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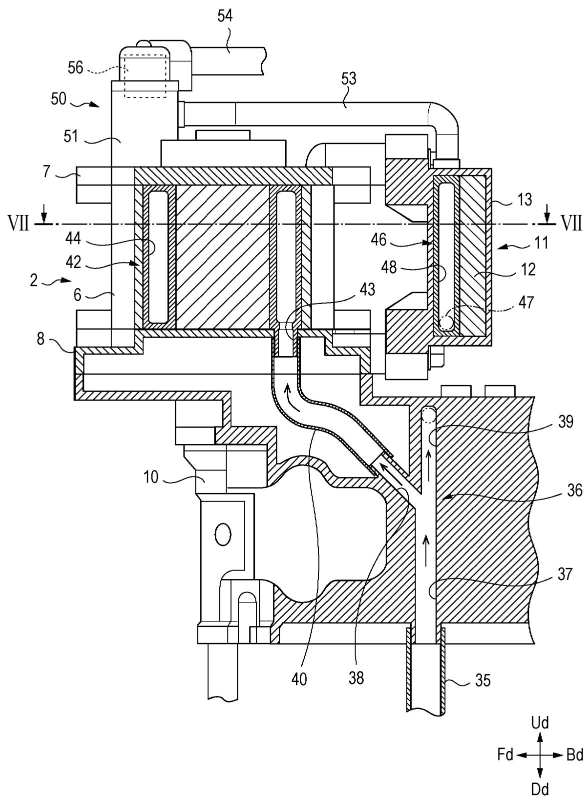
(54) **SHIP PROPULSION MACHINE**

(57) A ship propulsion machine (1) includes a motor (2), an inverter (11), a propeller, a power transmission mechanism, and a cooling mechanism (31). The cooling mechanism includes: a motor water jacket (42) configured to cool the motor by allowing cooling water to flow therein; an inverter water jacket (46) configured to cool the inverter by allowing the cooling water to flow therein; a first cooling water passage (35) configured to allow the cooling water to flow toward the motor water jacket and the inverter water jacket; and a branch passage (36) connecting the motor water jacket and the inverter water jacket to the first cooling water passage such that the motor water jacket and the inverter water jacket are connected in parallel with each other. The branch passage is configured to distribute and supply the cooling water flowing in the first cooling water passage to the motor water jacket and the inverter water jacket.

FIG. 6



EP 4 563 460 A1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a ship propulsion machine using a motor (electric motor) as a power source to propel a ship.

BACKGROUND ART

[0002] JP2022-34677A (Patent Literature 1) describes an electric ship propulsion machine. In electric ship propulsion machines, an AC motor is often used as a power source to propel a ship. When an AC motor is used, an inverter is used to convert direct current from a battery into alternating current to drive the AC motor.

[0003] Motors and inverters generate heat during operation. In electric ship propulsion machines, a mechanism is provided to cool the motor and the inverter. For example, in a ship propulsion machine described in JP2022-34677A, a cooling water passage for allowing cooling water to flow provided, a water jacket is provided in each of an inverter and a motor, a pump, the water jacket of the inverter, and the water jacket of the motor are connected in series to the cooling water passage, and a heat sink for cooling the cooling water flowing in the cooling water passage is attached to a part of the cooling water passage.

[0004] Patent Literature 1: JP2022-34677A

SUMMARY OF INVENTION

[0005] When cooling the motor and the inverter by the cooling water, it is preferable to smoothly flow the cooling water in the cooling water passage, the water jacket of the motor, and the water jacket of the inverter, respectively, to increase cooling efficiency.

[0006] In this regard, in the ship propulsion machine described in JP2022-34677A, the water jacket of the inverter and the water jacket of the motor are connected in series to the cooling water passage, and the cooling water first flows in a passage formed within the water jacket of the inverter, and then flows in a passage formed within the water jacket of the motor. For this reason, a cooling water flow path from a cooling water inflow location in the water jacket of the inverter to a cooling water outflow location in the water jacket of the motor is long, resulting in significant pressure loss of the cooling water. As a result, to smoothly allow the cooling water to flow, a pump with high discharge capacity must be used, which leads to increases in pump size, power consumption, or the like.

[0007] In addition, when the water jacket of the inverter and the water jacket of the motor are connected in series to the cooling water passage, it is difficult to individually set a flow rate of the cooling water flowing in the water jacket of the motor and a flow rate of the cooling water flowing in the water jacket of the inverter, in response to the respective amounts of heat generation of the motor and the inverter. For this reason, it is difficult to individually optimize the cooling capacity for cooling the motor and the cooling capacity for cooling the inverter.

[0008] The present disclosure has been made in view of the problems described above, for example, and an object of the present disclosure is to provide a ship propulsion machine capable of enhancing cooling efficiencies for a motor and an inverter, and easily optimizing a cooling capacity for cooling each of the motor and the inverter, in response to the respective amounts of heat generation of the motor and the inverter.

[0009] The present disclosure provides a ship propulsion machine including: a motor; an inverter configured to generate a drive current for controlling drive of the motor; a propeller; a power transmission mechanism configured to transmit power of the motor to the propeller; and a cooling mechanism configured to cool the motor and the inverter. The cooling mechanism includes: a motor water jacket provided in the motor and configured to cool the motor by allowing cooling water to flow therein; an inverter water jacket provided in the inverter and configured to cool the inverter by allowing the cooling water to flow therein; a first cooling water passage configured to allow the cooling water to flow toward the motor water jacket and the inverter water jacket; and a branch passage connecting the motor water jacket and the inverter water jacket to the first cooling water passage such that the motor water jacket and the inverter water jacket are connected in parallel with each other, the branch passage being configured to distribute and supply the cooling water flowing in the first cooling water passage to the motor water jacket and the inverter water jacket.

[0010] According to the present disclosure, it is possible to enhance cooling efficiencies for a motor and an inverter, and easily optimize a cooling capacity for cooling each of the motor and the inverter, in response to the respective amounts of heat generation of the motor and the inverter.

BRIEF DESCRIPTION OF DRAWINGS

[0011] The present disclosure will be described in detail based on the following without being limited thereto, wherein:

FIG. 1 is an explanatory view showing an outboard motor, which is an embodiment of a ship propulsion machine of the present disclosure;

FIG. 2 is a perspective view showing a motor, an inverter, a motor holder, and the like in the outboard motor according to the embodiment of the present disclosure;

FIG. 3 is an explanatory view showing a state of the motor, the inverter, the motor holder, and the like in FIG. 2, as viewed from the left;

FIG. 4 is an explanatory view showing a state of the motor, the inverter, the motor holder, and the like in

FIG. 2, as viewed from above;

FIG. 5 is a circuit diagram showing a cooling mechanism in the outboard motor according to the embodiment of the present disclosure;

FIG. 6 is a cross-sectional view taken along cutting line VI-VI in FIG. 4, showing the motor, the inverter, the motor holder, and the like;

FIG. 7 is a cross-sectional view taken along cutting line VII-VII in FIG. 6, showing the motor, the inverter, the motor holder, and the like;

FIG. 8 is a cross-sectional view taken along cutting line VIII-VIII in FIG. 4, showing the motor, the inverter, the motor holder, and the like;

FIGS. 9A to 9H are explanatory views regarding effects of the cooling mechanism in the embodiment of the present disclosure; and

FIGS. 10A and 10B are explanatory views showing modifications of the outboard motor according to the embodiment of the present disclosure.

DESCRIPTION OF EMBODIMENTS

[0012] A ship propulsion machine according to an embodiment of the present disclosure includes a motor, an inverter that generates a drive current for controlling drive of the motor, a propeller, a power transmission mechanism that transmits power of the motor to the propeller, and a cooling mechanism that cools the motor and the inverter.

[0013] In addition, in the ship propulsion machine according to the embodiment of the present disclosure, the cooling mechanism includes: a motor water jacket provided in the motor and configured to cool the motor by allowing cooling water to flow therein; an inverter water jacket provided in the inverter and configured to cool the inverter by allowing the cooling water to flow therein; a first cooling water passage for allowing the cooling water to flow toward the motor water jacket and the inverter water jacket; and a branch passage connecting the motor water jacket and the inverter water jacket to the first cooling water passage such that the motor water jacket and the inverter water jacket are connected in parallel with each other, and configured to distribute and supply the cooling water flowing in the first cooling water passage to the motor water jacket and the inverter water jacket.

[0014] In the cooling mechanism of the ship propulsion machine according to the embodiment of the present disclosure, the motor water jacket and the inverter water jacket are connected, via the branch passage, to the first cooling water passage such that the motor water jacket and the inverter water jacket are connected in parallel with each other, via the branch passage. With this, a cooling water flow path in the cooling mechanism can be shortened compared to a case where the motor water jacket and the inverter water jacket are connected in series to the first cooling water passage. This makes it possible to reduce pressure loss of the cooling water flowing through the flow path, thereby facilitating the flow of the cooling water. Therefore, even when a small pump with low discharge capacity is used, the cooling efficiency of the cooling water by the cooling mechanism can be enhanced.

[0015] In addition, in the cooling mechanism of the present embodiment, since the motor water jacket and the inverter water jacket are connected, via the branch passage, to the first cooling water passage such that the motor water jacket and the inverter water jacket are connected in parallel with each other, it becomes easy to individually set a flow rate of cooling water flowing in the motor water jacket and a flow rate of cooling water flowing in the inverter water jacket, in response to respective amounts of heat generation of the motor and the inverter. Therefore, it is possible to easily optimize a cooling capacity for cooling the motor and a cooling capacity for cooling the inverter.

[0016] An embodiment of a ship propulsion machine of the present disclosure will be described with reference to the drawings. In the description of the present embodiment, when referring to upper (Ud), lower (Dd), front (Fd), rear (Bd), left (Ld), and right (Rd) directions, they follow arrows drawn at the lower right in each drawing except for FIG. 5.

(Outboard Motor)

[0017] FIG. 1 shows an entire outboard motor 1, which is an embodiment of the ship propulsion machine of the present disclosure. In FIG. 1, the outboard motor 1 includes a motor 2, an inverter 11, a propeller 15, a drive shaft 16, a propeller shaft 17, and a gear mechanism 18. In addition, the outboard motor 1 includes a cooling mechanism 31 shown in FIG. 5.

[0018] The motor 2 is an AC motor and generates power to propel a ship. The motor 2 is attached to a motor holder 10. The inverter 11 is a device that generates a drive current for controlling drive of the motor 2 and is attached to the motor 2. The motor 2, the inverter 11, and the motor holder 10 are arranged in an upper part of the outboard motor 1 and covered with a motor cover 21.

[0019] The propeller 15 converts the power of the motor 2 into a propulsive force for the ship. The drive shaft 16, the propeller shaft 17, and the gear mechanism 18 constitute a power transmission mechanism that transmits the power of the motor 2 to the propeller 15. The propeller 15, the propeller shaft 17, and the gear mechanism 18 are arranged in a lower part of the outboard motor 1. The drive shaft 16 extends vertically between the upper and lower parts of the outboard motor 1.

[0020] An upper end portion of the drive shaft 16 is connected to the motor 2. The gear mechanism 18 includes a drive gear 19 and a driven gear 20, the drive gear 19 being fixed to a lower end portion of the drive shaft 16 and the driven gear 20 being fixed to a front end portion of the propeller shaft 17. The drive gear 19 and the driven gear 20 are both bevel gears and are in mesh with each other. Additionally, the propeller 15 is fixed to a rear end portion of the propeller shaft 17. Additionally, the drive shaft 16 is accommodated within a drive shaft case 22. Additionally, the propeller shaft 17 and the gear mechanism 18 are accommodated within a gear case 23.

[0021] Additionally, the outboard motor 1 is provided with a clamp mechanism 24 for attaching the outboard motor 1 to a transom of the ship. In a state in which the outboard motor 1 is attached to the transom of the ship, the lower part of the outboard motor 1, specifically, the lower portion of the drive shaft case 22 and the gear case 23, are located below a water surface.

[0022] FIG. 2 shows a unit, which is formed by attaching the motor 2 to the motor holder 10 and the inverter 11 to the motor 2, as viewed from the upper left front side. FIG. 3 shows the unit as viewed from the left, and FIG. 4 shows the unit as viewed from above.

[0023] As shown in FIG. 2, the motor holder 10 is a robust structure having a three-dimensional shape that serves as a base for the motor 2, and is formed of, for example, a metal material. The motor 2 is placed on an upper surface of a front part of the motor holder 10 and is firmly fixed to the motor holder 10 using a fixing member such as a bolt.

[0024] As shown in FIG. 3, the motor 2 includes a motor shaft 3, a rotor 4 provided on an outer periphery side of the motor shaft 3, a stator 5 provided on an outer periphery side of the rotor 4, a cylindrical motor housing 6 provided on an outer periphery side of the stator 5, and two motor brackets 7 and 8 provided on one end side and other end side (upper end side and lower end side) in an axial direction of the motor housing 6, respectively.

[0025] The inverter 11 includes an inverter body 12 and a rectangular parallelepiped inverter housing 13 that accommodates the inverter body 12. The inverter body 12 generates a drive current for controlling drive of the motor 2 by converting current supplied from a battery from direct current to alternating current. The inverter body 12 includes a power semiconductor, which is a component that generates a large amount of heat, and the like.

[0026] The motor 2 is arranged on the motor holder 10 such that an extension direction of the motor shaft 3, i.e., an extension direction of a rotation axis A of the motor 2 is oriented vertically. Additionally, the motor 2 and the inverter 11 are arranged above the motor holder 10 such that they are aligned in the front-rear direction. The inverter 11 is arranged at the rear of the motor 2 and is attached and fixed to the motor 2 via inverter attachment portions 9 provided at rear portions of the two motor brackets 7 and 8, respectively. In the present embodiment, the vertical direction corresponds to an example of an "X direction", and the front-rear direction corresponds to an example of a "Y direction".

(Configuration of Cooling Mechanism)

[0027] FIG. 5 shows a configuration of the cooling mechanism 31 provided in the outboard motor 1. FIG. 6 is a cross-sectional view taken along cutting line VI-VI in FIG. 4, showing the motor 2, the inverter 11, the motor holder 10, and the like, as viewed from the left (from below in FIG. 4). FIG. 7 is a cross-sectional view taken along cutting line VII-VIIin FIG. 6, showing the motor 2, the inverter 11, the motor holder 10, and the like, as viewed from above. FIG. 8 is a cross-sectional view taken along cutting line VIII-VIII in FIG. 4, showing the motor 2, the inverter 11, the motor holder 10, and the like, as viewed from the right (from above in FIG. 4).

[0028] The cooling mechanism 31 is a mechanism that uses water around the outboard motor 1 as cooling water and cools the motor 2 and the inverter 11. As shown in FIG. 5, the cooling mechanism 31 includes a water inlet port 32, a water intake passage 33, a pump 34, a cooling water supply passage 35, a branch passage 36, a motor water jacket 42, an inverter water jacket 46, a joint passage 50, a cooling water discharge passage 54, a water outlet port 55, and a control valve 56.

[0029] As shown in FIG. 1, the water inlet port 32 is an inlet for drawing water from around the outboard motor 1 into the cooling mechanism 31 and is provided on the gear case 23. A strainer is attached to the water inlet port 32 to prevent trash, algae, or the like in the water around the outboard motor 1 from entering the cooling mechanism 31.

[0030] The water intake passage 33 is a passage that connects the water inlet port 32 and a suction port of the pump 34 and delivers water flowing into the water inlet port 32 to the pump 34.

[0031] The pump 34 is a device that causes cooling water to flow in the cooling mechanism 31 by drawing up water flowing into the water inlet port 32 and discharging the water as cooling water into the cooling water supply passage 35. As the pump 34, various pumps can be used, such as a Jabsco pump. In the present embodiment, the pump 34 is driven using rotation of the drive shaft 16.

[0032] The cooling water supply passage 35 is a passage that allows cooling water to flow toward the motor water jacket 42 and the inverter water jacket 46. The cooling water supply passage 35 is formed by, for example, a hose. A lower end portion of the cooling water supply passage 35 is connected to a discharge port of the pump 34, and an upper end portion of the cooling water supply passage 35 is connected to the branch passage 36, as shown in FIG. 6. The cooling water supply passage 35 is an example of a "first cooling water passage".

[0033] As shown in FIG. 5, the branch passage 36 is a passage that connects the motor water jacket 42 and the inverter water jacket 46 to the cooling water supply passage 35 such that the motor water jacket 42 and the inverter water jacket 46 are connected in parallel with each other, and distributes and supplies cooling water flowing in the cooling water supply path 35 to the motor water jacket 42 and the inverter water jacket 46. The branch passage 36 is formed by a trunk passage hole 37, a branched passage hole 38, and a branched passage hole 39 formed in the motor holder 10 as shown in FIG. 6, a connecting pipe 40 shown in FIG. 6, and a connecting pipe 41 shown in FIG. 3. As shown in FIG. 6, the upper end portion of the cooling water supply passage 35 is connected to a lower end portion of the trunk passage hole 37. The trunk passage hole 37 extends upward in the motor holder 10 and then branches into the two branched passage holes 38 and 39. A lower end portion of the connecting pipe 40 arranged in the motor holder 10 is connected to an upper end portion of the branched passage hole 38 on one side, and an upper end portion of the connecting pipe 40 is connected to an inlet 43 of the motor water jacket 42. As shown in FIG. 3, a lower end portion of the connecting pipe 41 arranged outside the motor holder 10 is connected to an upper end portion of the branched passage hole 39 on the other side, and an upper end portion of the connecting pipe 41 is connected to an inlet 47 of the inverter water jacket 46.

[0034] The motor water jacket 42 is a mechanism that is provided in the motor 2 and cools the motor 2 by allowing cooling water to flow therein. As shown in FIG. 7, the motor water jacket 42 is provided to surround the motor 2 on an outer periphery side of the motor 2. Specifically, the motor water jacket 42 is arranged between the stator 5 and the motor housing 6 and surrounds the stator 5. Additionally, an internal passage 44 for allowing cooling water to flow is formed inside the motor water jacket 42. The internal passage 44 surrounds the stator 5. In addition, as shown in FIG. 6, the motor water jacket 42 widely covers the stator 5 from a lower end-side portion to an upper end-side portion of the stator 5. Additionally, the internal passage 44 is formed from the lower end-side portion to the upper end-side portion of the stator 5.

[0035] In addition, the motor water jacket 42 has an inlet 43 that allows cooling water supplied through the branch passage 36 to flow into the internal passage 44 of the motor water jacket 42. The inlet 43 communicates with an inside of the internal passage 44. The inlet 43 is arranged at a left rear portion of the motor 2, as shown in FIGS. 4 and 7. Additionally, the inlet 43 is arranged at a lower part of the motor 2, as shown in FIG. 6. Additionally, the upper end portion of the connecting pipe 40 of the branch passage 36 is connected to the inlet 43. The inlet 43 serves as an example of a first inlet.

[0036] In addition, the motor water jacket 42 has an outlet 45 that allows cooling water flowing in the internal passage 44 of the motor water jacket 42 to flow out to the outside of the motor water jacket 42. The outlet 45 communicates with the inside of the internal passage 44. The outlet 45 is arranged at a right front portion of the motor 2, as shown in FIGS. 4 and 7. Additionally, the outlet 45 is arranged at an upper part of the motor 2, as shown in FIG. 8. The internal passage 44 communicates with an inside of a joint chamber 52 through the outlet 45. The outlet 45 serves as an example of a first outlet.

[0037] The inverter water jacket 46 is a mechanism that is provided in the inverter 11 and cools the inverter body 12 by allowing cooling water to flow therein. As shown in FIGS. 6 and 7, the inverter water jacket 46 is provided within the inverter housing 13 and arranged in front of the inverter body 12. The inverter water jacket 46 widely covers a front surface of the inverter body 12 from a left end portion to a right end portion and from a lower end portion to an upper end portion. Additionally, an internal passage 48 for allowing cooling water to flow is formed inside the inverter water jacket 46. The internal passage 48 is formed to widely cover the front surface of the inverter body 12 from the left end portion to the right end portion and from the lower end portion to the upper end portion.

[0038] Additionally, the inverter water jacket 46 has an inlet 47 that allows cooling water supplied through the branch passage 36 to flow into the internal passage 48 of the motor water jacket 46. The inlet 47 communicates with an inside of the internal passage 48. The inlet 47 is arranged at a left part of the inverter 11, as shown in FIG. 7. Additionally, the inlet 47 is arranged at a lower part of the inverter 11, as shown in FIG. 6. Additionally, the upper end portion of the connecting pipe 41 of the branch passage 36 is connected to the inlet 47. The inlet 47 serves as an example of a second inlet.

[0039] In addition, the inverter water jacket 46 has an outlet 49 that allows cooling water flowing in the internal passage 48 of the inverter water jacket 46 to flow out to the outside of the inverter water jacket 46. The outlet 49 communicates with the internal passage 48. The outlet 49 is arranged at a right part of the inverter 11, as shown in FIG. 7. Additionally, the outlet 49 is arranged at an upper part of the inverter 11, as shown in FIG. 8. Additionally, a rear end portion of a connecting pipe 53 is connected to the outlet 49. In addition, as shown in FIG. 4, the outlet 49 of the inverter water jacket 46 is arranged at the same position as the outlet 45 of the motor water jacket 42 in the left-right direction. The outlet 49 serves as an example of a second outlet. In the present embodiment, the left-right direction corresponds to an example of a "Z direction".

[0040] The joint passage 50 is a passage that is connected to the outlet 45 of the motor water jacket 42, the outlet 49 of the inverter water jacket 46, and the cooling water discharge passage 54, joins the cooling water flowing from the outlet 45 of the motor water jacket 42 with the cooling water flowing from the outlet 49 of the inverter water jacket 46, and allows the joined cooling water to flow into the cooling water discharge passage 54. As shown in FIG. 8, the joint passage 50 is formed by the joint chamber 52 and the connecting pipe 53. As shown in FIG. 2, a joint chamber forming part 51 protruding upward is formed at a right front part of the motor bracket 7. As shown in FIG. 8, the joint chamber 52 is formed in the joint chamber forming part 51. The outlet 45 of the motor water jacket 42 is connected to a bottom portion of the joint chamber forming part 51, and the internal passage 44 of the motor water jacket 42 communicates with an inside of the joint chamber 52 through the outlet 45. In addition, a front end portion of the connecting pipe 53 is connected to a rear portion of a peripheral part of the joint chamber forming part 51, and the internal passage 48 of the inverter water jacket 46 communicates with the inside of the joint chamber 52 through the outlet 49 and the connecting pipe 53. In addition, an upper end portion of the cooling water discharge passage 54 is connected to an upper portion of the joint chamber forming part 51, and the joint chamber 52 communicates with an inside of the cooling water discharge passage 54.

[0041] The cooling water discharge passage 54 is a passage that allows cooling water, which has flowed out from the inside of the motor water jacket 42 and the inside of the inverter water jacket 46, to flow therein. A lower end side of the cooling water discharge passage 54 is connected to the water outlet port 55 (see FIG. 5). The water outlet port 55 is provided, for example, at a rear portion of the lower part of the outboard motor 1. In addition, the cooling water discharge passage 54 is a specific example of a "second cooling water passage."

[0042] The control valve 56 is a valve that controls a flow rate of cooling water after being joined in the joint passage 50. As shown in FIG. 8, the control valve 56 is arranged at an upper part of the joint chamber 52 and between a joint position P where the cooling water flowing out from the outlet 45 of the motor water jacket 42 joins the cooling water flowing out from the outlet 49 of the inverter water jacket 46 and a connection position Q of the cooling water discharge passage 54. The control valve 56 changes a degree of valve opening in response to a temperature of the cooling water after joining, thereby regulating the temperature of the cooling water. Specifically, the control valve 56 increases the degree of valve opening in response to an increase in the temperature of the cooling water after joining. With this, when the temperature of the cooling water rises, the flow rates of the cooling water flowing in the motor water jacket 42 and the inverter water jacket 46 can be increased to lower the temperature of the cooling water. For example, the control valve 56 has a sensor that detects a temperature of the cooling water in the joint chamber 52. As the control valve 56, for example, a thermostat may be used.

[0043] A bypass passage for directly connecting the cooling water supply passage 35 and the water outlet port 55 may be added, and the bypass passage may be provided with a relief valve to connect and block the bypass passage. The relief valve closes when a pressure in the cooling water supply passage 35 falls to a predetermined pressure or below, and opens when the pressure in the cooling water supply passage 35 exceeds the predetermined pressure.

(Operation of Cooling Mechanism)

[0044] An operation of the cooling mechanism 31 is as follows. The pump 34 is driven along with rotation of the drive shaft 16 due to the drive of the motor 2. As the pump 34 is driven, water flowing into the water inlet port 32 is drawn up, flows through the water intake passage 33, flows into the suction port of the pump 34, and continues to flow into the cooling water supply passage 35 as cooling water from the discharge port of the pump 34. The cooling water flows in the cooling water supply passage 35, moves to the upper part of the outboard motor 1, and flows into the trunk passage hole 37 of the branch passage 36. In the branch passage 36, the cooling water flowing into the trunk passage hole 37 is divided into cooling water flowing through the branched passage hole 38 and the connecting pipe 40, and cooling water flowing through the branched passage hole 39 and the connecting pipe 41.

[0045] The cooling water flowing through the branched passage hole 38 and the connecting pipe 40 passes through the inlet 43 of the motor water jacket 42 and flows into the internal passage 44 of the motor water jacket 42. The cooling water flowing into the internal passage 44 flows in the internal passage 44, receives heat from the motor 2 during the flow, and passes through the outlet 45 of the motor water jacket 42 to flow into the joint chamber 52.

[0046] On the other hand, the cooling water flowing through the branched passage hole 39 and the connecting pipe 41 passes through the inlet 47 of the inverter water jacket 46 to flow into the internal passage 48 of the inverter water jacket 46. The cooling water flowing into the internal passage 48 flows in the internal passage 48, receives heat from the inverter body 12 during the flow, and passes through the outlet 49 of the inverter water jacket 46 to flow into the connecting pipe 53. Subsequently, the cooling water flows in the connecting pipe 53 and flows into the joint chamber 52.

[0047] The cooling water passing through the outlet 45 of the motor water jacket 42 to flow into the joint chamber 52, and the cooling water passing through the outlet 49 of the inverter water jacket 46, flowing in the connecting pipe 53, and flowing into the joint chamber 52 join in the joint chamber 52. The joined cooling water flows into the cooling water discharge passage 54 from the joint chamber 52, flows in the cooling water discharge passage 54, and is discharged outside the outboard motor 1 through the water outlet port 55.

[0048] In addition, the flow rate of cooling water flowing in the motor water jacket 42 and the flow rate of cooling water flowing in the inverter water jacket 46 are regulated by the degree of valve opening of the control valve 56. As a result, the temperature of the cooling water can be regulated. When the degree of valve opening of the control valve 56 increases, the flow rates of the cooling water flowing in the motor water jacket 42 and the inverter water jacket 46 increase, resulting in a lowered temperature of the cooling water and an enhanced cooling capacity for cooling the motor 2 and the inverter body 12. On the other hand, when the degree of valve opening of the control valve 56 decreases, the flow rates of the cooling water flowing in the motor water jacket 42 and the inverter water jacket 46 decrease.

(Main Features and Effects of Cooling Mechanism)

[0049]

(1) In the cooling mechanism 31 of the embodiment of the present disclosure, the motor water jacket 42 and the inverter water jacket 46 are connected, through the branch passage 36, to the cooling water supply passage 35 through the branch passage 36 such that the motor water jacket 42 and the inverter water jacket 46 are connected in parallel with each other. Here, FIG. 9A shows a configuration in which a motor water jacket 71 and an inverter water jacket 72 are connected in parallel between a beginning point B and an end point E of the cooling water passage. FIG. 9B shows a configuration in which the motor water jacket 71 and the inverter water jacket 72 are connected in series between the beginning point B and the end point E of the cooling water passage. In each of FIGS. 9A and 9B, the cooling water flows from the beginning point B to the end point E as indicated by the arrows in each drawing.

[0050] As can be seen by comparing the configurations of FIGS. 9A and 9B, a length of a cooling water flow path from the beginning point B through the motor water jacket 71 to the end point E in the configuration of FIG. 9A, and a length of a cooling water flow path from the beginning point B through the inverter water jacket 72 to the end point E in the configuration of FIG. 9A are both shorter than a length of a cooling water flow path from the beginning point B sequentially through the motor water jacket 71 and the inverter water jacket 72 to the end point E in the configuration of FIG. 9B. Therefore, the configuration of FIG. 9A can reduce the pressure loss between the beginning point B and the end point E of the cooling water passage compared to the configuration of FIG. 9B, and can allow the cooling water to smoothly flow from the beginning point B to the end point E.

[0051] As such, according to the outboard motor 1 of the embodiment of the present disclosure including the cooling mechanism 31 in which the motor water jacket 42 and the inverter water jacket 46 are connected, via the branch passage 36, to the cooling water supply passage 35 such that the motor water jacket 42 and the inverter water jacket 46 are connected in parallel with each other, the cooling water can smoothly flow in the cooling mechanism, compared to an outboard motor of the related art including a cooling mechanism in which the motor water jacket and the inverter water jacket are connected in series, such as the outboard motor described in JP2022-34677A. Therefore, even when a small pump with low discharge capacity is used, the efficiency of cooling the motor 2 and the inverter 11 by the cooling mechanism 31 can be enhanced.

[0052] In addition, according to the cooling mechanism 31, since the motor water jacket 42 and the inverter water jacket 46 are connected, via the branch passage 36, to the cooling water supply passage 35 such that the motor water jacket 42 and the inverter water jacket 46 are connected in parallel with each other, the flow rate of the cooling water flowing in the motor water jacket 42 and the flow rate of the cooling water flowing in the inverter water jacket 46 can be easily set individually in response to the respective amounts of heat generation of the motor 2 and the inverter body 12. Therefore, the cooling capacity for cooling the motor 2 and the cooling capacity for cooling the inverter body 12 can each be individually and easily optimized. For example, when the amount of heat generation of the motor 2 is greater than that of the inverter 11, diameters of the branched passage hole 38 of the branch passage 36 and the connecting pipe 40 are made larger than diameters of the branched passage hole 39 and the connecting pipe 41, allowing the flow rate of the cooling water flowing from the trunk passage hole 37 through the branched passage hole 38 and the connecting pipe 40 into the motor water jacket 42 to be greater than the flow rate of the cooling water flowing from the trunk passage hole 37 through the branched passage hole 39 and the connecting pipe 41 into the inverter water jacket 46. With this, the cooling capacity for cooling the motor 2 can be easily increased to be higher than the cooling capacity for cooling the inverter body 12.

[0053] (2) In the cooling mechanism 31 of the embodiment of the present disclosure, the inlet 43 of the motor water jacket 42 and the inlet 47 of the inverter water jacket 46 are arranged at the lower parts of the motor 2 and the inverter 11, respectively, and the outlet 45 of the motor water jacket 42 and the outlet 49 of the inverter water jacket 46 are arranged at the upper parts of the motor 2 and the inverter 11, respectively. Here, FIG. 9C shows a configuration in which a motor water jacket 81 and an inverter water jacket 82 are connected in parallel between the beginning point B and the end point E of the cooling water passage, a position of an inlet of the motor water jacket 81 and a position of an outlet of the motor water jacket 81 are located on opposite sides in a motor 61, a position of an inlet of the inverter water jacket 82 and a position of an outlet of the inverter water jacket 82 are located on opposite sides in an inverter 62, and the positions of the inlet and outlet of the motor water jacket 81 and the inlet and outlet of the inverter water jacket 82 are set such that when the motor 61 and the inverter 62 are arranged in the motor case of the outboard motor, the position of the inlet of the motor water jacket 81 and the position of the inlet of the inverter water jacket 82 are located on the same side in each of the motor 61 and the inverter 62, and when the motor 61 and the inverter 62 are arranged in the motor case of the outboard motor, the position of the outlet of the motor water jacket 81 and the position of the outlet of the inverter water jacket 82 are located on the same side in each of the motor 61 and the inverter 62. FIG. 9D shows a configuration in which a motor water jacket 91 and an inverter water jacket 92 are connected in parallel between the beginning point B and the end point E of the cooling water passage, a position of an inlet of the motor water jacket 91 and a position of an outlet of the motor water jacket 91 are located on the same side in the motor 61, a position of an inlet of the inverter water jacket 92 and a position of an outlet of the inverter water jacket 92 are located on the same side in the inverter 62, and the positions of the inlet and outlet of the motor water jacket 91 and the inlet and outlet of the inverter water jacket 92 are set such that when the motor 61 and the inverter 62 are arranged in the motor case of the outboard motor, the positions of the inlet and outlet of the motor water jacket 91 and the positions of the inlet and outlet of the inverter water jacket 92 are located on the same side in each of the motor 61 and the inverter 62. In each of FIGS. 9C and 9D, the cooling water flows from the beginning point B to the end point E as indicated by the arrows in each drawing.

[0054] In the configuration of FIG. 9C, the position of the inlet of the motor water jacket 81 and the position of the inlet of the inverter water jacket 82 are located on the same side in each of the motor 61 and the inverter 62. With this, the length of the cooling water passage from the beginning point B to the inlet of the motor water jacket 81 and the length of the cooling water passage from the beginning point B to the inlet of the inverter water jacket 82 can be shortened, respectively. In the configuration of FIG. 9D, the position of the inlet of the motor water jacket 91 and the position of the inlet of the inverter water jacket 92 are located on the same side in each of the motor 61 and the inverter 62. With this, the length of the cooling water passage from the beginning point B to the inlet of the motor water jacket 91 and the length of the cooling water passage from the beginning point B to the inlet of the inverter water jacket 92 can be shortened, respectively.

[0055] In the configuration of FIG. 9C, the position of the outlet of the motor water jacket 81 and the position of the outlet of the inverter water jacket 82 are located on the same side in each of the motor 61 and the inverter 62. With this, the length of the cooling water passage from the outlet of the motor water jacket 81 to the end point E and the length of the cooling water passage from the outlet of the inverter water jacket 82 to the end point E can be shortened, respectively. In addition, in the configuration of FIG. 9D, the position of the outlet of the motor water jacket 91 and the position of the outlet of the inverter water jacket 92 are located on the same side in each of the motor 61 and the inverter 62. With this, the length of the cooling water passage from the outlet of the motor water jacket 91 to the end point E and the length of the cooling water passage from the outlet of the inverter water jacket 92 to the end point E can be shortened, respectively.

[0056] Further, as can be seen by comparing the configuration of FIG. 9C with the configuration of FIG. 9D, in the configuration of FIG. 9C, the direction of the internal passage of the motor water jacket 81 is not reversed. On the other hand, in the configuration of FIG. 9D, the direction of the internal passage of the motor water jacket 91 is reversed. That is, in the configuration of FIG. 9C, since the positions of the inlet of the motor water jacket 81 and the outlet of the motor water jacket 81 are located on opposite sides in the motor 61, the cooling water can flow throughout the surroundings of the motor 61 to efficiently cool the motor 61 without reversing the direction of the internal passage of the motor water jacket 81. On the other hand, in the configuration of FIG. 9D, since the positions of the inlet of the motor water jacket 91 and the outlet of the motor water jacket 91 are located on the same side in the motor 61, it is difficult to efficiently cool the motor 61 by allowing the cooling water to flow throughout the surroundings of the motor 61, unless the direction of the internal passage of the motor water jacket 91 is reversed. In addition, an internal passage without a structure in which the direction is reversed can be more easily simplified in structure than an internal passage with a structure in which the direction is reversed. Therefore, the structure shown in FIG. 9C can simplify the internal passage of the motor water jacket more easily than the structure shown in FIG. 9D. Further, for the same reason, the structure of FIG. 9C in which the direction of the internal passage of the inverter water jacket 82 is not reversed can simplify the internal passage of the inverter water jacket more easily than the structure of FIG. 9D in which the direction of the internal passage of the inverter water jacket 92 is reversed.

[0057] As such, according to the cooling mechanism 31 of the embodiment of the present disclosure, the inlet 43 of the motor water jacket 42 and the inlet 47 of the inverter water jacket 46 are arranged at the lower parts of the motor 2 and the inverter 11, respectively, and the outlet 45 of the motor water jacket 42 and the outlet 49 of the inverter water jacket 46 are arranged at the upper parts of the motor 2 and the inverter 11, respectively. As a result, the cooling water supply passage 35 or the branch passage 36 and the joint passage 50 or the cooling water discharge passage 54 can be respectively shortened. Further, while realizing good cooling efficiency for the motor 2, the internal passage 44 of the motor water jacket 42 and the internal passage 48 of the inverter water jacket 46 can each be easily simplified.

[0058] (3) In the cooling mechanism 31 of the embodiment of the present disclosure, as shown in FIG. 4 or FIG. 7, when the motor 2 and the motor water jacket 42 are viewed from above, the outlet 45 of the motor water jacket 42 is arranged on a substantially opposite side to the inlet 43 of the motor water jacket 42 across a rotation center C of the motor 2. Here, FIG. 9E shows a configuration in which, when the motor 61 and a motor water jacket 101 are viewed from above, an outlet of the motor water jacket 101 is arranged on a substantially opposite side to an inlet of the motor water jacket 101 across a rotation center D of the motor 61. FIG. 9F shows a configuration in which, when the motor 61 and a motor water jacket 111 are viewed from above, an outlet of the motor water jacket 111 is not arranged on a substantially opposite side to an inlet of the motor water jacket 111 across the rotation center D of the motor 61, but the inlet and outlet of the motor water jacket 111 are arranged close to each other at portions on the outer peripheral part of the motor 61. In each of FIGS. 9E and 9F, the cooling water flows from the beginning point B to the end point E as indicated by the arrows in each drawing.

[0059] As can be seen by comparing the configuration of FIG. 9E with the configuration of FIG. 9F, in the internal passage of the motor water jacket 101 of the configuration of FIG. 9E, a counterclockwise passage length from the inlet to the outlet and a clockwise passage length from the inlet to the outlet are substantially the same. On the other hand, in the internal passage of the motor water jacket 111 of the configuration of FIG. 9F, a counterclockwise passage length from the inlet to the outlet is significantly longer than a clockwise passage length from the inlet to the outlet. Accordingly, the configuration of FIG. 9E allows the cooling water to flow uniformly throughout the entire periphery of the motor 61 more easily than the configuration of FIG. 9F, thereby enhancing the cooling efficiency for the motor 61. That is, in the configuration of FIG. 9E, the flow rate of cooling water flowing counterclockwise from the inlet to the outlet within the internal passage of the motor water jacket 101 and the flow rate of cooling water flowing clockwise from the inlet to the outlet within the internal passage of the motor water jacket 101 become substantially the same, and as a result, the entire periphery of the motor 61 can be uniformly cooled. In contrast, in the configuration of FIG. 9F, most of the cooling water flows clockwise from the inlet to the outlet within the internal passage of the motor water jacket 111, and as a result, the cooling water flowing counterclockwise from the inlet to the outlet within the internal passage of the motor water jacket 111 is reduced, and therefore, a part of the motor 61 may not be sufficiently cooled.

[0060] As such, according to the cooling mechanism 31 of the embodiment of the present disclosure, when the motor 2 and the motor water jacket 42 are viewed from above, the outlet 45 of the motor water jacket 42 is arranged on the substantially opposite side to the inlet 43 of the motor water jacket 42 across the rotation center C of the motor 2, so the cooling water is allowed to uniformly flow over the entire periphery of the motor 2, thereby enhancing the cooling efficiency for the motor 2.

[0061] (4) In the cooling mechanism 31 of the embodiment of the present disclosure, as shown in FIGS. 6 to 8, the inlet 47 of the inverter water jacket 46 is arranged at the lower left portion of the inverter 11, and the outlet 49 of the inverter water jacket 46 is arranged at the upper right portion of the inverter 11. As can be seen from FIG. 2, when the inverter 11 is viewed from the front, a shape of the inverter 11 is rectangular, and the inlet 47 and the outlet 49 are respectively arranged at diagonal portions of the inverter 11. Here, FIG. 9G shows a configuration in which the inlet and outlet of an inverter water jacket 102 are respectively arranged at diagonal portions of the inverter 62, which has a rectangular shape when viewed from the front. FIG. 9H shows a configuration in which the inlet and outlet of an inverter water jacket 112 are not arranged at the diagonal portions of the inverter 62, but are arranged on the same side in the left-right direction of the inverter 62, respectively. In each of FIGS. 9G and 9H, the cooling water flows from the beginning point B to the end point E as indicated by the arrows in each drawing.

[0062] As can be seen by comparing the configuration of FIG. 9G with the configuration of FIG. 9H, in the configuration of FIG. 9G, the direction of the internal passage of the inverter water jacket 102 is not reversed. On the other hand, in the configuration of FIG. 9H, the direction of the internal passage of the inverter water jacket 112 is reversed. That is, in the configuration of FIG. 9G, since the inlet and outlet of the inverter water jacket 102 are respectively arranged at diagonal portions of the inverter 62, the cooling water can flow throughout the surface of the inverter body where the inverter water jacket 102 is in contact or proximity to efficiently cool the inverter body without reversing the direction of the internal passage of the inverter water jacket 102. On the other hand, in the configuration of FIG. 9H, since the positions of the inlet and outlet of the inverter water jacket 112 are located on the same side in the inverter 62, it is difficult to efficiently cool the inverter body by allowing the cooling water to flow throughout the surface of the inverter body where the inverter water jacket 102 is in contact or proximity, unless the direction of the internal passage of the inverter water jacket 112 is reversed. In addition, an internal passage without a structure in which the direction is reversed can be more easily simplified in structure than an internal passage with a structure in which the direction is reversed. Therefore, the structure shown in FIG. 9G can simplify the internal passage of the inverter water jacket more easily than the structure shown in FIG. 9H.

[0063] As such, according to the cooling mechanism 31 of the embodiment of the present disclosure, the inlet 47 of the inverter water jacket 46 is arranged at the lower left portion of the inverter 11, and the outlet 49 of the inverter water jacket 46 is arranged at the upper right portion of the inverter 11. That is, when the inverter 11 is viewed from the front, the inlet 47 and the outlet 49 are respectively arranged at the diagonal portions of the inverter 11 having a rectangular shape. Therefore, while realizing good cooling efficiency for the inverter body 12, the internal passage 48 of the inverter water jacket 46 can be easily simplified.

[0064] (5) In the cooling mechanism 31 of the embodiment of the present disclosure, the outlet 49 of the inverter water jacket 46 is arranged at the same position in the left-right direction as the outlet 45 of the motor water jacket 42, as shown in FIG. 4. With this, the joint passage

50, specifically the connecting pipe 53, can be shortened. Accordingly, the pressure loss of the cooling water flowing in the connecting pipe 53 from the outlet 49 of the inverter water jacket 46 toward the joint chamber 52 can be reduced.

[0065] (6) In the embodiment of the present disclosure, the cooling mechanism 31 is provided with the control valve 56 that controls the flow rate of cooling water after joining in the joint passage 50. The configuration of controlling the flow rate of the cooling water after joining allows for temperature regulation of the cooling water by the single control valve 56, leading to a simplified structure of the cooling mechanism 31.

[0066] In the cooling mechanism 31 of the above embodiment, the arrangement of each of the branch passage 36, the inlet 43 and the outlet 45 of the motor water jacket 42, the inlet 47 and the outlet 49 of the inverter water jacket 46, the joint passage 50, and the like may be entirely reversed left and right.

[0067] In addition, in the cooling mechanism 31 of the above embodiment, the inlet 43 of the motor water jacket 42 and the inlet 47 of the inverter water jacket 46 are arranged at the lower parts of the motor 2 and the inverter 11, respectively, and the outlet 45 of the motor water jacket 42 and the outlet 49 of the inverter water jacket 46 are arranged at the upper parts of the motor 2 and the inverter 11, respectively. However, the present disclosure is not limited thereto. For example, as shown in FIG. 10A, the inlet of the motor water jacket 42 and the inlet of the inverter water jacket 46 may be arranged at the upper parts of the motor 2 and the inverter 11, respectively, and the outlet of the motor water jacket 42 and the outlet of the inverter water jacket 46 may be arranged at the lower parts of the motor 2 and the inverter 11, respectively. In addition, as shown in FIG. 10B, the inlet of the motor water jacket 42 and the inlet of the inverter water jacket 46 may be arranged at the front parts of the motor 2 and the inverter 11, respectively, and the outlet of the motor water jacket 42 and the outlet of the inverter water jacket 46 may be arranged at the rear parts of the motor 2 and the inverter 11, respectively.

[0068] In addition, in the above embodiment, the inverter water jacket 46 is arranged in front of the inverter body 12, but the inverter water jacket 46 may be arranged behind the inverter body 12, or in front of and behind the inverter body 12.

[0069] In addition, in the above embodiment, the inverter 11 is arranged behind the motor 2, but the inverter 11 may be arranged in front of the motor 2, or the inverter 11 may be arranged at the left or right of motor 2.

[0070] In addition, in the above embodiment, the water around the outboard motor 1 is introduced into the cooling mechanism 31 and used as cooling water, and the cooling water after cooling is discharged outside the outboard motor 1. However, the present disclosure is not limited thereto, and a configuration may be adopted in which the cooling water flows in the outboard motor, and a heat dissipation mechanism for dissipating the heat of the cooling water, such as a heat sink, is provided in the middle of the cooling water flowing path.

[0071] In addition, the present disclosure can be applied to a ship propulsion machine other than the outboard motor.

[0072] In addition, the present disclosure can be changed as appropriate without departing from the scope or spirit of the disclosure which can be read from the claims and the entire specification, and the ship propulsion machine to which such a change is applied is also included in the technical spirit of the present disclosure.

Claims

1. A ship propulsion machine (1) comprising:

   a motor (2);
   an inverter (11) configured to generate a drive current for controlling drive of the motor (2);
   a propeller (15);
   a power transmission mechanism (16, 17, 18) configured to transmit power of the motor (2) to the propeller (15); and
   a cooling mechanism (31) configured to cool the motor (2) and the inverter (11),
   wherein the cooling mechanism (31) comprises:

      a motor water jacket (42) provided in the motor (2) and configured to cool the motor (2) by allowing cooling water to flow therein;
      an inverter water jacket (46) provided in the inverter (11) and configured to cool the inverter (11) by allowing the cooling water to flow therein;
      a first cooling water passage (35) configured to allow the cooling water to flow toward the motor water jacket (42) and the inverter water jacket (46); and
      a branch passage (36) connecting the motor water jacket (42) and the inverter water jacket (46) to the first cooling water passage (35) such that the motor water jacket (42) and the inverter water jacket (46) are connected in parallel with each other, the branch passage (36) being configured to distribute and supply the cooling water flowing in the first cooling water passage (35) to the motor water jacket (42) and the inverter water jacket (46).

2. The ship propulsion machine (1) according to claim 1,

   wherein when an extension direction of a rotation axis (A) of the motor (2) is defined as an X direction and a direction perpendicular to the extension direction of the rotation axis (A) of the motor (2) is defined as a Y direction, the motor (2) and the inverter (11) are arranged side by side in the Y direction,

wherein the motor water jacket (42) comprises a first inlet (43) configured to allow the cooling water supplied through the branch passage (36) to flow into the motor water jacket (42), and a first outlet (45) configured to allow the cooling water flowing in the motor water jacket (42) to flow out to an outside of the motor water jacket (42),

wherein the inverter water jacket (46) comprises a second inlet (47) configured to allow the cooling water supplied through the branch passage (36) to flow into the inverter water jacket (46), and a second outlet (48) configured to allow the cooling water flowing in the inverter water jacket (46) to flow out to an outside of the inverter water jacket (46),

wherein the first inlet (43) of the motor water jacket (42) and the second inlet (47) of the inverter water jacket (46) are arranged on one side in the X direction of the motor (2) and the inverter (11), and

wherein the first outlet (45) of the motor water jacket (42) and the second outlet (48) of the inverter water jacket (46) are arranged on another side in the X direction of the motor (2) and the inverter (11).

3. The ship propulsion machine (1) according to claim 2,

wherein the motor water jacket (42) is provided to surround the motor (2) on an outer periphery side of the motor (2), and

wherein when the motor (2) and the motor water jacket (42) are viewed from one side in the X direction, the first outlet (45) of the motor water jacket (42) is arranged on a substantially opposite side to the first inlet (43) of the motor water jacket (42) across a rotation center of the motor (2).

4. The ship propulsion machine (1) according to claim 2, wherein when a direction perpendicular to the X-direction and the Y-direction is defined as the Z-direction, the second inlet (47) of the inverter water jacket (46) is arranged on one side in the Z-direction of the inverter (11), and the second outlet (48) of the inverter water jacket (46) is arranged on another side in the Z-direction of the inverter (11).

5. The ship propulsion machine (1) according to claim 2,

wherein the cooling mechanism (31) comprises:

a second cooling water passage (54) configured to allow the cooling water, which has flowed out from an inside of the motor water jacket (42) and an inside of the inverter water jacket (46), to flow therein; and

a joint passage (50) connected to the first outlet (45) of the motor water jacket (42), the second outlet (48) of the inverter water jacket (46), and the second cooling water passage (54), the joint passage (50) configured to join the cooling water flowing out from the first outlet (45) of the motor water jacket (42) with the cooling water flowing out from the second outlet (48) of the inverter water jacket (46) and to allow the joined cooling water to flow into the second cooling water passage (54), and

wherein when a direction perpendicular to the X direction and the Y direction is defined as a Z direction, the first outlet (45) of the motor water jacket (42) and the second outlet (48) of the inverter water jacket (46) are arranged at a same position in the Z direction.

6. The ship propulsion machine (1) according to claim 5, wherein the cooling mechanism (31) comprises a valve (56) configured to control a flow rate of the cooling water after joining in the joint passage (50).

FIG. 1

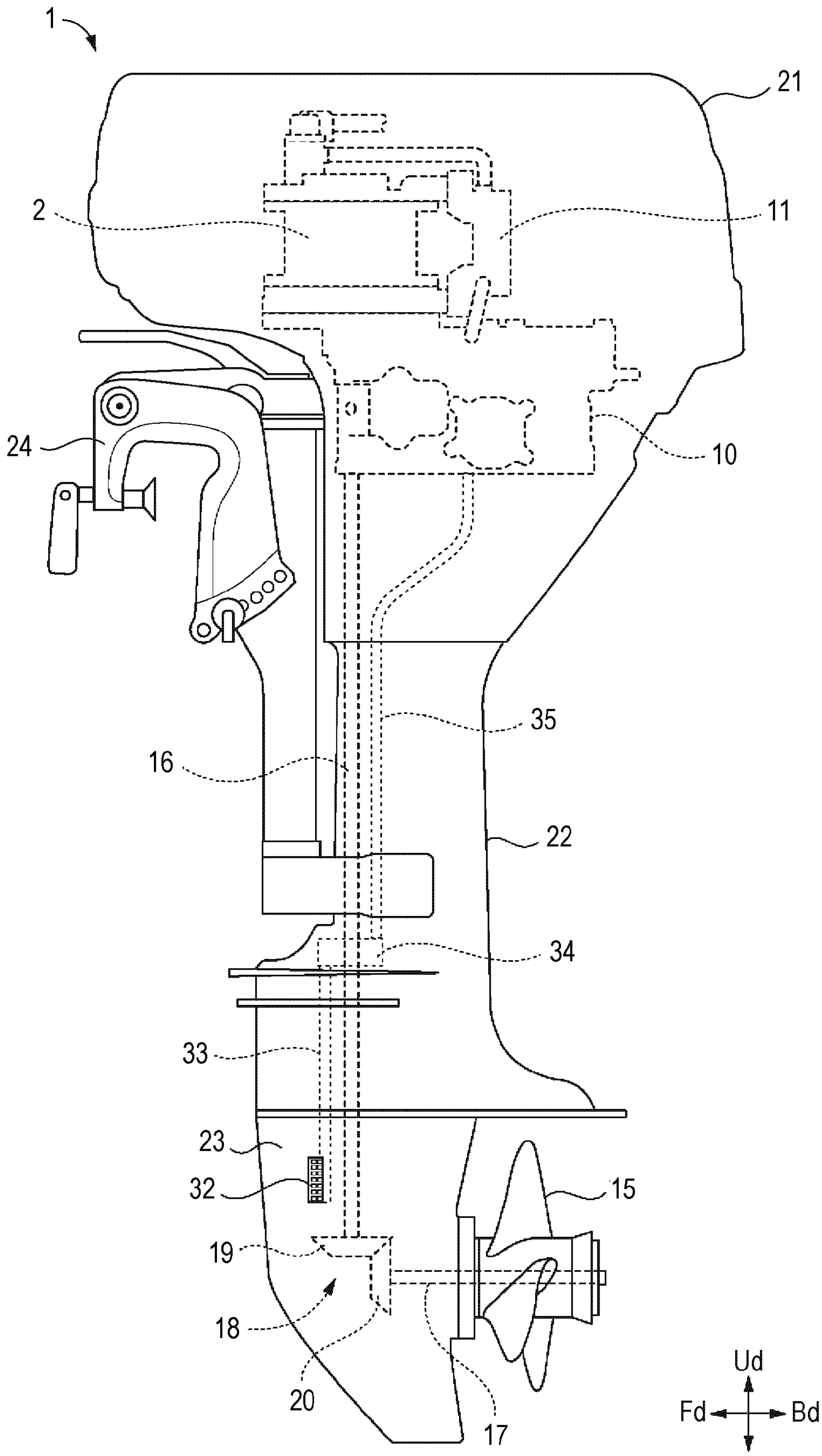


FIG. 2

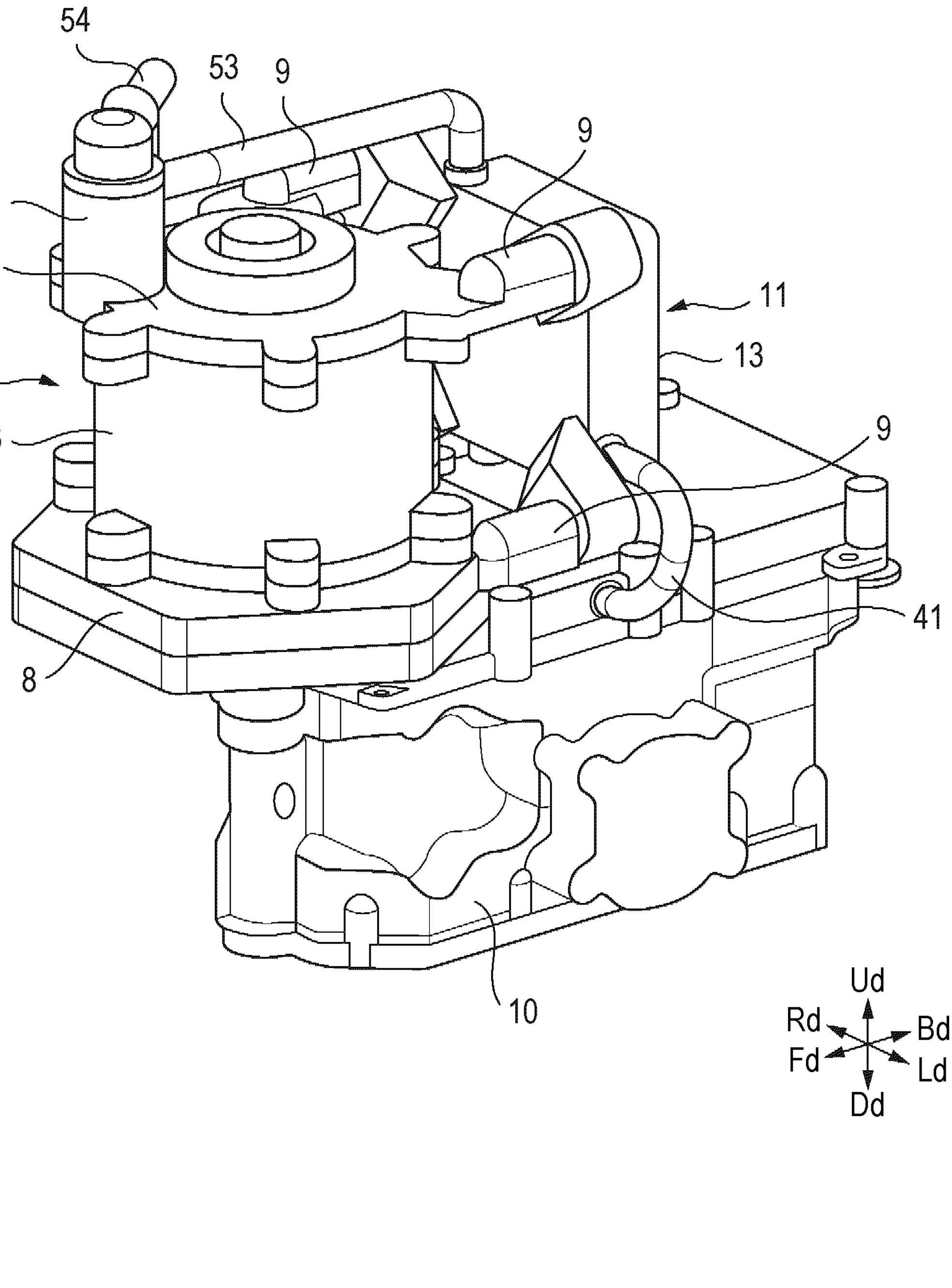
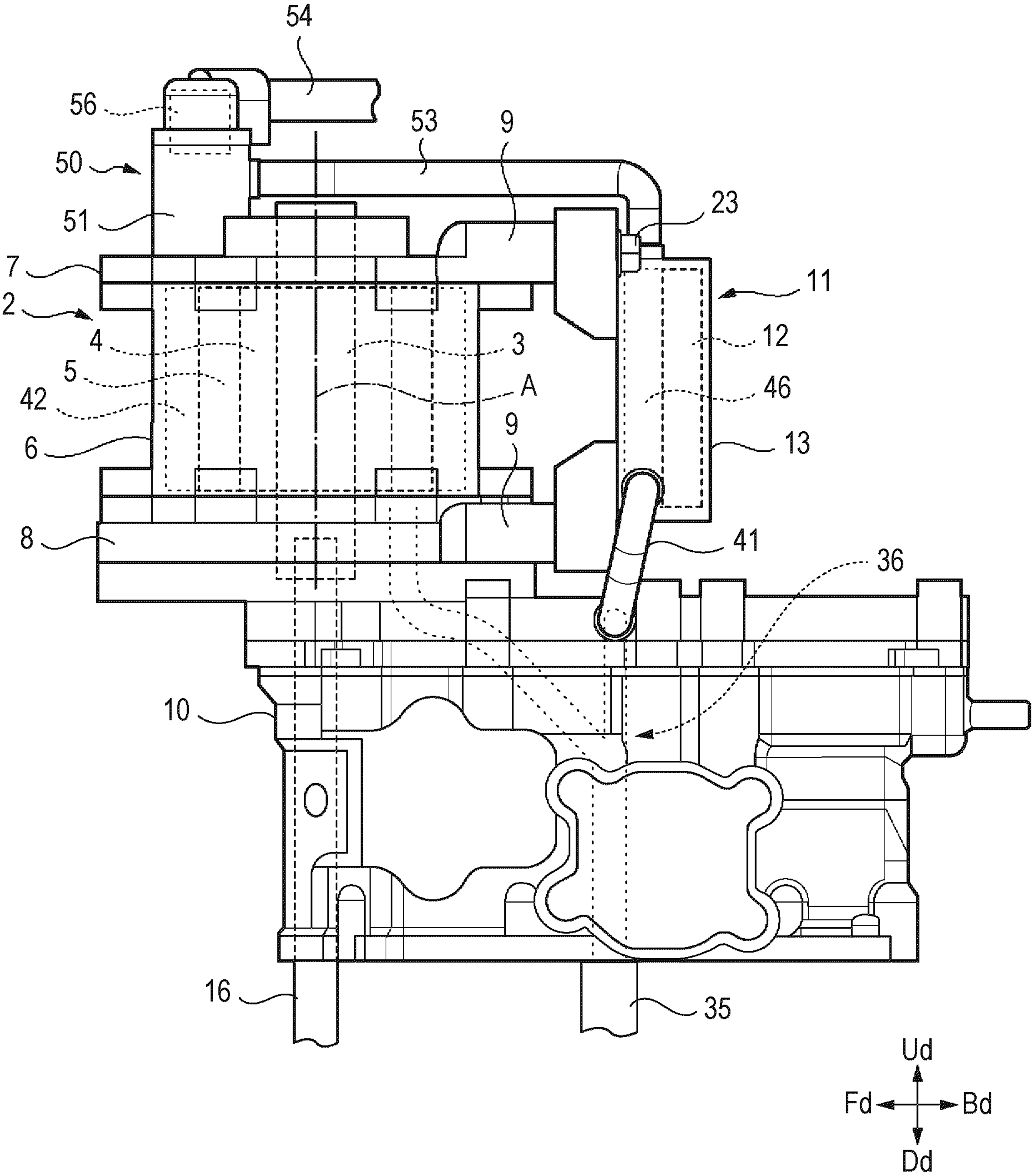


FIG. 3



54
56
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9
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23
7
11
2
12
4
3
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A
46
42
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8
41
36
10
16
35
Ud
Fd
Bd
Dd

FIG. 4

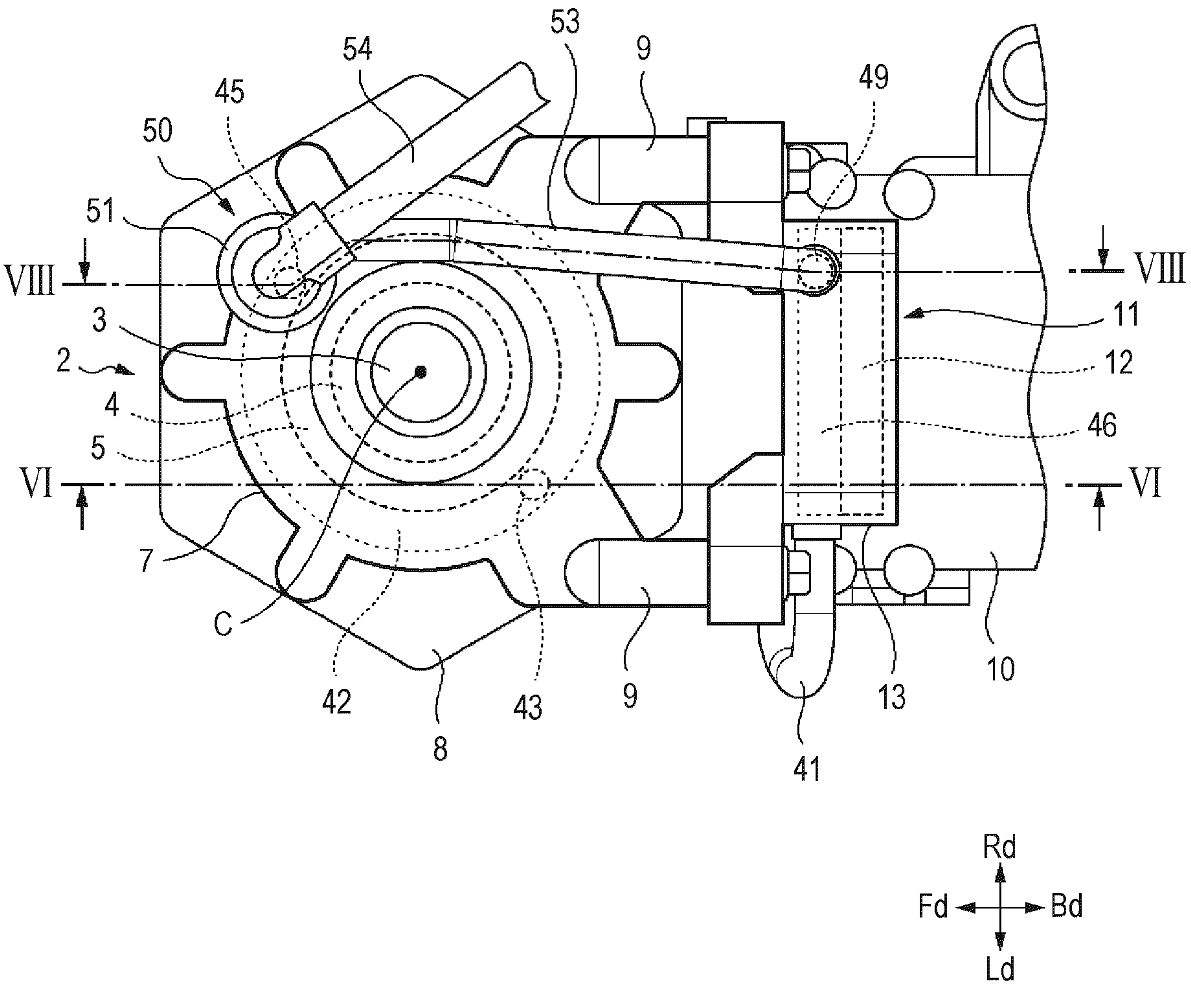

54
53
9
49
45
50
51
VIII
VIII
3
11
2
12
4
46
5
VI
VI
7
C
42
43
9
8
13
10
41
Rd
Fd
Bd
Ld

FIG. 5

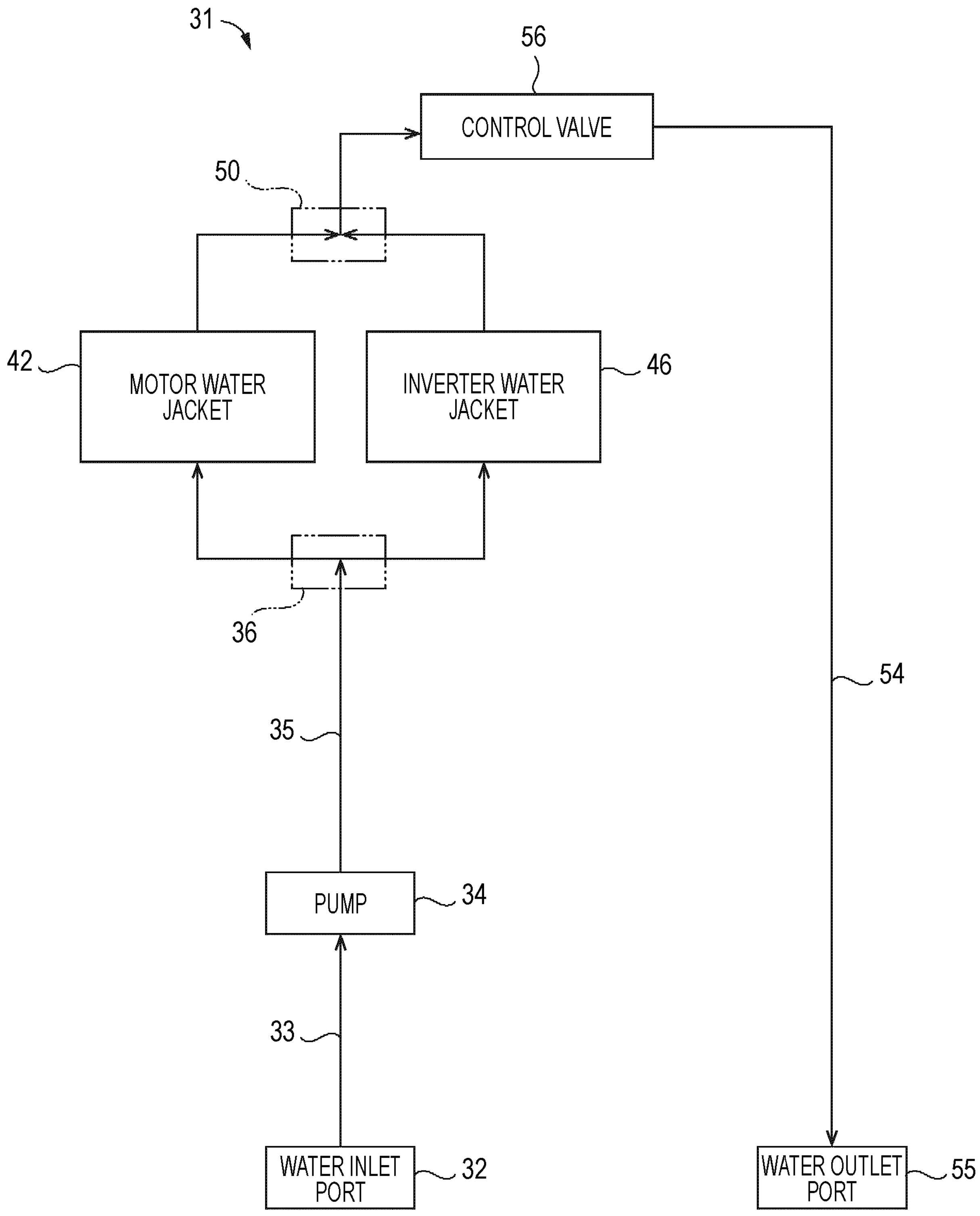
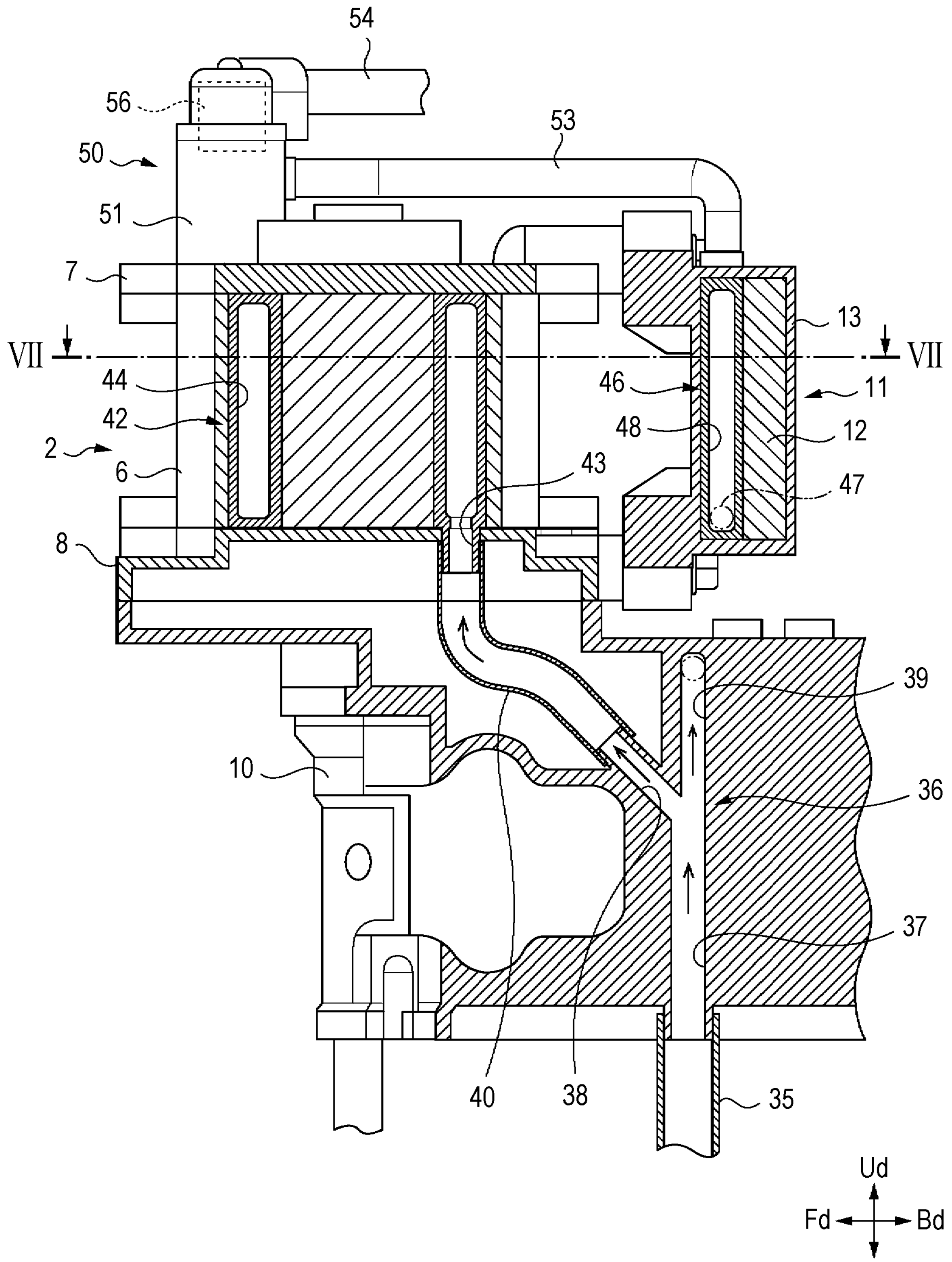

31
56
CONTROL VALVE
50
42
MOTOR WATER JACKET
INVERTER WATER JACKET
46
36
54
35
PUMP
34
33
WATER INLET PORT
32
WATER OUTLET PORT
55

FIG. 6


54
56
53
50
51
7
13
VII
VII
44
46
11
42
48
12
2
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43
47
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10
36
37
40
38
35
Ud
Fd
Bd
Dd

FIG. 7

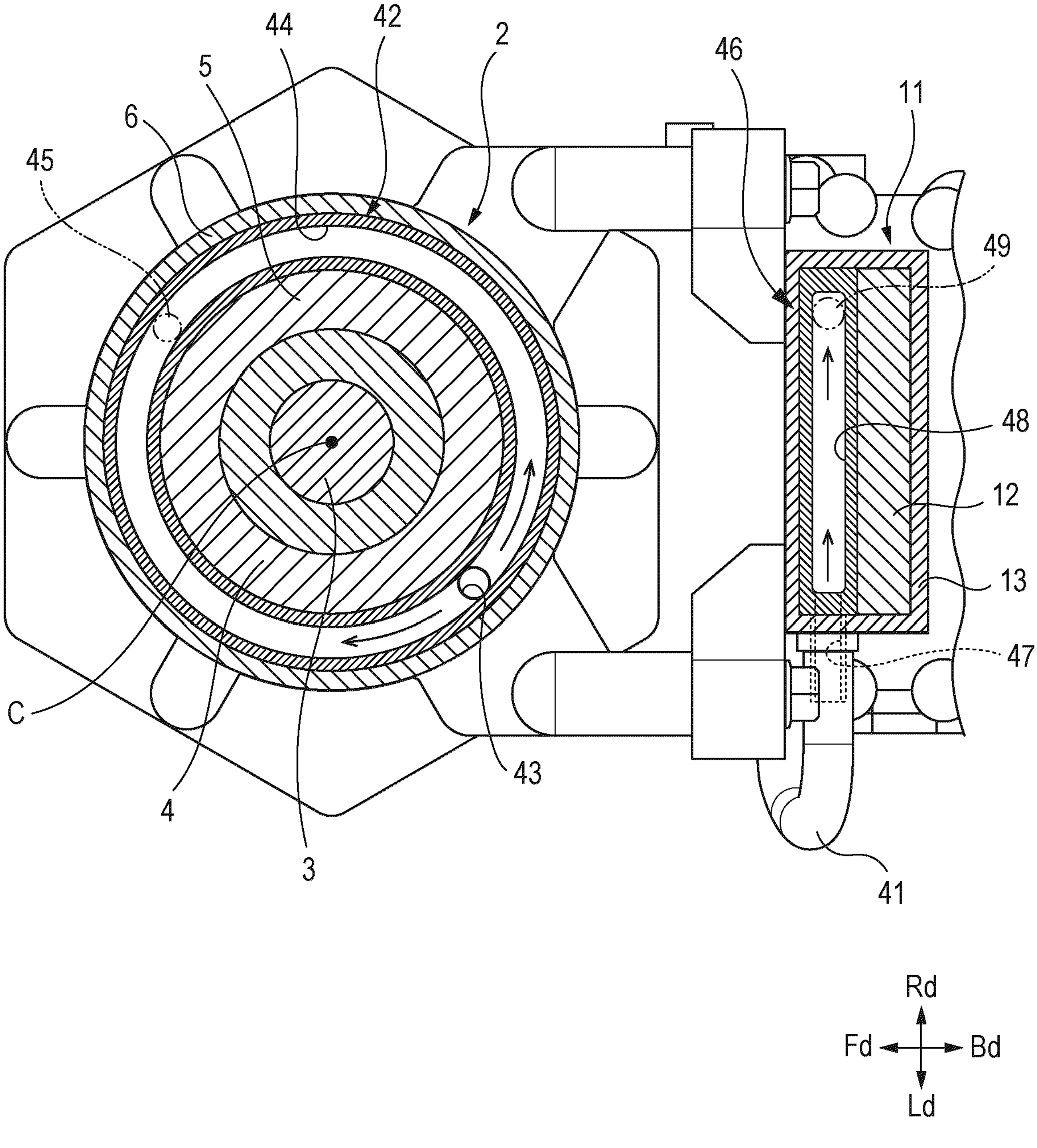
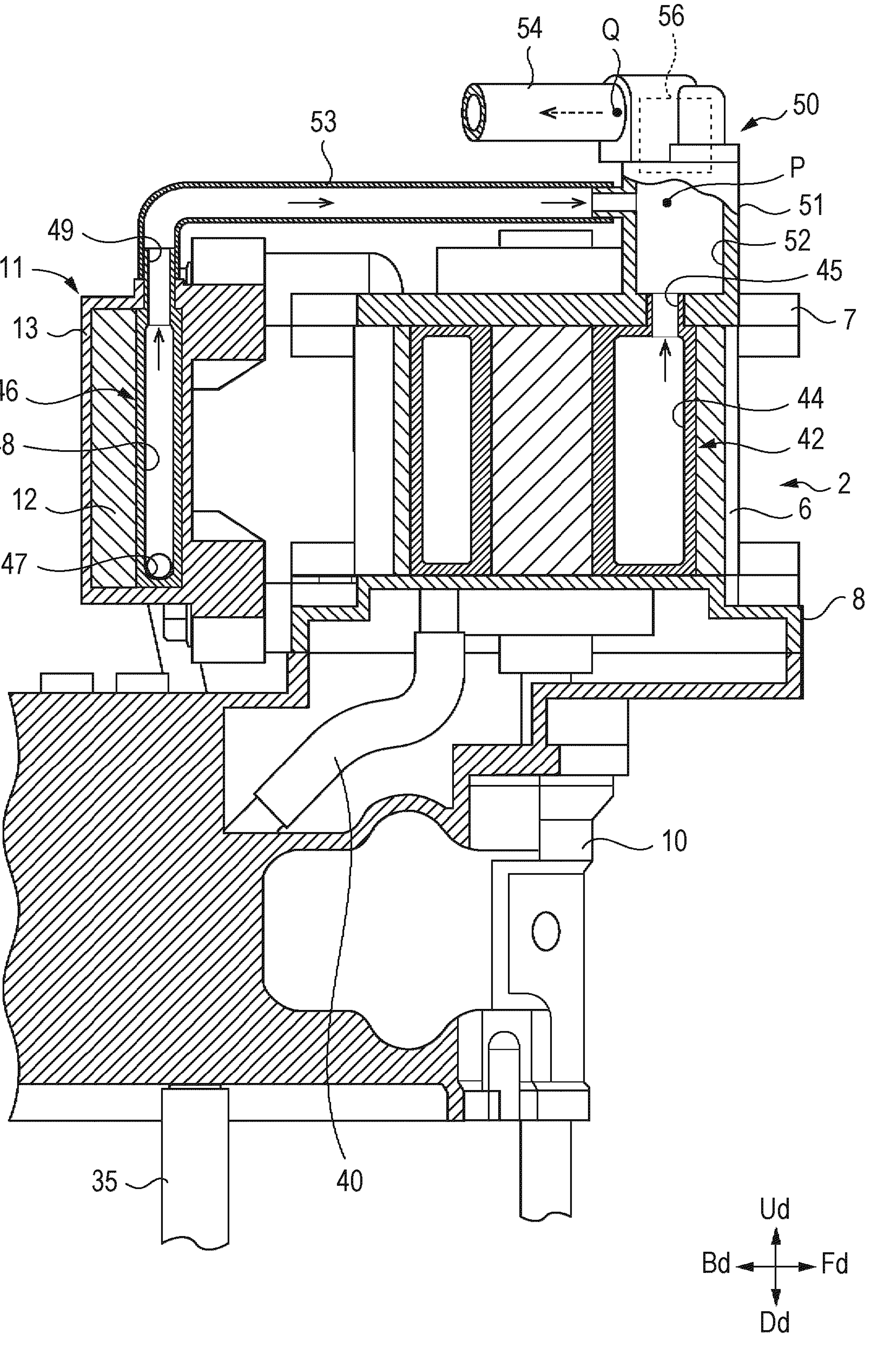


FIG. 8


54
Q
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P
51
52
45
49
11
7
13
44
46
42
48
2
12
6
47
8
10
35
40
Ud
Bd
Fd
Dd

FIG. 9A

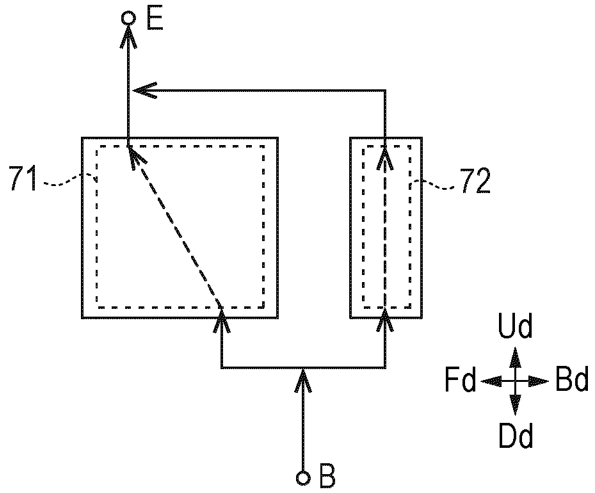


FIG. 9B

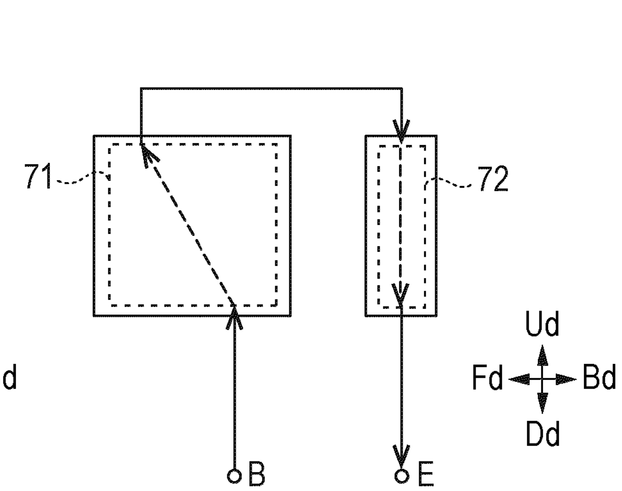


FIG. 9C

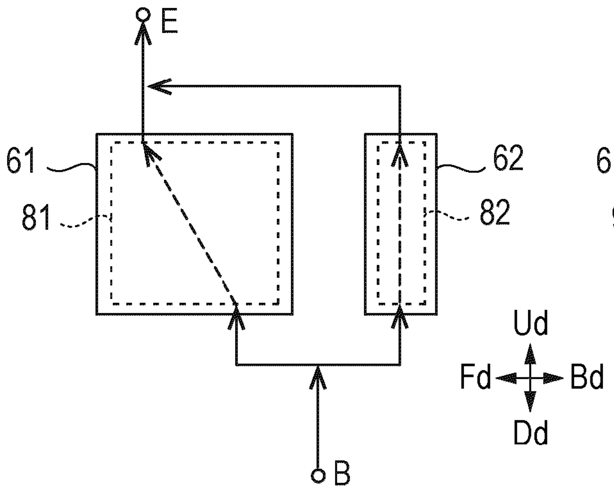


FIG. 9D

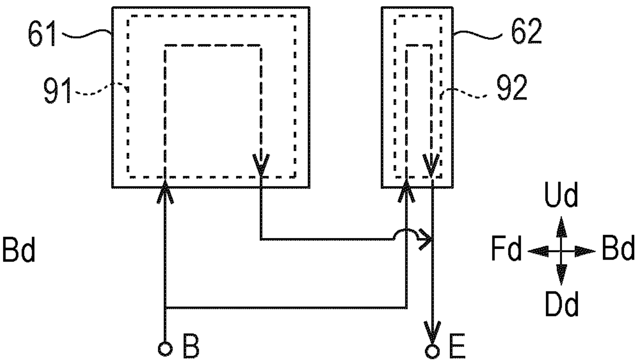


FIG. 9E

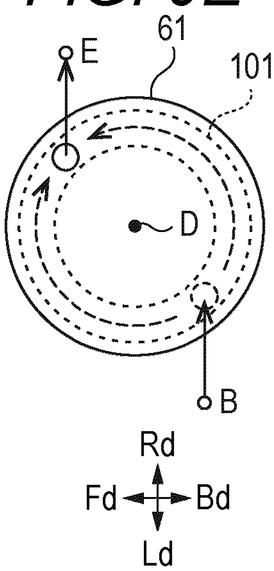


FIG. 9F

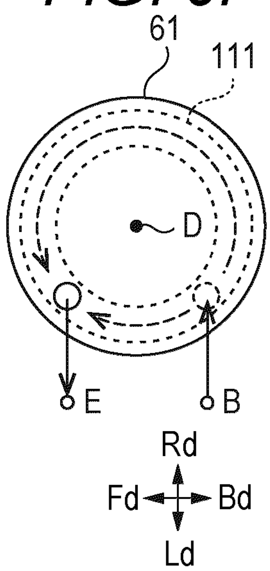


FIG. 9G

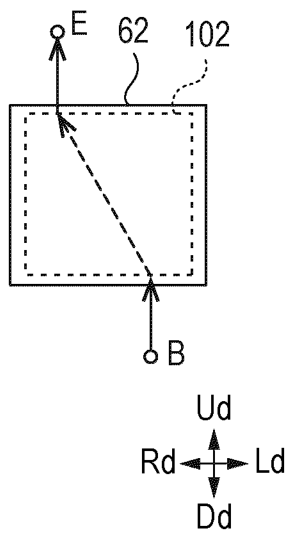


FIG. 9H

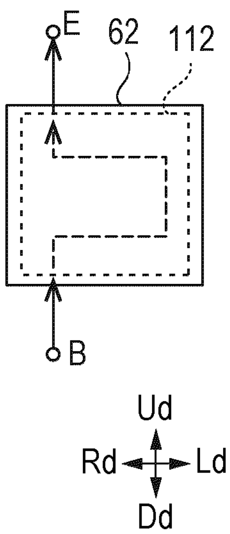


FIG. 10A

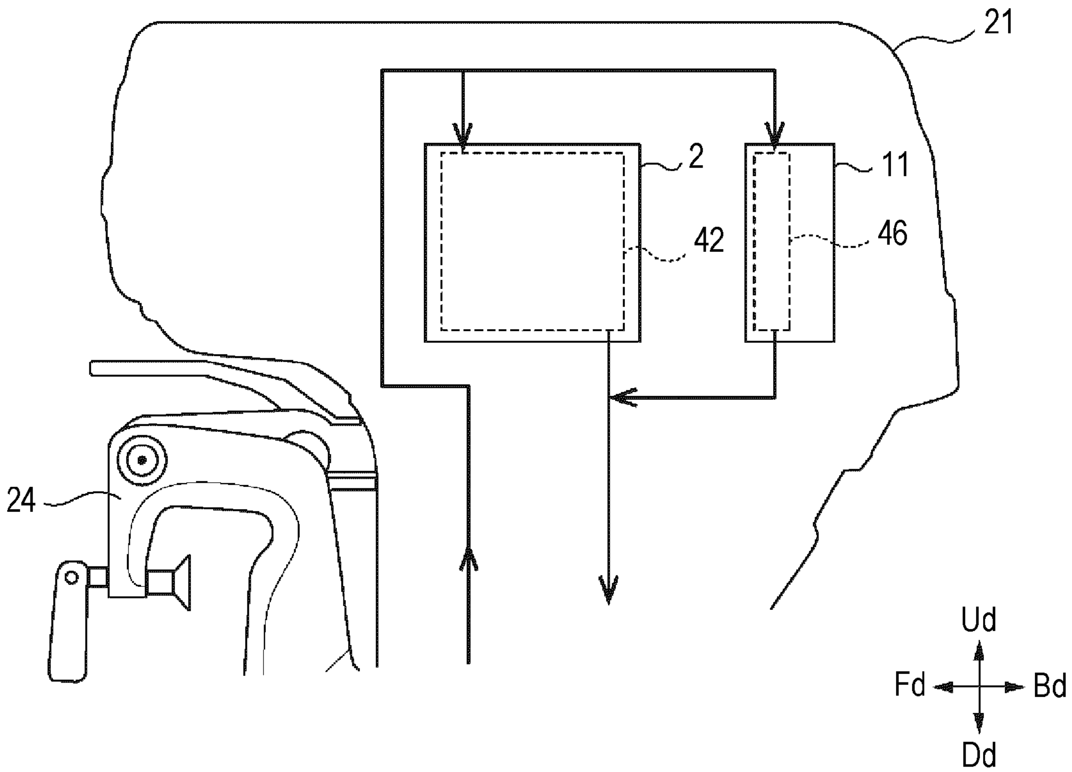
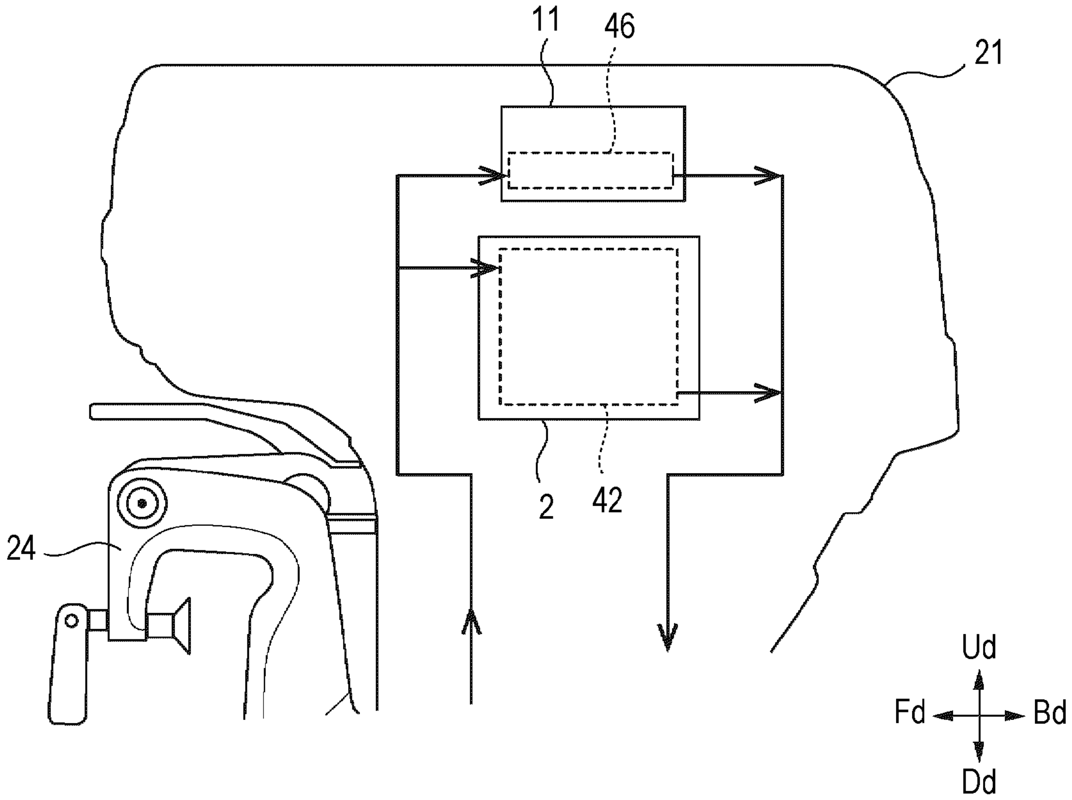


FIG. 10B



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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 24 21 3087

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2022/089261 A1 (BRUESTLE CLAUS [DE]) 24 March 2022 (2022-03-24) * paragraphs [0047], [0055]; figures 1, 7 *	1	INV. B63H20/28 B63H21/17
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B63H

The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
The Hague	14 April 2025	Székely, Zsolt

CATEGORY OF CITED DOCUMENTS

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