through which the hydraulic oil is supplied is increased as compared with a case in which the flow passage through which the hydraulic oil is supplied is limited to the outer peripheral side flow passage **81**. Consequently, the pressure loss of the hydraulic oil is decreased when the hydraulic oil is supplied to the oil chamber **51**.

According to the first preferred embodiment of the present invention, the air guide **70** moves in the right-left direction in the oil chamber **51** to close the inner peripheral side flow passage **82** when the hydraulic oil is discharged from the oil chamber **51** and to open the inner peripheral side flow passage **82** when the hydraulic oil is supplied to the oil chamber **51**. Accordingly, the air guide **70** is moved in the right-left direction in the oil chamber **51** such that the outer peripheral side flow passage **81** is easily provided when the hydraulic oil is discharged from the oil chamber **51**, and the outer peripheral side flow passage **81** and the inner peripheral side flow passage **82** are easily provided when the hydraulic oil is supplied to the oil chamber **51**.

According to the first preferred embodiment of the present invention, the air guide **70** includes the contact portion **71** that contacts the end surface **56** in the right-left direction in the oil chamber **51**. Furthermore, the air guide **70** moves in the right-left direction to the contact position P**1** at which the contact portion **71** contacts the end surface **56** to close the inner peripheral side flow passage **82** when the hydraulic oil is discharged from the oil chamber **51**, and moves in the right-left direction to the separated position P**2** at which the contact portion **71** is spaced apart from the end surface **56** to open the inner peripheral side flow passage **82** when the hydraulic oil is supplied to the oil chamber **51**. Accordingly, the air guide **70** is moved in the right-left direction between the contact position P**1** and the separated position P**2** in the oil chamber **51** such that the inner peripheral side flow passage **82** is easily closed when the hydraulic oil is discharged from the oil chamber **51**, and the inner peripheral side flow passage **82** is easily opened when the hydraulic oil is supplied to the oil chamber **51**.

According to the first preferred embodiment of the present invention, the air guide **70** moves to the contact position P**1** in the right-left direction due to the flow of the hydraulic oil discharged from the oil chamber **51** to the oil passage connection port **55** when the hydraulic oil is discharged from the oil chamber **51**, and moves to the separated position P**2** in the right-left direction due to the flow of the hydraulic oil supplied from the oil passage connection port **55** to the oil chamber **51** when the hydraulic oil is supplied to the oil chamber **51**. Accordingly, the air guide **70** is moved to the contact position P**1** in the right-left direction through the normal operation of the steering cylinder **41** that discharges the hydraulic oil from the oil chamber **51**, and the air guide **70** is moved to the separated position P**2** in the right-left direction through the normal operation of the steering cylinder **41** that supplies the hydraulic oil to the oil passage **42**, and thus the air guide **70** is moved in the right-left direction to the contact position P**1** and the separated position P**2** in the oil chamber **51** without separately providing a dedicated movement mechanism to move the air guide **70**.

According to the first preferred embodiment of the present invention, the outboard motors **120** (marine vessel **100**) each include the restrictor **52***b* to restrict the air guide **70** from moving to the side opposite to the contact position P**1** relative to the separated position P**2** in the right-left direction. Accordingly, the moving range of the air guide **70** is limited between the contact position P**1** and the separated position P**2** in the right-left direction by the restrictor **52***b*, and thus an excessive increase in the moving range of the air guide **70** is significantly reduced or prevented.

According to the first preferred embodiment of the present invention, the oil passage connection port **55** is located in the vicinity of or adjacent to the end surface **56** in the right-left direction. Accordingly, the separated position P**2** is located relatively close to the end surface **56** in the right-left direction, and thus an excessive increase in the moving range of the air guide **70** is significantly reduced or prevented.

According to the first preferred embodiment of the present invention, the oil passage **42** is provided in the piston rod **52**. Furthermore, the oil passage connection port **55** is provided on the outer peripheral surface **52***a* of the piston rod **52** provided in the cylinder body **54**. Moreover, the piston rod **52** is provided on the inner peripheral side of the oil chamber **51**, and the air guide **70** includes, as the contact portion **71**, the plurality of first protrusions **72** that protrude toward the end surface **56** in the right-left direction, and the inside-outside connection recesses **73** located between the plurality of first protrusions **72** to connect the outer peripheral side of the oil chamber **51** to the inner peripheral side. Accordingly, the plurality of first protrusions **72** corresponding to the contact portion **71** easily close the inner peripheral side flow passage **82** when the hydraulic oil is discharged from the oil chamber **51**, and easily open the inner peripheral side flow passage **82** when the hydraulic oil is supplied to the oil chamber **51**. Furthermore, the inside-outside connection recesses **73** easily connect, on the end surface **56** side of the air guide **70**, the outer peripheral side flow passage **81** to the oil passage connection port **55** provided on the outer peripheral surface **52***a* of the piston rod **52** on the inner peripheral side when the hydraulic oil is discharged from the oil chamber **51**, and easily connect, on the end surface **56** side of the air guide **70**, the outer peripheral side flow passage **81** and the inner peripheral side flow passage **82** to the oil passage connection port **55** when the hydraulic oil is supplied to the oil chamber **51**.

According to the first preferred embodiment of the present invention, the air guide **70** includes, as the inner peripheral side flow passage **82**, the through-hole **72***a* provided on at least one of the plurality of first protrusions **72** to penetrate therethrough in the right-left direction. Accordingly, with the through-hole **72***a*, the inner peripheral side flow passage **82**, which is closed due to contact of the plurality of first protrusions **72** with the end surface **56** in the right-left direction when the hydraulic oil is discharged from the oil chamber **51**, and is opened due to being spaced apart from the plurality of first protrusions **72** from the end surface **56** in the right-left direction when the hydraulic oil is supplied to the oil chamber **51**, is easily provided.

According to the first preferred embodiment of the present invention, the through-hole **72***a* is provided on each of the plurality of first protrusions **72**. Accordingly, the sectional area of the inner peripheral side flow passage **82** is easily increased as compared with a case in which the through-hole **72***a* is provided on one or more but not all of the plurality of first protrusions **72**. Consequently, the pressure loss of the hydraulic oil is effectively decreased when the hydraulic oil is supplied to the oil chamber **51**.

According to the first preferred embodiment of the present invention, the plurality of first protrusions **72** each have a sectoral shape as viewed in the right-left direction, and the through-hole **72***a* has a sectoral shape smaller than the sectoral shape of each of the plurality of first protrusions **72** as viewed in the right-left direction. Accordingly, the sectional area of the inner peripheral side flow passage **82** is easily increased as compared with a case in which the through-hole **72***a* does not have the same sectoral shape as the plurality of first protrusions **72**. Consequently, the pressure loss of the hydraulic oil is effectively decreased when the hydraulic oil is supplied to the oil chamber **51**.

According to the first preferred embodiment of the present invention, the oil passage connection port **55** is provided on a portion of the outer peripheral surface **52***a* of the piston rod **52** in the circumferential direction. Furthermore, the air guide **70** includes the first annular recess **75** recessed away from the end surface **56** with respect to the plurality of first protrusions **72** on the inner peripheral side, on which the piston rod **52** is provided, to connect the inside-outside connection recesses **73** to the oil passage connection port **55**. Accordingly, the inside-outside connection recesses **73** that connect the outer peripheral side to the inner peripheral side with the piston rod **52** are easily connected to the oil passage connection port **55** provided on a portion of the outer peripheral surface **52***a* of the piston rod **52** in the circumferential direction by the first annular recess **75**.

Second Preferred Embodiment

The structure of a marine vessel **200** including outboard motors **220** (two outboard motors, for example) according to a second preferred embodiment of the present invention is now described with reference to FIGS. **9** and **11**. In the figures, the same or similar structures as those of the outboard motors **120** and the marine vessel **100** according to the first preferred embodiment are denoted by the same reference numerals.

As shown in FIG. **9**, in the second preferred embodiment, an oil passage **242** is located in front of a steering cylinder **241**, unlike the first preferred embodiment in which the oil passage **42** is provided inside the piston rod **52**. Specifically, in front of an oil chamber **251**, the oil passage **242** including a first end connected to oil pipes **245** and a second end connected to the oil chamber **251** is aligned with the steering cylinder **241** in a forward-rearward direction and extends in a right-left direction. The oil passage **242** includes an oil passage **242***a* connected to a left oil chamber **251***a* and an oil passage **242***b* connected to a right oil chamber **251***b*. The oil passage **242***a* is connected to the left oil chamber **251***a* on the left end cap **257** side of the steering cylinder **241** and is connected to one of the oil pipes **245** on the piston **253** side of the steering cylinder **241**. Furthermore, the oil passage **242***b* is connected to the right oil chamber **251***b* on the right end cap **257** side of the steering cylinder **241** and is connected to the other of the oil pipes **245** on the piston **253** side of the steering cylinder **241**. FIG. **9** shows a state in which hydraulic oil is supplied from the oil passage **242***a* to the left oil chamber **251***a* via an oil passage connection port **255***a*, and hydraulic oil is discharged from the right oil chamber **251***b* to the oil passage **242***b* via an oil passage connection port **255***b*. In FIG. **9**, the hatching of an air guide **270** indicating a cross-section is omitted in order to clearly show the shape of the air guide **270**.

In the second preferred embodiment, an oil passage connection port **255**, which is a connection port of the oil chamber **251** to the oil passage **242**, is provided on a portion of the inner peripheral surface **254***a* of a cylinder body **254** (the inner peripheral surface **251***c* of the oil chamber **251**) in a circumferential direction, unlike the first preferred embodiment in which the oil passage connection port **55** is located in a portion of the outer peripheral surface **52***a* of the piston rod **52** provided in the cylinder body **54** in the circumferential direction. Specifically, the oil passage connection port **255***a* of the oil passage **242***a* connected to the left oil chamber **251***a* extends from the oil passage **242***a* to an end (inner peripheral surface **251***c*) of the left oil chamber **251***a* on the oil passage **242***a* side toward the inner circumference side inside an outer peripheral portion (having a tubular shape) of the cylinder body **254**. The oil passage connection port **255***b* of the oil passage **242***b* connected to the right oil chamber **251***b* extends from the oil passage **242***b* to an end (inner peripheral surface **251***c*) of the right oil chamber **251***b* on the oil passage **242***b* side toward the inner circumference side inside the outer peripheral portion of the cylinder body **254**.

In the second preferred embodiment, the oil passage connection port **255** is located in the vicinity of or adjacent to an end surface **256** (on the side opposite to the piston **253** side) of the oil chamber **251** in the right-left direction, unlike the first preferred embodiment in which the oil passage connection port **55** is located in the vicinity of or adjacent to the end surface **56** (on the piston **53** side) of the oil chamber **51** in the right-left direction.

In the second preferred embodiment, the outboard motors **220** each include the air guide **270** located in the vicinity of or adjacent to the oil passage connection port **255** to guide air **60** (see FIG. **10**) remaining in the oil chamber **251** to the oil passage connection port **255** when the hydraulic oil is discharged from the oil chamber **251** via the oil passage **242**, similarly to the first preferred embodiment. As shown in FIG. **10**, the air **60** remains in the oil chamber **251** without being discharged from the oil passage connection port **255** after the air **60** enters the oil chamber **251** when the steering cylinder **241** is assembled, similarly to the first preferred embodiment.

As shown in FIG. **11**, in the second preferred embodiment, the air guide **270** includes, as a contact portion **271**, a second protrusion **272** that protrudes toward the end surface **256** (see FIG. **6**) of the oil chamber **251**, unlike the first preferred embodiment in which the air guide **70** includes the plurality of (eight) first protrusions **72** as the contact portion **71** and the inside-outside connection recesses **73** located between the plurality of (eight) first protrusions **72**. That is, as shown in FIG. **9**, when the hydraulic oil is discharged from the right oil chamber **251***b* (oil chamber **251**) to the oil passage **242***b* (oil passage **242**) via the oil passage connection port **255***b* (oil passage connection port **255**), a surface **272***b* of the second protrusion **272** on the end surface **256** side in the right-left direction contacts the end surface **256** in the right-left direction. In this state, an inner peripheral side flow passage **282** is closed.

In the second preferred embodiment, the inner peripheral side flow passage **282** is an annular gap between the outer peripheral surface **252***a* of a piston rod **252** and the inner peripheral surface **273***a* of a through-hole **273** that penetrates in the right-left direction in a central portion of the air guide **270**, unlike the first preferred embodiment in which the through-hole **72***a* is provided as the inner peripheral side flow passage **82** on at least one of the first protrusions **72** to penetrate therethrough in the right-left direction. The width of the annular gap between the outer peripheral surface **252***a* and the inner peripheral surface **273***a* is set to several millimeters, for example.

In the second preferred embodiment, the air guide **270** includes notches **276** as the outer peripheral flow passage **281**, unlike the first preferred embodiment in which the annular gap is provided as the outer peripheral side flow passage **81** between the outer peripheral surface **70***a* of the disk-shaped air guide **70** and the inner peripheral surface **51***c* of the oil chamber **51**. The notches **276** are provided on the outer peripheral side to penetrate in the right-left direction. The notches **276** are portions of the outer peripheral surface **270***a* of the air guide **270**. A plurality of (eight, for example) of notches **276***a* are provided at equal or substantially equal intervals as viewed in the axial direction (right-left direction) of the piston rod **252**. The diameter of a portion of the outer peripheral surface **270***a* of the air guide **270** without the notches is slightly smaller than the diameter of the inner peripheral surface **254***a* of the cylinder body **254** within a predetermined range (at a contact position P**1** and a separated position P**2**). Thus, the air guide **270** moves within the predetermined range in the oil chamber **251** while being guided by the inner peripheral surface **254***a* of the cylinder body **254**.

In the second preferred embodiment, the air guide **270** includes a second annular recess **275**. The second annular recess **275** is recessed away from the end surface **256** with respect to the second protrusion **272** on the outer peripheral side and is connected to the oil passage connection port **255**.

In the second preferred embodiment, a restrictor **254*b*** has a stepped shape that is recessed to the outer peripheral side as compared with the inner peripheral surface **254*a*** on the piston **253** side and is located in the vicinity of or adjacent to the oil passage connection port **255** of the inner peripheral surface **254*a*** of the cylinder body **254**, unlike the first preferred embodiment in which the restrictor **52*b*** that protrudes toward the outer peripheral side relative to the oil passage connection port **55** is provided at the end of the piston rod **52** on the oil passage connection port **55** side.

The remaining structures of the second preferred embodiment are similar to those of the first preferred embodiment.

According to the second preferred embodiment of the present invention, the following advantageous effects are achieved.

According to the second preferred embodiment of the present invention, the outboard motors **220** (marine vessel **200**) each include the air guide **270** located in the vicinity of or adjacent to the oil passage connection port **255**, which is the connection port of the oil chamber **251** to the oil passage **242**, in the right-left direction to guide the air **60** remaining in the oil chamber **251** to the oil passage connection port **255** when the hydraulic oil is discharged from the oil chamber **251** via the oil passage **242**. Accordingly, similarly to the first preferred embodiment, the air **60** remaining in the oil chamber **251** is guided to the oil passage connection port **255** by the normal operation of the steering cylinder **241** that discharges the hydraulic oil from the oil chamber **251** via the oil passage **242**, and thus the air **60** is automatically discharged from the oil chamber **251** to the outside without an operator performing a complex operation such as tilting the steering cylinder **241**. Consequently, similarly to the first preferred embodiment, the air in the oil chamber **251** of the steering cylinder **241** is easily bled.

According to the second preferred embodiment of the present invention, the oil passage **242** is located in front of the steering cylinder **241**. Furthermore, the oil passage connection port **255** is provided on the inner peripheral surface **254*a*** of the cylinder body **254**. Moreover, the air guide **270** includes, as the contact portion **271**, the second protrusion **272** that protrudes toward the end surface **256** of the oil chamber **251**. Accordingly, the second protrusion **272** corresponding to the contact portion **271** easily closes the inner peripheral side flow passage **282** when the hydraulic oil is discharged from the oil chamber **251**, and easily opens the inner peripheral side flow passage **282** when the hydraulic oil is supplied to the oil chamber **251**.

According to the second preferred embodiment of the present invention, the air guide **270** includes, as the outer peripheral side flow passage **281**, the notches **276** provided on the outer peripheral side to penetrate in the right-left direction. Accordingly, with the notches **276**, the outer peripheral side flow passage **281** is easily provided in the oil chamber **251** when the hydraulic oil is discharged from the oil chamber **251**.

According to the second preferred embodiment of the present invention, the oil passage connection port **255** is provided on a portion of the inner peripheral surface **254*a*** of the cylinder body **254** in the circumferential direction. Furthermore, the air guide **270** includes the second annular recess **275** recessed away from the end surface **256** with respect to the second protrusion **272** on the outer peripheral side and is connected to the oil passage connection port **255**. Accordingly, the outer peripheral side flow passage **281** is easily connected to the oil passage connection port **255** provided on a portion of the inner peripheral surface **254*a*** of the cylinder body **254** in the circumferential direction by the second annular recess **275**.

The remaining advantageous effects of the second preferred embodiment are similar to those of the first preferred embodiment.

The preferred embodiments of the present invention described above are illustrative in all points and not restrictive. The extent of the present invention is not defined by the above description of the preferred embodiments but by the scope of the claims, and all modifications within the meaning and range equivalent to the scope of the claims are further included.

For example, while the marine vessel preferably includes two outboard motors in each of the first and second preferred embodiments described above, the present invention is not restricted to this. In the present invention, the marine vessel may alternatively include one or three or more outboard motors.

While the oil passage **242** is preferably located in front of the steering cylinder **241** in the second preferred embodiment described above, the present invention is not restricted to this. In the present invention, the oil passage may alternatively be provided behind the steering cylinder or below the steering cylinder.

While the through-hole **72*a*** corresponding to the inner peripheral side flow passage **82** is preferably provided on each of the plurality of first protrusions **72** corresponding to the contact portion **71** in the first preferred embodiment described above, the present invention is not restricted to this. In the present invention, as in an air guide **370** according to a first modified example shown in FIG. **12**, a through-hole **372*a*** corresponding to an inner peripheral side flow passage **382** may alternatively be provided only on one or more but not all of the plurality of first protrusions **372** corresponding to the contact portion **371**.

While each of the plurality of first protrusions **72** preferably has a sectoral shape as viewed in the right-left direction, and the through-hole **72*a*** corresponding to the inner peripheral side flow passage **82** preferably has a sectoral shape smaller than the sectoral shape of each of the plurality of first protrusions **72** as viewed in the right-left direction in the first preferred embodiment described above, the present invention is not restricted to this. In the present invention, as in the air guide **370** according to the first modified example shown in FIG. **12**, each of the plurality of first protrusions **372** may alternatively have a sectoral shape as viewed in the right-left direction, and the through-hole **372*a*** corresponding to the inner peripheral side flow passage **382** may alternatively have a shape other than the sectoral shape as viewed in the right-left direction. Furthermore, although not shown, each of the plurality of first protrusions may alternatively have a shape other than the sectoral shape as viewed in the right-left direction.

While the air guide **70** preferably includes the annular recess **74** recessed away from the end surface **56** with respect to the plurality of first protrusions **72** on the outer peripheral side of the plurality of first protrusions **72** and connected to the outer peripheral side flow passage **81** in the first preferred embodiment described above, the present invention is not restricted to this. In the present invention, the air guide may not include the annular recess recessed away from the end surface with respect to the plurality of first protrusions on the outer peripheral side of the plurality of first protrusions and connected to the outer peripheral side flow passage.

While the plurality of oil passage connection ports **55** are preferably provided at equal or substantially equal intervals in the circumferential direction on the outer peripheral surface **52***a* of the piston rod **52** in the first preferred embodiment described above, the present invention is not restricted to this. In the present invention, the plurality of oil passage connection ports may alternatively be provided at non-uniform intervals in the circumferential direction on the outer peripheral surface of the piston rod. Furthermore, only one oil passage connection port may alternatively be provided in the circumferential direction on the outer peripheral surface of the piston rod.

While the air guide **270** preferably includes, as the outer peripheral flow passage **281**, the notches **276** provided on the outer peripheral side to penetrate in the right-left direction in the second preferred embodiment described above, the present invention is not restricted to this. In the present invention, as in an air guide **470** according to a second modified example shown in FIG. **13**, the air guide according to the first preferred embodiment may alternatively include notches as an outer peripheral side flow passage, or as in an air guide **570** according to a third modified example shown in FIG. **14**, the air guide according to the first modified example may alternatively include notches as an outer peripheral side flow passage.

While the air guide **70** (**270**) preferably supplies the hydraulic oil to the oil chamber **51** (**251**) via the inner peripheral side flow passage **82** (**282**) in addition to the outer peripheral side flow passage **81** (**281**) when the hydraulic oil is supplied to the oil chamber **51** (**251**) in each of the first and second preferred embodiments described above, the present invention is not restricted to this. In the present invention, the air guide may alternatively supply the hydraulic oil to the oil chamber not via the inner peripheral side flow passage but via the outer peripheral side flow passage when the hydraulic oil is supplied to the oil chamber.

While an electric signal is preferably transmitted from the steering wheel **111** to the steering control unit provided in each of the outboard motors **120** (**220**) as the user operates the steering wheel **111**, the steering control unit preferably controls the steering motor **46***b* of the steering device **40** provided in each of the outboard motors **120** (**220**) to change the propulsion direction of the hull **110** (**210**) based on the electric signal transmitted from the steering wheel **111**, and the steering pump **46***a* provided in each of the outboard motors **120** (**220**) is preferably driven by the control of the steering motor **46***b* to supply the hydraulic oil from the steering pump **46***a* to the oil chamber **51** (**251**) and discharge the hydraulic oil from the oil chamber **51** (**251**) to the outside in each of the first and second preferred embodiments described above, the present invention is not restricted to this. In the present invention, as the user operates the steering wheel, a mechanical steering pump provided in the hull may alternatively be driven to supply the hydraulic oil to the oil chamber of the steering cylinder provided in each of the outboard motors and discharge the hydraulic oil from the oil chamber.

While preferred embodiments of the present invention have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing from the scope and spirit of the present invention. The scope of the present invention, therefore, is to be determined solely by the following claims.

What is claimed is:

1. An outboard motor comprising:
an outboard motor body;
a steering shaft;
a steering cylinder including:
  a piston rod extending in a right-left direction of the outboard motor body;
  a piston fixed to the piston rod; and
  a cylinder body including therein the piston and an oil chamber to store hydraulic oil;
an oil passage connected to the oil chamber via an oil passage connection port to supply the hydraulic oil to the oil chamber and discharge the hydraulic oil from the oil chamber; and
an air guide, having a disk shape and located in a vicinity of or adjacent to the oil passage connection port in the right-left direction, to guide air remaining in the oil chamber to the oil passage connection port when the hydraulic oil is discharged from the oil chamber via the oil passage; wherein
the steering cylinder is operable to rotate the steering shaft and the outboard motor body in the right-left direction by adjusting an amount of the hydraulic oil in the oil chamber and moving the cylinder body in the right-left direction.

2. The outboard motor according to claim **1**, wherein the air guide is operable to guide air remaining in an upper portion of the oil chamber to the oil passage connection port via an outer peripheral side flow passage provided on an outer peripheral side of the air guide when the hydraulic oil is discharged from the oil chamber.

3. The outboard motor according to claim **2**, wherein
the outer peripheral side flow passage is defined by an outer peripheral surface of the air guide and an inner peripheral surface of the oil chamber.

4. The outboard motor according to claim **2**, wherein the air guide is operable to supply the hydraulic oil to the oil chamber via an inner peripheral side flow passage provided on an inner peripheral side of the outer peripheral side flow passage in addition to the outer peripheral side flow passage when the hydraulic oil is supplied to the oil chamber.

5. The outboard motor according to claim **4**, wherein the air guide is operable to move in the right-left direction in the oil chamber to close the inner peripheral side flow passage when the hydraulic oil is discharged from the oil chamber and to open the inner peripheral side flow passage when the hydraulic oil is supplied to the oil chamber.

6. The outboard motor according to claim **5**, wherein
the air guide includes a contact portion to contact an end surface of the oil chamber in the right-left direction; and
the air guide is operable to move in the right-left direction to a contact position at which the contact portion contacts the end surface to close the inner peripheral side flow passage when the hydraulic oil is discharged from the oil chamber, and to move in the right-left direction to a separated position at which the contact portion is spaced apart from the end surface to open the inner peripheral side flow passage when the hydraulic oil is supplied to the oil chamber.

7. The outboard motor according to claim **6**, wherein the air guide is operable to move to the contact position in the right-left direction due to a flow of the hydraulic oil discharged from the oil chamber to the oil passage connection port when the hydraulic oil is discharged from the oil chamber, and to move to the separated position in the right-left direction due to a flow of the hydraulic oil supplied from the oil passage connection port to the oil chamber when the hydraulic oil is supplied to the oil chamber.

8. The outboard motor according to claim **6**, further comprising:

a restrictor to restrict the air guide from moving to a side opposite to the contact position relative to the separated position in the right-left direction.

9. The outboard motor according to claim **6**, wherein the oil passage connection port is located in a vicinity of or adjacent to the end surface of the oil chamber in the right-left direction.

10. The outboard motor according to claim **6**, wherein

the oil passage is provided in the piston rod;

the oil passage connection port is provided on an outer peripheral surface of the piston rod;

the piston rod is provided on an inner peripheral side of the oil chamber; and

the air guide further includes, as the contact portion, a plurality of first protrusions that protrude toward the end surface in the right-left direction, and an inside-outside connection recess located between the plurality of first protrusions to connect an outer peripheral side of the oil chamber to the inner peripheral side.

11. The outboard motor according to claim **10**, wherein the air guide further includes, as the inner peripheral side flow passage, a through-hole provided on at least one of the plurality of first protrusions extending therethrough in the right-left direction.

12. The outboard motor according to claim **11**, wherein the through-hole is provided on each of the plurality of first protrusions.

13. The outboard motor according to claim **11**, wherein

the plurality of first protrusions each have a sectoral shape as viewed in the right-left direction; and

the through-hole has a sectoral shape smaller than the sectoral shape of each of the plurality of first protrusions as viewed in the right-left direction.

14. The outboard motor according to claim **10**, wherein

the oil passage connection port is provided on a portion of the outer peripheral surface in a circumferential direction of the piston rod; and

the air guide further includes a first annular recess recessed away from the end surface with respect to the plurality of first protrusions on the inner peripheral side to connect the inside-outside connection recess to the oil passage connection port.

15. The outboard motor according to claim **6**, wherein

the oil passage is located in front of, behind, or below the steering cylinder;

the oil passage connection port is provided on an inner peripheral surface of the cylinder body; and

the air guide further includes, as the contact portion, a second protrusion that protrudes toward the end surface in the oil chamber.

16. The outboard motor according to claim **15**, wherein the air guide further includes, as the outer peripheral side flow passage, a notch provided on the outer peripheral side of the air guide extending therethrough in the right-left direction.

17. The outboard motor according to claim **15**, wherein

the oil passage connection port is provided on a portion of the inner peripheral surface in a circumferential direction of the cylinder body; and

the air guide further includes a second annular recess recessed away from the end surface with respect to the second protrusion on the outer peripheral side of the air guide and connected to the oil passage connection port.

18. A marine vessel comprising:

a hull including a steering wheel; and

an outboard motor attached to the hull; wherein

the outboard motor includes:

an outboard motor body;

a steering shaft;

a steering cylinder including:

a piston rod extending in a right-left direction of the outboard motor body;

a piston fixed to the piston rod; and

a cylinder body including therein the piston and an oil chamber to store hydraulic oil;

an oil passage connected to the oil chamber via an oil passage connection port to supply the hydraulic oil to the oil chamber and discharge the hydraulic oil from the oil chamber; and

an air guide, having a disk shape and located in a vicinity of or adjacent to the oil passage connection port in the right-left direction, to guide air remaining in the oil chamber to the oil passage connection port when the hydraulic oil is discharged from the oil chamber via the oil passage; wherein

the steering cylinder is operable to rotate the steering shaft and the outboard motor body in the right-left direction by adjusting an amount of the hydraulic oil in the oil chamber and moving the cylinder body in the right-left direction based on an operation of the steering wheel.

19. The marine vessel according to claim **18**, wherein the air guide is operable to guide air remaining in an upper portion of the oil chamber to the oil passage connection port via an outer peripheral side flow passage provided on an outer peripheral side of the air guide when the hydraulic oil is discharged from the oil chamber.

20. The marine vessel according to claim **19**, wherein

the outer peripheral side flow passage is defined by an outer peripheral surface of the air guide and an inner peripheral surface of the oil chamber.

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