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(54) OUTBOARD MOTOR AND BOAT

(57) To simplify the configuration, an outboard motor includes a drive source, a drive shaft, a steering shaft, a case, and an angle detection sensor. The drive shaft extends in an upper-lower direction and rotates by the driving force of the drive source. The hollow tubular steering shaft is arranged to surround the outer circumference of the drive shaft. The case is arranged at a position lower than the drive source, and an oil chamber is formed in which oil is stored, and at least part of the steering shaft is housed in the oil chamber. The angle detection sensor is arranged at a position higher than the oil chamber and detects the rotation angle of the steering shaft.

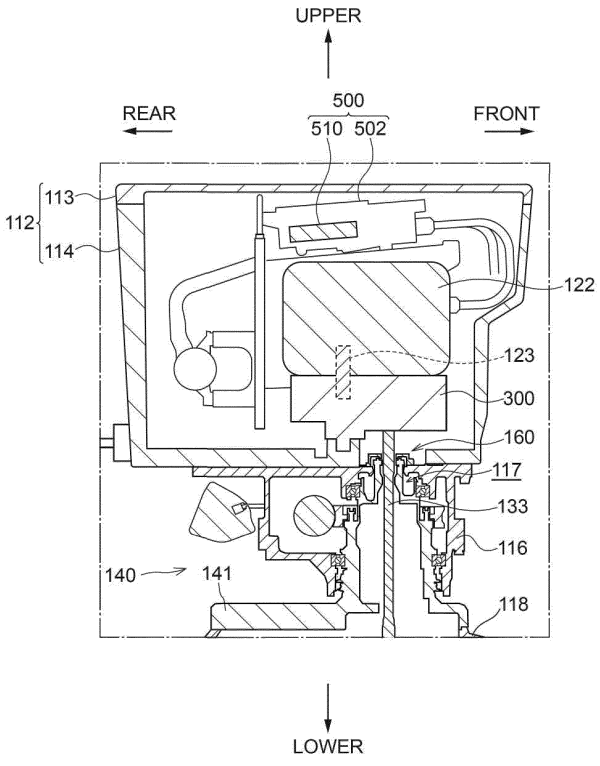

FIG.3

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Description

[0001] The present invention relates to an outboard motor and a boat.

[0002] A boat is provided with a hull and an outboard motor mounted to a rear portion of the hull. The outboard motor is a device that generates thrust to propel the boat.

[0003] The outboard motor includes a drive source, a drive shaft that extends in an upper-lower direction and rotates by the driving force of the drive source, a hollow tubular steering shaft arranged to surround the outer circumference of the drive shaft, and a case that is arranged at a position lower than the drive source. The case is provided with an oil chamber in which oil is stored, and at least a part of the steering shaft is housed in the oil chamber.

[0004] An outboard motor has been disclosed that includes an outboard motor main body and a steering mechanism that rotates the outboard motor main body about a steering axis. The steering mechanism includes a pinion that is fixed around the steering axis and rotates together with the outboard motor main body, a rack that moves linearly to rotate the pinion, and a rack position detection unit (angle detection sensor) that detects the position of the rack (e.g. see JP 2023-102979 A).

[0005] When the angle detection sensor is provided in an oil chamber formed in the case, at least part of the wiring connected to the angle detection sensor should also be arranged in the oil chamber, so that the layout of the wiring of the angle detection sensor becomes complex, which might complicate the configuration of the outboard motor.

[0006] It is the object of the present invention to provide an outboard motor, which simplifies the layout of the wiring and the configuration of the outboard motor.

[0007] According to the present invention said object is solved by an outboard motor having the features of independent claim 1. Preferred embodiments are laid down in the dependent claims.

[0008] Accordingly, the technology disclosed herein can be implemented in the following aspects.

[0009] An outboard motor disclosed herein includes a drive source, a drive shaft, a steering shaft, a case, and an angle detection sensor. The drive shaft extends in an upper-lower direction and rotates by the driving force of the drive source. The hollow tubular steering shaft is arranged to surround the outer circumference of the drive shaft. The case is arranged at a position lower than the drive source, and an oil chamber is formed in which oil is stored, and at least part of the steering shaft is housed in the oil chamber. The angle detection sensor is arranged at a position higher than the oil chamber and detects the rotation angle of the steering shaft.

[0010] According to this outboard motor, the angle detection sensor is arranged outside the oil chamber formed in the case. Therefore, the angle detection sensor is arranged in the air, which simplifies the layout of the wiring connected to the angle detection sensor and thus the configuration of the outboard motor.

[0011] The outboard motor may be configured such that the angle detection sensor is arranged between the drive source and the oil chamber in the upper-lower direction. According to this configuration, e.g., when a dead space is formed between the drive source and the oil chamber in the upper-lower direction, the angle detection sensor can be arranged in the dead space, which simplifies the configuration of the outboard motor.

[0012] The outboard motor may be configured to further include a primary reduction gear arranged at a position lower than the drive source and higher than the oil chamber, wherein the angle detection sensor is arranged between the primary reduction gear and the oil chamber in the upper-lower direction. According to this configuration, when a dead space is formed between the primary reduction gear and the oil chamber in the upper-lower direction, the angle detection sensor can be arranged in the dead space, which simplifies the configuration of the outboard motor.

[0013] The outboard motor may be configured to further include a rotating member that rotates in conjunction with the rotation of the steering shaft and at least a part of which is located at a position higher than the oil chamber, wherein the angle detection sensor detects the rotation angle of the steering shaft by measuring the rotation angle of the rotating member. According to this configuration, it is possible to detect the rotation angle of the steering shaft even when the angle detection sensor is arranged at a position higher than the oil chamber. This simplifies the layout of the wiring connected to the angle detection sensor and thus the configuration of the outboard motor.

[0014] In addition, according to this configuration, the angle detection sensor, which indirectly detects the rotation angle of the steering shaft by measuring the rotation angle of the rotating member, can be selected according to the size of the rotating member regardless of the size of the steering shaft. Therefore, by using a rotating member that is smaller than the steering shaft, the size of which is difficult to change due to the structure of the outboard motor, the angle detection sensor can be made smaller, which in turn reduces the size of the outboard motor.

[0015] The outboard motor may be configured such that a part of the steering shaft is located at a position higher than the oil chamber, and the rotation of the steering shaft is transmitted to the rotating member at a position higher than the oil chamber. According to this configuration, it is possible to detect the rotation angle of the steering shaft even when the angle detection sensor is arranged at a position higher than the oil chamber. This simplifies the layout of the wiring connected to the angle detection sensor and thus the configuration of the outboard motor.

[0016] The outboard motor may be configured such that the rotating member is an offset shaft that is parallel to the steering shaft, and the outboard motor further includes a transmission mechanism that is arranged at

a position higher than the oil chamber and transmits the rotation of the steering shaft to the offset shaft. According to this configuration, it is possible to detect the rotation angle of the steering shaft even when the angle detection sensor is arranged at a position higher than the oil chamber. This simplifies the layout of the wiring connected to the angle detection sensor and thus the configuration of the outboard motor.

[0017] The outboard motor may be configured such that the drive source includes an electric motor, and the outboard motor further includes a waterproof case arranged at a position higher than the oil chamber and housing the electric motor and the angle detection sensor. According to this configuration, the angle detection sensor is housed in a waterproof case arranged at a position higher than the oil chamber, which simplifies the layout of the wiring connected to the angle detection sensor, thereby simplifying the configuration of the outboard motor and suppressing the angle detection sensor from getting wet by water.

[0018] The outboard motor may be configured to further include a rotating member that rotates in conjunction with the rotation of the steering shaft and at least a part of which is located inside the waterproof case, wherein the angle detection sensor detects the rotation angle of the steering shaft by measuring the rotation angle of the rotating member. According to this configuration, it is possible to detect the rotation angle of the steering shaft even when the angle detection sensor is located inside the waterproof case. This simplifies the layout of the wiring connected to the angle detection sensor, simplifies the configuration of the outboard motor, and suppresses the angle detection sensor from getting wet by water.

[0019] In addition, according to this configuration, the angle detection sensor, which indirectly detects the rotation angle of the steering shaft by measuring the rotation angle of the rotating member, can be selected according to the size of the rotating member regardless of the size of the steering shaft. Therefore, by using a rotating member that is smaller than the steering shaft, the size of which is difficult to change due to the structure of the outboard motor, the angle detection sensor can be made smaller, which in turn reduces the size of the outboard motor.

[0020] The outboard motor may be configured such that a part of the steering shaft is located inside the waterproof case, and the rotation of the steering shaft is transmitted to the rotating member inside the waterproof case. According to this configuration, it is possible to detect the rotation angle of the steering shaft even when the angle detection sensor is located inside the waterproof case. This simplifies the layout of the wiring connected to the angle detection sensor, simplifies the configuration of the outboard motor, and suppresses the angle detection sensor from getting wet by water.

[0021] The outboard motor may be configured such that the rotating member is an offset shaft that is parallel to the steering shaft, and the outboard motor further includes a transmission mechanism that is arranged inside the waterproof case and transmits the rotation of the steering shaft to the offset shaft. According to this configuration, it is possible to detect the rotation angle of the steering shaft even when the angle detection sensor is located inside the waterproof case. This simplifies the layout of the wiring connected to the angle detection sensor, simplifies the configuration of the outboard motor, and suppresses the angle detection sensor from getting wet by water.

[0022] Another outboard motor disclosed herein includes a drive source, a drive shaft, a steering shaft, and an angle detection sensor. The drive shaft extends in an upper-lower direction and rotates by the driving force of the drive source. The hollow tubular steering shaft is arranged to surround the outer circumference of the drive shaft. The angle detection sensor is arranged in the air and detects the rotation angle of the steering shaft.

[0023] According to the present outboard motor, the angle detection sensor is arranged in the air, which simplifies the layout of the wiring connected to the angle detection sensor and thus the configuration of the outboard motor.

[0024] The technology disclosed herein can be implemented in various aspects, including, e.g., an outboard motor, a boat provided with an outboard motor and a hull, among other forms.

[0025] According to the present outboard motor, the angle detection sensor is arranged in the air, which simplifies the layout of the wiring connected to the angle detection sensor and thus the configuration of the outboard motor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

FIG. 1 is a perspective view schematically illustrating a configuration of a boat of this embodiment.

FIG. 2 is a side view schematically illustrating a configuration of an outboard motor of this embodiment.

FIG. 3 is an explanatory view illustrating a cross-sectional configuration of an outboard motor main body.

FIG. 4 is an explanatory view illustrating a detailed configuration of an angle detection assembly.

FIG. 5 is an explanatory view illustrating a detailed configuration of the angle detection assembly.

FIG. 6 is an explanatory view illustrating a detailed configuration of the angle detection assembly.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] FIG. 1 is a perspective view schematically illustrating a configuration of a boat 10 of this embodiment. FIG. 1 and other drawings described below show arrows

representing each direction with respect to the position of the boat 10. More specifically, each drawing shows arrows representing the front direction (FRONT), rear direction (REAR), left direction (LEFT), right direction (RIGHT), upper direction (UPPER), and lower direction (LOWER), respectively. The front-rear direction, left-right direction, and upper-lower direction are orthogonal to each other. It should be noted that, in this specification, axes, members, and the like extending in the front-rear direction need not necessarily be parallel to the front-rear direction. Axes and members extending in the front-rear direction include axes and members inclined within the range of ±45° to the front-rear direction. Similarly, axes and members extending in the upper-lower direction include axes and members inclined within a range of ±45° to the upper-lower direction, and axes and members extending in the left-right direction include axes and members inclined within a range of ±45° to the left-right direction.

[0028] The boat 10 includes a hull 200 and an outboard motor 100. In this embodiment, the boat 10 has only one outboard motor 100, but the boat 10 may have multiple outboard motors 100.

[0029] The hull 200 is a part of the boat 10 for occupants to ride. The hull 200 includes a hull main body 202 including a living space 204, a pilot seat 240 installed in the living space 204, and an operating device 250 installed near the pilot seat 240. The operating device 250 is a device for steering the boat and includes, e.g., a steering wheel 252, a sh ift/throttle lever 254, a joystick 255, a monitor 256, and an input device 258. The hull 200 includes a partition wall 220 to partition the rear end of the living space 204 and a transom 210 disposed at the rear end of the hull 200. In the front-rear direction, a space 206 is provided between the transom 210 and the partition wall 220.

[0030] FIG. 2 is a side view schematically illustrating a configuration of an outboard motor 100 of this embodiment. The outboard motor 100 in the reference attitude will be described below unless otherwise specified. The reference attitude is an attitude in which the rotation axis Ac of the output shaft 123, which will be described later, extends in the upper-lower direction, and the rotation axis Ap of the propeller shaft 135, which will be described later, extends in the front-rear direction. The front-rear direction, the left-right direction, and the upper-lower direction are respectively defined based on the outboard motor 100 in the reference attitude.

[0031] The outboard motor 100 is a device that generates thrust to propel the boat 10. The outboard motor 100 is attached to the transom 210 at a rear portion of the hull 200. The outboard motor 100 includes an outboard motor main body 110 and a suspension device 150.

[0032] The outboard motor main body 110 includes a waterproof case 112, a middle case 116, a lower case 118, a motor assembly 120, a control assembly 500, a transmission mechanism 130, a propeller 111, and a steering mechanism 140.

[0033] The waterproof case 112 is a housing located at an upper portion of the outboard motor main body 110. The waterproof case 112 houses an electric motor 122 described below and other electrical components to protect the electric motor 122 and electrical components from being exposed to seawater. The waterproof case 112 includes an upper cover 113 constituting the upper part of the waterproof case 112 and a lower box 114 constituting the lower part of the waterproof case 112. The lower box 114 has a box-shaped configuration with an open top. The upper cover 113 is removably attached to the lower box 114 so as to cover the open top of the lower box 114.

[0034] The middle case 116 is a housing located below the waterproof case 112 and arranged near the center of the outboard motor main body 110 in the upper-lower direction. The upper part of the middle case 116 is connected to the lower box 114 of the waterproof case 112. The middle case 116 is an example of the case.

[0035] The lower case 118 is a housing located below the middle case 116 and arranged at the bottom of the outboard motor main body 110.

[0036] The motor assembly 120 is housed inside the waterproof case 112. The motor assembly 120 includes an electric motor 122 as a driving source. The electric motor 122 is a prime mover that generates power. The electric motor 122 has an output shaft 123 that outputs the driving force generated by the electric motor 122. The output shaft 123 is arranged in an attitude in which its rotation axis Ac extends in the upper-lower direction. The electric motor 122 is an example of the drive source.

[0037] The control assembly 500 is housed inside the waterproof case 112 and is arranged at a position higher than the motor assembly 120. The control assembly 500 controls the rotation of the electric motor 122 and the like. The control assembly 500 includes a control case 502, a motor control unit (MCU) 510, and a power supply line 520 (see FIG. 3). The MCU 510 is a circuit board that controls the rotation of the electric motor 122 and the like. The control case 502 houses the MCU 510. The power supply line 520 supplies power to the MCU 510 from a battery or the like (not shown) provided on the hull 200.

[0038] The transmission mechanism 130 transmits the driving force of the electric motor 122 to the propeller 111. The transmission mechanism 130 includes a primary reduction gear 300, a drive shaft 133, and a propeller shaft 135.

[0039] The primary reduction gear 300 is housed inside the waterproof case 112 and is arranged at a position lower than the motor assembly 120. The primary reduction gear 300 is connected to the output shaft 123 of the electric motor 122 and the drive shaft 133. The primary reduction gear 300 reduces the driving force of the electric motor 122 and transmits it to the drive shaft 133. This allows the propeller 111 to rotate at a desired torque.

[0040] The drive shaft 133 is a rod-shaped member that transmits power to the propeller shaft 135 and is arranged in an attitude extending in the upper-lower

direction. The drive shaft 133 is housed so that it spans the inside of the waterproof case 112, the inside of the middle case 116, and the inside of the lower case 118.

[0041] The propeller shaft 135 is a rod-shaped member and is extended in the front-rear direction at a height relatively lower than the outboard motor main body 110. The propeller shaft 135 rotates along with the propeller 111. The front end of the propeller shaft 135 is accommodated in the lower case 118, and the rear end of the propeller shaft 135 protrudes rearward from the lower case 118.

[0042] A gear is provided at the lower end of the drive shaft 133 and at the front end of the propeller shaft 135, respectively. The rotation of the drive shaft 133 is transmitted to the propeller shaft 135 by meshing the gears of the drive shaft 133 and the propeller shaft 135.

[0043] The propeller 111 is a rotating member with multiple blades and is attached to the rear end of the propeller shaft 135. The propeller 111 rotates along with the rotation of the propeller shaft 135 about the rotation axis Ap. The propeller 111 generates thrust to propel the boat 10 by rotating.

[0044] The steering mechanism 140 is a mechanism that controls changes in the traveling direction of the boat 10. The steering mechanism 140 has a steering shaft 141. Details of the steering mechanism 140 will be described later.

[0045] The suspension device 150 is a device to suspend the outboard motor main body 110 to the hull 200. The suspension device 150 includes a pair of left and right clamp brackets 152, a tilt shaft 154, and a swivel bracket 156.

[0046] The pair of left and right clamp brackets 152 are disposed behind the hull 200 in a state separated from each other in the left-right direction and are fixed to the transom 210 of the hull 200 by using, e.g., bolts.

[0047] The tilt shaft 154 is a rod-shaped member and is rotatably supported by the clamp brackets 152. The tilt axis At, which is the center line of the tilt shaft 154, constitutes the horizontal (left-right) axis of the outboard motor 100 during tilting.

[0048] The swivel bracket 156 is disposed so as to be sandwiched between the pair of clamp brackets 152 and is supported by the clamp brackets 152 via the tilt shaft 154 so as to be rotatable about the tilt axis At. The swivel bracket 156 is driven to rotate about the tilt axis At with respect to the clamp bracket 152 by a tilting device (not shown) including an actuator, such as a hydraulic cylinder, for example.

[0049] When the swivel bracket 156 rotates about the tilt axis At with respect to the clamp bracket 152, the outboard motor main body 110 supported by the swivel bracket 156 also rotates about the tilt axis At. This achieves the tilting operation of rotating the outboard motor main body 110 in the upper-lower direction with respect to the hull 200. By this tilting operation, the outboard motor 100 can change the angle of the outboard motor main body 110 about the tilt axis At in the range from the tilt-down state in which the propeller 111 is disposed under the water (the state in which the outboard motor 100 is in the reference attitude) to the tilt-up state in which the propeller 111 is disposed above the water surface. Trimming operation for adjusting the attitude of the boat 10 during travel can also be performed by adjusting the angle about the tilt axis At of the outboard motor main body 110.

[0050] FIG. 3 is an explanatory view illustrating a cross-sectional structure of the outboard motor main body 110. As shown in FIG. 3, the steering shaft 141 is a hollow tubular member that is arranged to surround the outer circumference of the drive shaft 133 at a position where it does not contact the drive shaft 133. At least a part of the steering shaft 141 is housed in the middle case 116. More specifically, the middle case 116 is provided with an oil chamber 117 in which oil is stored. The middle case 116 houses at least a part of the steering shaft 141 (specifically, the middle portion of the steering shaft 141 in the upper-lower direction) in the oil chamber 117. The steering shaft 141 is rotatably supported about the rotation axis As, e.g. by being attached to a bearing provided in the middle case 116. The upper part of the steering shaft 141 is located at a position higher than the oil chamber 117 and inside the waterproof case 112 (see FIG. 5). The lower part of the steering shaft 141 protrudes downward from the middle case 116 and is connected to the lower case 118.

[0051] The steering shaft 141 rotates about the rotation axis As, e.g. by the driving force of a driving motor (not shown) housed in the middle case 116. When the steering shaft 141 rotates, the lower case 118 connected to the steering shaft 141 also rotates, and the direction of the propeller 111 is changed. This changes the direction of the thrust generated by the propeller 111 to enable the steering of the boat 10.

[0052] As shown in FIG. 3, the outboard motor 100 further includes an angle detection assembly 160 that detects the rotation angle of the steering shaft 141.

[0053] FIGS. 4 to 6 each show an explanatory view of the detailed configuration of the angle detection assembly 160. The angle detection assembly 160 includes a potentiometer 168, an offset shaft 164, a transmission mechanism 163, and a cover 166.

[0054] The offset shaft 164 is a shaft member that is arranged in parallel with the drive shaft 133 and the steering shaft 141. At least a part of the offset shaft 164 is arranged at a position higher than the oil chamber 117 and inside the waterproof case 112. The offset shaft 164 rotates in conjunction with the rotation of the steering shaft 141, as will be described in more detail later. The offset shaft 164 is an example of the rotating member.

[0055] The transmission mechanism 163 is a mechanism that transmits the rotation of the steering shaft 141 to the offset shaft 164. The transmission mechanism 163 is arranged at a position higher than the oil chamber 117 and inside the waterproof case 112. More specifically, the transmission mechanism 163 includes a first gear 161

and a second gear 162. The first gear 161 is attached to the outer circumference of a portion of the steering shaft 141 located inside the waterproof case 112. The second gear 162 is attached to the outer circumference of a portion of the offset shaft 164 located inside the waterproof case 112. The first gear 161 and the second gear 162 are arranged in positions where they mesh with each other. In this embodiment, the gear ratio between the first gear 161 and the second gear 162 is, for example, 1:1.

[0056] The rotation of the steering shaft 141 is transmitted to the offset shaft 164 at a position higher than the oil chamber 117 and inside the waterproof case 112 by the action of the transmission mechanism 163. Specifically, when the steering shaft 141 rotates by the driving force of the drive motor housed in the middle case 116, the rotation of the steering shaft 141 is transmitted to the first gear 161, the rotation of the first gear 161 is transmitted to the second gear 162, and the rotation of the second gear 162 is transmitted to the offset shaft 164. As a result, the offset shaft 164 rotates in conjunction with the rotation of the steering shaft 141. In this embodiment, since the gear ratio between the first gear 161 and the second gear 162 is 1:1, the number of rotations of the steering shaft 141 and the number of rotations of the offset shaft 164 are the same.

[0057] As will be explained in more detail later, the potentiometer 168 is a sensor that detects the rotation angle of the steering shaft 141 by measuring the rotation angle of the offset shaft 164. The potentiometer 168 is arranged at a position higher than the oil chamber 117 and is therefore not positioned in the oil. In other words, the potentiometer 168 is positioned in the air and is surrounded by the air. More specifically, the potentiometer 168 is housed inside the waterproof case 112 below the primary reduction gear 300. In other words, the potentiometer 168 is positioned between the electric motor 122 and the oil chamber 117 in the upper-lower direction, and between the primary reduction gear 300 and the oil chamber 117. Although not shown in the cross-section in FIG. 3, there is a dead space between the primary reduction gear 300 and the oil chamber 117 because a pipe for pouring oil into the oil chamber 117 is arranged below the primary reduction gear 300 and above the oil chamber 117, and the potentiometer 168 is arranged in this dead space. In addition, the wiring that is connected to the potentiometer 168 to connect the potentiometer 168 and the electrical components is also housed inside the waterproof case 112 as with the potentiometer 168. In other words, the potentiometer 168 and the wiring connected to the potentiometer 168 are both housed inside the waterproof case 112 and are not arranged across other housings (e.g. the middle case 116) other than the waterproof case 112, which simplifies the layout of the wiring. The potentiometer 168 is an example of the angle detection sensor.

[0058] As shown in FIG. 6, at least a part of the transmission mechanism 163 and the offset shaft 164 are covered by the cover 166. Furthermore, the potentiometer 168 is attached to the upper portion of the offset shaft 164. Specifically, the potentiometer 168 includes a resistor and a wiper (not shown in the figure), and is configured so that the displacement of the wiper can be measured by applying voltage across the both ends of the resistor and measuring the voltage across one terminal of the resistor and the wiper. In addition, the wiper of the potentiometer 168 is configured to rotate in conjunction with the rotation of the offset shaft 164. As a result, the potentiometer 168 is able to measure the rotation angle of the offset shaft 164. In other words, the potentiometer 168 indirectly detects the rotation angle of the steering shaft 141 by measuring the rotation angle of the offset shaft 164, which rotates in conjunction with the rotation of the steering shaft 141.

[0059] As explained above, the outboard motor 100 of this embodiment includes the drive source, the drive shaft 133, the steering shaft 141, the middle case 116, and the potentiometer 168. The drive shaft 133 extends in an upper-lower direction and rotates by the driving force of the drive source. The hollow tubular steering shaft 141 is arranged to surround the outer circumference of the drive shaft 133. The middle case 116 is arranged at a position lower than the drive source and provided with the oil chamber 117 to store oil, and at least a part of the steering shaft 141 is housed in the oil chamber 117. The potentiometer 168 is arranged at a position higher than the oil chamber 117 and detects the rotation angle of the steering shaft 141.

[0060] According to the present embodiment of the outboard motor 100, the potentiometer 168 is arranged outside the oil chamber 117 formed in the middle case 116. In other words, the potentiometer 168 is located in the air, which simplifies the layout of the wiring connected to the potentiometer 168 and thus the configuration of the outboard motor 100.

[0061] In addition, in the outboard motor 100 of this embodiment, the potentiometer 168 is arranged between the drive source and the oil chamber 117 in the upper-lower direction. According to the present outboard motor 100 of this embodiment, when a dead space is formed between the drive source and the oil chamber 117 in the upper-lower direction, the potentiometer 168 can be arranged in the dead space, which simplifies the configuration of the outboard motor 100.

[0062] In addition, the outboard motor 100 of this embodiment further includes the primary reduction gear 300 arranged at a position lower than the drive source and higher than the oil chamber 117, and the potentiometer 168 is arranged between the primary reduction gear 300 and the oil chamber 117 in the upper-lower direction. According to the present outboard motor 100 of this embodiment, when a dead space is formed between the primary reduction gear 300 and the oil chamber 117 in the upper-lower direction, the potentiometer 168 can be arranged in the dead space, which simplifies the configuration of the outboard motor 100.

[0063] In addition, the outboard motor 100 of this em-

bodiment further includes the rotating member that rotates in conjunction with the rotation of the steering shaft 141 and at least a part of which is located above the oil chamber 117, and the potentiometer 168 detects the rotation angle of the steering shaft 141 by measuring the rotation angle of the rotating member. According to the present outboard motor 100 of this embodiment, it is possible to detect the rotation angle of the steering shaft 141 even when the potentiometer 168 is arranged at a position higher than the oil chamber 117. This simplifies the layout of the wiring connected to the potentiometer 168 and the configuration of the outboard motor 100.

[0064] In addition, according to the present outboard motor 100 of this embodiment, the potentiometer 168, which indirectly detects the rotation angle of the steering shaft 141 by measuring the rotation angle of the rotating member, can be selected according to the size of the rotating member regardless of the size of the steering shaft 141. Therefore, by using a rotating member that is smaller than the steering shaft 141, the size of which is difficult to change due to the structure of the outboard motor 100, the potentiometer 168 can be made smaller, which in turn reduces the size of the outboard motor 100.

[0065] In addition, in the outboard motor 100 of this embodiment, a part of the steering shaft 141 is located at a position higher than the oil chamber 117, and the rotation of the steering shaft 141 is transmitted to the rotating member at a position higher than the oil chamber 117. According to the present outboard motor 100 of this embodiment, it is possible to detect the rotation angle of the steering shaft 141 even when the potentiometer 168 is arranged at a position higher than the oil chamber 117. This simplifies the layout of the wiring connected to the potentiometer 168 and thus the configuration of the outboard motor 100.

[0066] In addition, in the outboard motor 100 of this embodiment, the rotating member is the offset shaft 164 that is parallel to the steering shaft 141, and the outboard motor 100 further includes the transmission mechanism 163 that is arranged at a position higher than the oil chamber 117 and transmits the rotation of the steering shaft 141 to the offset shaft 164. According to the present embodiment of the outboard motor 100, it is possible to detect the rotation angle of the steering shaft 141 even when the potentiometer 168 is arranged at a position higher than the oil chamber 117. This simplifies the layout of the wiring connected to the potentiometer 168 and thus the configuration of the outboard motor 100.

[0067] In addition, in the outboard motor 100 of this embodiment, the drive source includes the electric motor 122, and the outboard motor 100 further includes a waterproof case 112 arranged at a position higher than the oil chamber 117 and housing the electric motor 122 and the potentiometer 168. According to the present embodiment of the outboard motor 100, the potentiometer 168 is housed in the waterproof case 112 arranged at a position higher than the oil chamber 117, which simplifies the layout of the wiring connected to the potentiometer 168, thereby simplifying the configuration of the outboard motor 100 and suppressing the potentiometer 168 from getting wet by water.

[0068] In addition, the outboard motor 100 of this embodiment includes the rotating member that rotates in conjunction with the rotation of the steering shaft 141 and at least a part of which is located inside the waterproof case 112, and the potentiometer 168 detects the rotation angle of the steering shaft 141 by measuring the rotation angle of the rotating member. According to the present outboard motor 100 of this embodiment, it is possible to detect the rotation angle of the steering shaft 141 even when the potentiometer 168 is located inside the waterproof case 112. This simplifies the layout of the wiring connected to the potentiometer 168, simplifies the configuration of the outboard motor 100, and suppresses the potentiometer 168 from getting wet by water.

[0069] In addition, according to the present outboard motor 100 of this embodiment, the potentiometer 168, which indirectly detects the rotation angle of the steering shaft 141 by measuring the rotation angle of the rotating member, can be selected according to the size of the rotating member regardless of the size of the steering shaft 141. Therefore, by using the rotating member smaller than the steering shaft 141, the size of which is difficult to change due to the structure of the outboard motor 100, the potentiometer 168 can be made smaller, which in turn reduces the size of the outboard motor 100.

[0070] In addition, in the outboard motor 100 of this embodiment, a part of the steering shaft 141 is located inside the waterproof case 112, and the rotation of the steering shaft 141 is transmitted to the rotating member inside the waterproof case 112. According to the present embodiment of the outboard motor 100, it is possible to detect the rotation angle of the steering shaft 141 even when the potentiometer 168 is located inside the waterproof case 112. This simplifies the layout of the wiring connected to the potentiometer 168, simplifies the configuration of the outboard motor 100, and suppresses the potentiometer 168 from getting wet by water.

[0071] In addition, in the outboard motor 100 of this embodiment, the rotating member is the offset shaft 164 that is parallel to the steering shaft 141, and the outboard motor 100 further includes a transmission mechanism 163 that is arranged inside the waterproof case 112 and transmits the rotation of the steering shaft 141 to the offset shaft 164. According to the present embodiment of the outboard motor 100, it is possible to detect the rotation angle of the steering shaft 141 even when the potentiometer 168 is located inside the waterproof case 112. This simplifies the layout of the wiring connected to the potentiometer 168, simplifies the configuration of the outboard motor 100, and suppresses the potentiometer 168 from getting wet by water.

[0072] The configuration of the boat 10 and the outboard motor 100 of the preferred embodiment is an example and may be variously modified. For example, the drive source of the above embodiment includes the

electric motor 122. Alternatively, the drive source may include both the electric motor and an engine such as an internal combustion engine or may consist only of an internal combustion engine.

[0073] In the above embodiment, the outboard motor 100 is provided with a primary reduction gear 300. Alternatively, the outboard motor 100 can be provided without a primary reduction gear.

[0074] In the above embodiment, the rotation of the steering shaft 141 is transmitted to the offset shaft 164 at a position higher than the oil chamber 117. Alternatively, the rotation of the steering shaft may be transmitted to the rotating member inside the oil chamber.

[0075] The above embodiment is provided with the offset shaft 164 as the rotating member. Alternatively, another element may be selected as a rotating member.

[0076] In the above embodiment, the outboard motor 100 is provided with the waterproof case 112. Alternatively, the outboard motor may be provided without a waterproof case.

[0077] In the above embodiment, the transmission mechanism 163 includes the first gear 161 and the second gear 162. Alternatively, another configuration of the transmission mechanism can be selected. For example, the transmission mechanism may include a first sprocket attached to the steering shaft, a second sprocket attached to the rotating member, and a chain that meshes with the first and second sprockets.

[0078] In the above embodiment, the gear ratio between the first gear 161 and the second gear 162 is 1:1. Alternatively, another gear ratio between the first gear and the second gear may be selected.

[0079] In the above embodiment, the potentiometer 168 is employed as an angle detection sensor. Alternatively, other angle detection sensors such as a rotary sensor or rotary encoder may be employed.

Claims

1. An outboard motor (100), configured to be attached to a boat (10) in a reference attitude with regard to a front-rear direction of the boat (10), a left-right direction of the boat (10), and an upper-lower direction of the boat (10), the outboard motor (100) comprising:

   a drive source (122);
   a drive shaft (133) extending in the upper-lower direction of the boat (10) and is configured to rotate by a driving force of the drive source (122);
   a hollow tubular steering shaft (141) arranged to surround the outer circumference of the drive shaft (133); and
   an angle detection sensor (168) configured to detect a rotation angle of the steering shaft (141).

2. The outboard motor (100) according to claim 1, wherein the angle detection sensor (168) is arranged in air.

3. The outboard motor (100) according to claim 1 or 2, further comprising a case (116) arranged at a position lower than the drive source (122) with regard to the upper-lower direction of the boat (10), in which an oil chamber (117) is formed to store oil and at least a part of the steering shaft (141) is housed in the oil chamber (117), wherein the angle detection sensor (168) is arranged at a position higher than the oil chamber (117) with regard to the upper-lower direction of the boat (10) and configured to detect a rotation angle of the steering shaft (141).

4. The outboard motor (100) according to claim 3, wherein the angle detection sensor (168) is arranged between the drive source (122) and the oil chamber (117) with regard to the upper-lower direction of the boat (10).

5. The outboard motor (100) according to claim 3 or 4, further comprising:

   a primary reduction gear (300) arranged at a position lower than the drive source (122) and higher than the oil chamber (117) with regard to the upper-lower direction of the boat (10), wherein
   the angle detection sensor (168) is arranged between the primary reduction gear (300) and the oil chamber (117) with regard to the upper-lower direction of the boat (10).

6. The outboard motor (100) according to any one of claims 3 to 5, further comprising:

   a rotating member (164) that is configured to rotate in conjunction with a rotation of the steering shaft (141) and at least a part of which is located at a position higher than the oil chamber (117) with regard to the upper-lower direction of the boat (10), wherein
   the angle detection sensor (168) is configured to detect the rotation angle of the steering shaft (141) by measuring a rotation angle of the rotating member (164).

7. The outboard motor (100) according to claim 6, wherein a part of the steering shaft (141) is located at a position higher than the oil chamber (117) with regard to the upper-lower direction of the boat (10), and
   the rotation of the steering shaft (141) is transmitted to the rotating member (164) at a position higher than the oil chamber (117) with regard to the upper-lower direction of the boat (10).

8. The outboard motor (100) according to claim 6 or 7, wherein the rotating member is an offset shaft (164) that is parallel to the steering shaft (141), and
the outboard motor (100) further comprises a transmission mechanism (163) that is arranged at a position higher than the oil chamber (117) with regard to the upper-lower direction of the boat (10) and configured to transmit the rotation of the steering shaft (141) to the offset shaft (164).

9. The outboard motor (100) according to any one of claims 3 to 5, wherein the drive source includes an electric motor (122), and
the outboard motor (100) further comprises a waterproof case (112) arranged at a position higher than the oil chamber (117) with regard to the upper-lower direction of the boat (10) and housing the electric motor (122) and the angle detection sensor (168).

10. The outboard motor (100) according to claim 9, further comprising:

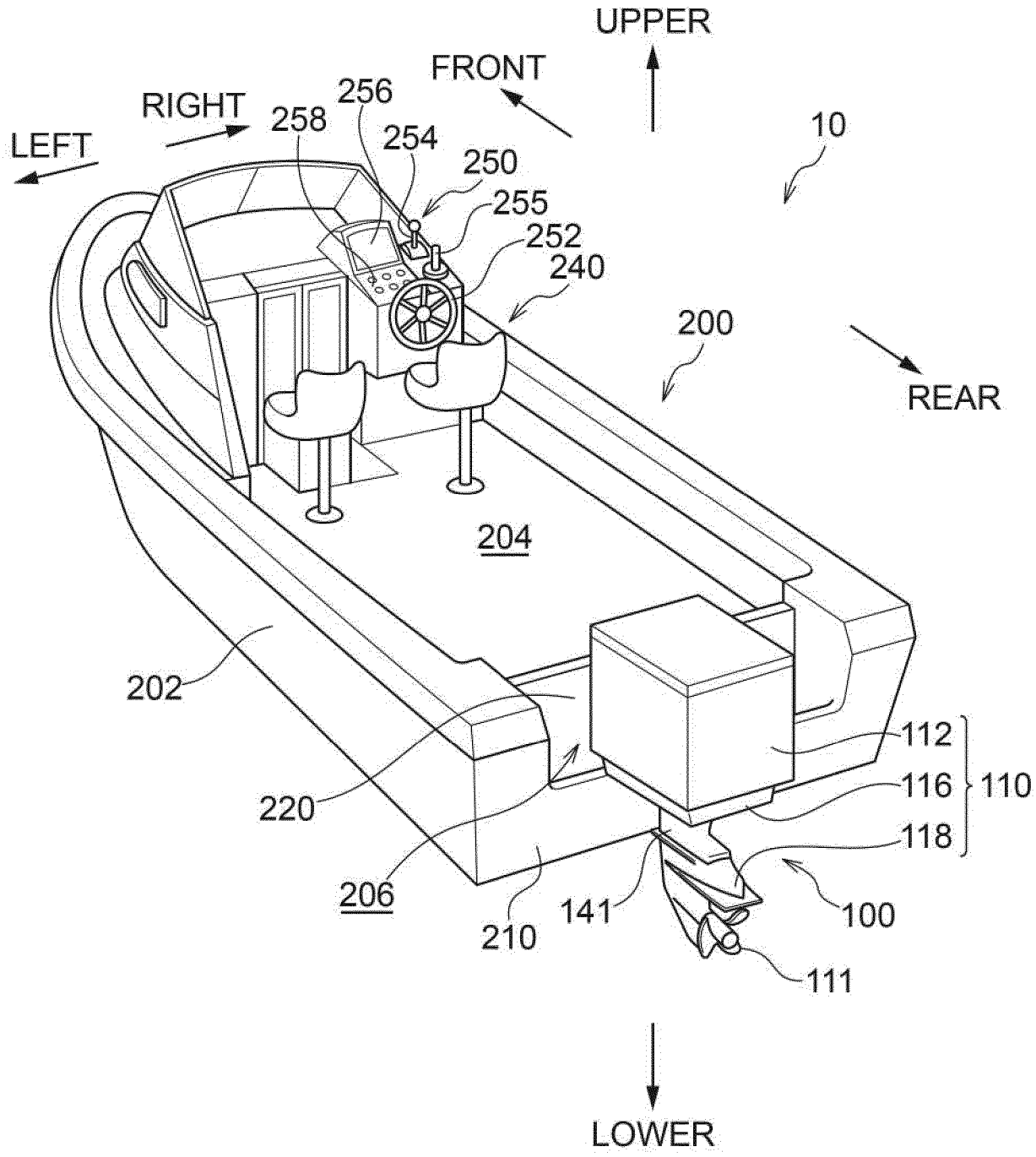
a rotating member (164) that is configured to rotate in conjunction with the rotation of the steering shaft (141) and at least a part of which is located inside the waterproof case (112), wherein
the angle detection sensor (168) is configured to detect the rotation angle of the steering shaft (141) by measuring a rotation angle of the rotating member (164).

11. The outboard motor (100) according to in claim 10, wherein a part of the steering shaft (141) is located inside the waterproof case (112), and
the rotation of the steering shaft (141) is transmitted to the rotating member (164) inside the waterproof case (112).

12. The outboard motor (100) according to claim 10 or 11, wherein the rotating member is an offset shaft (164) that is parallel to the steering shaft (141), and the outboard motor (100) further comprises a transmission mechanism (163) that is arranged inside the waterproof case (112) and configured to transmit the rotation of the steering shaft (141) to the offset shaft (164).

13. A boat (10), comprising;

a hull (200); and
the outboard motor (100) according to any one of claims 1 to 12 mounted to a rear portion of the hull (200) with regard to the front-rear direction of the boat (10) in the reference attitude with regard to the front-rear direction of the boat (10), the left-right direction of the boat (10), and the upper-lower direction of the boat (10).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141
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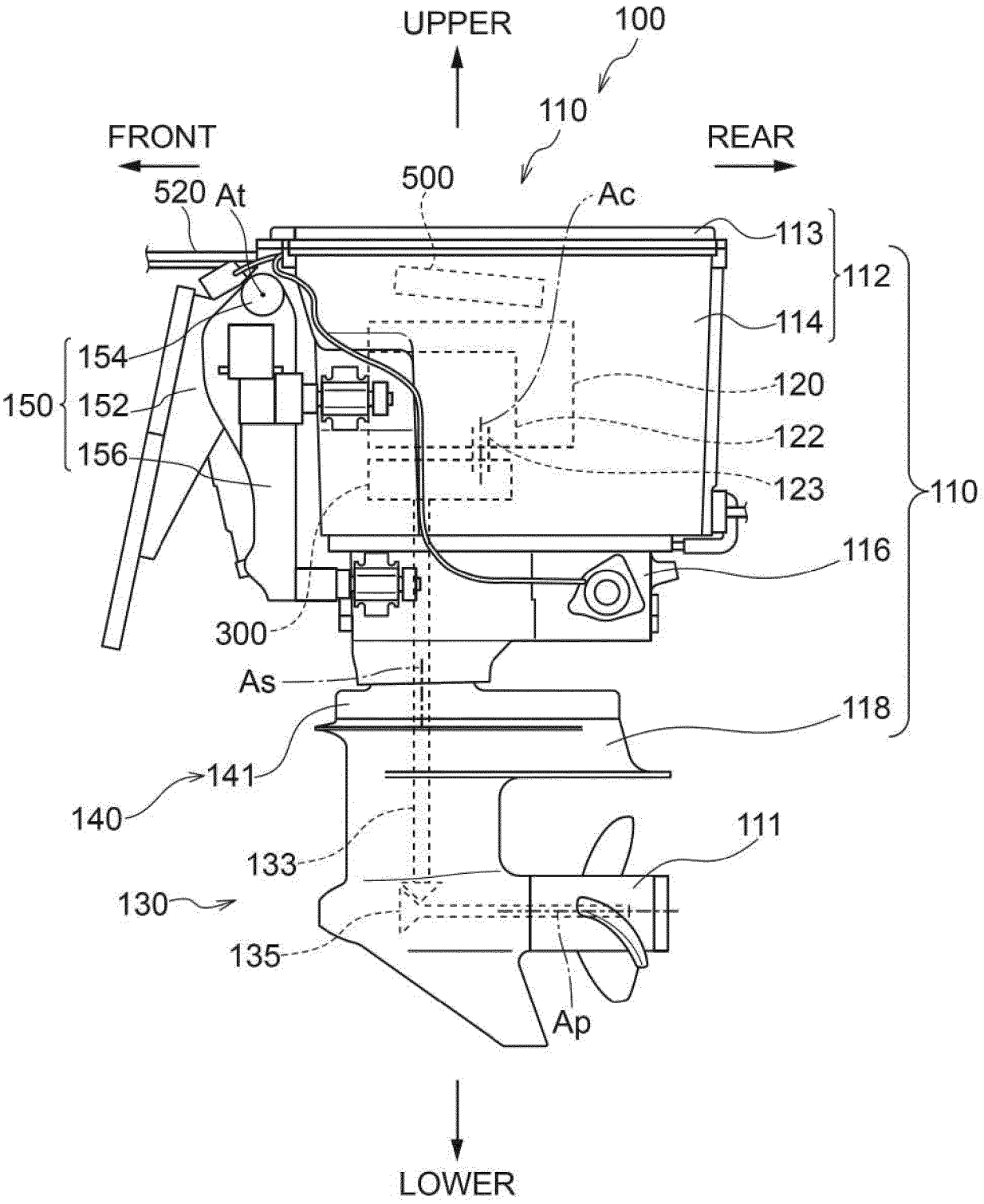
111
LOWER

FIG.1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154
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123
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116
300
As
118
141
140
111
133
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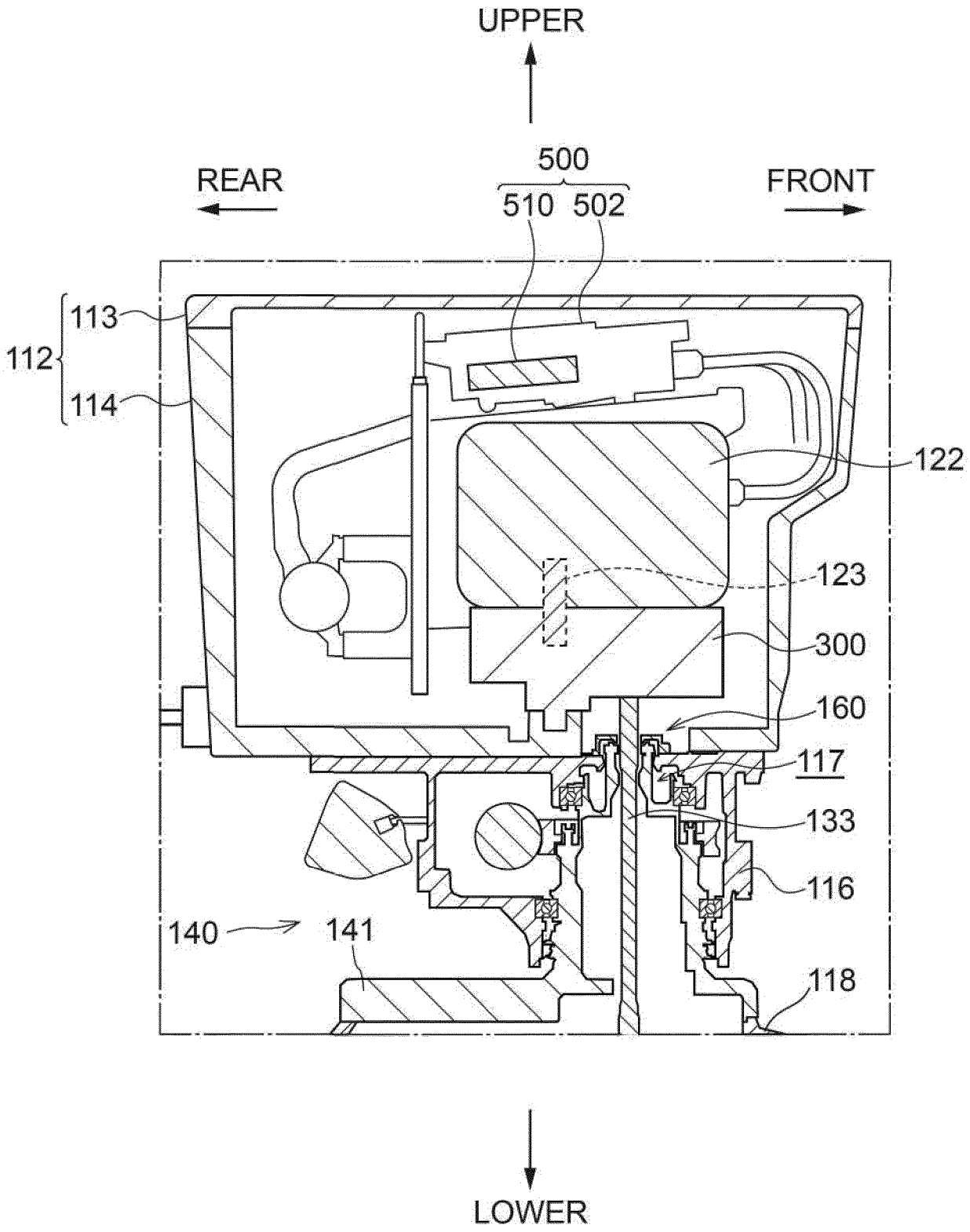
135
Ap
LOWER

FIG.2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122
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300
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116
140
141
118
LOWER

FIG.3

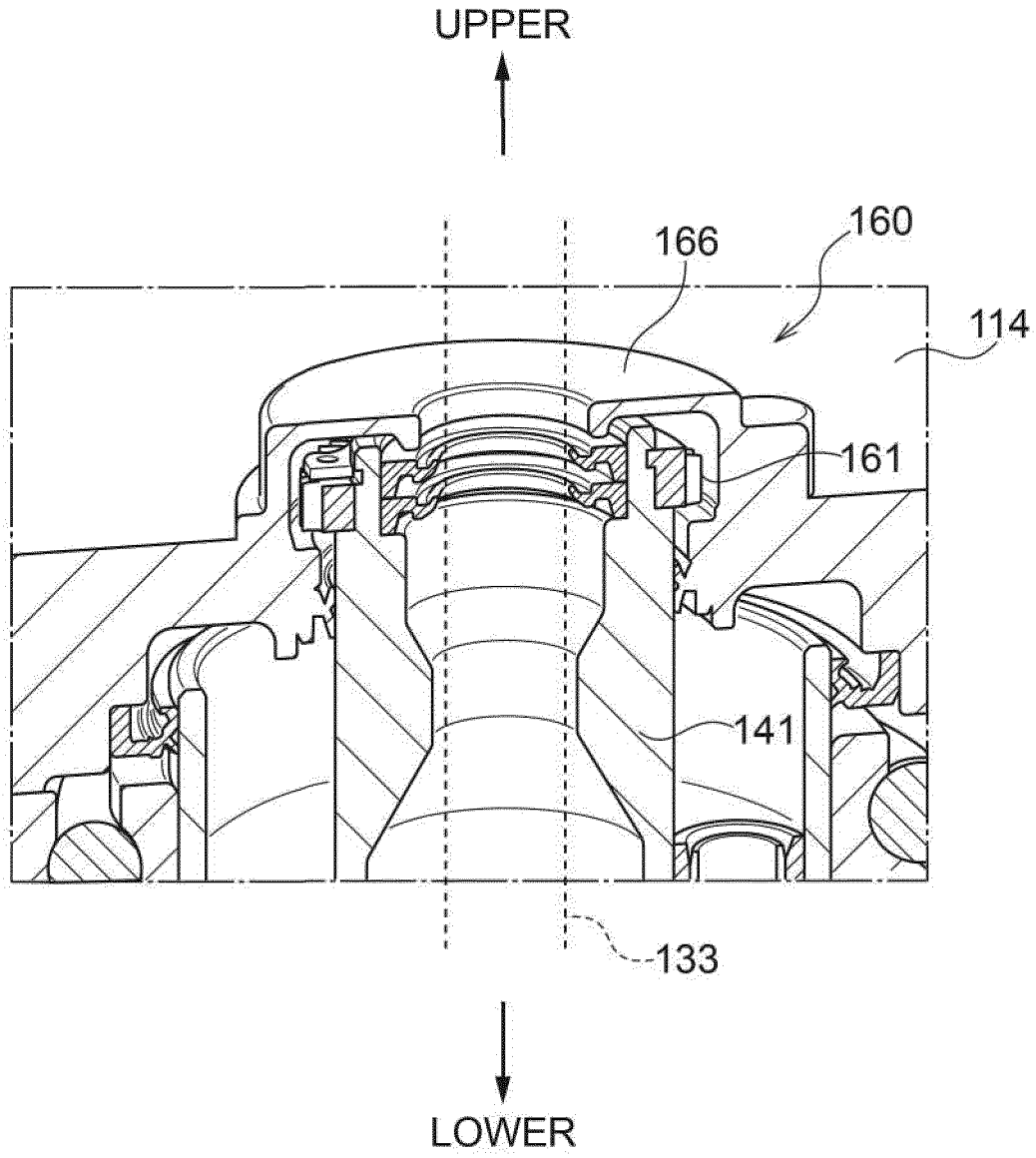

FIG.4

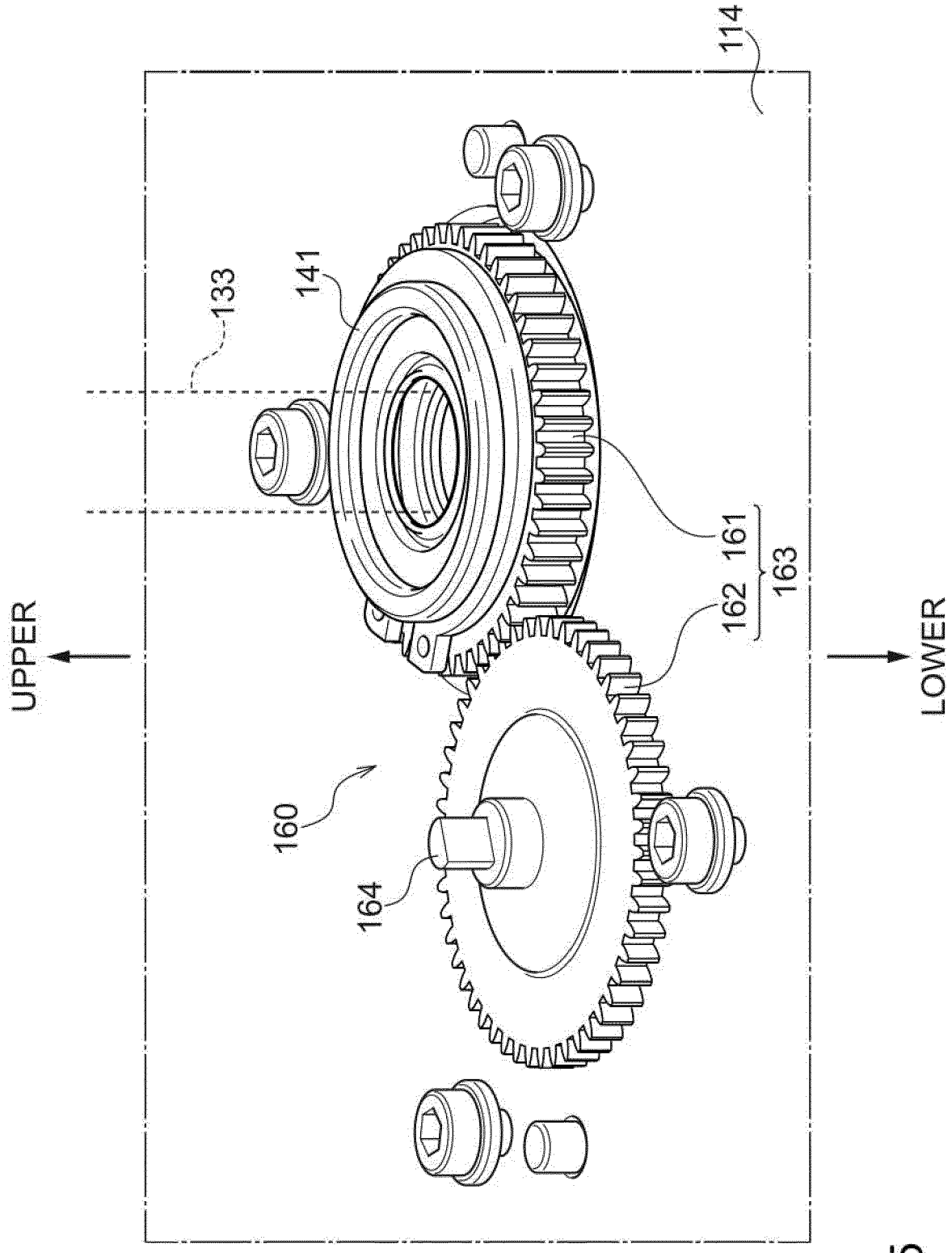

FIG.5

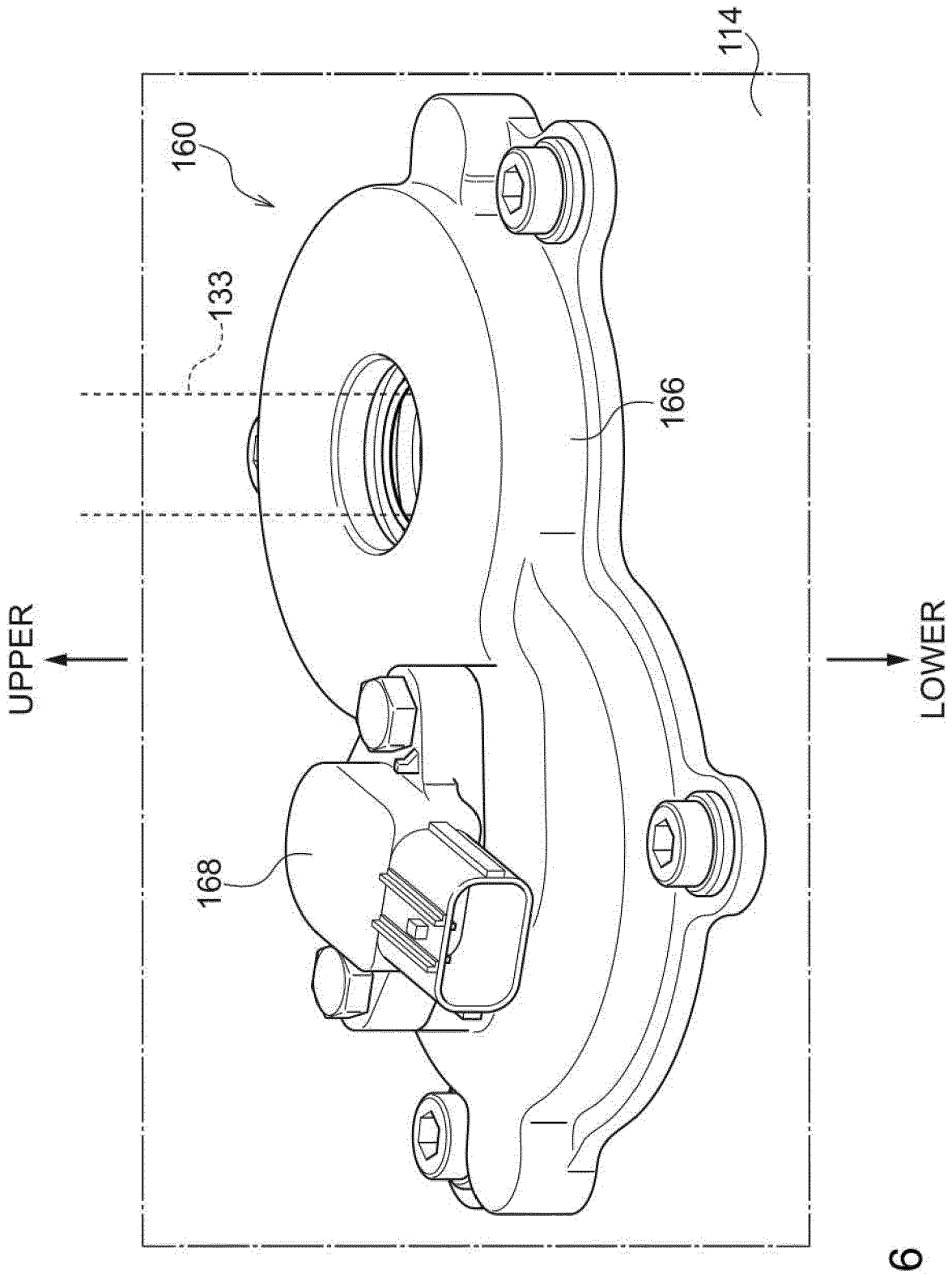

FIG.6

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EUROPEAN SEARCH REPORT

Application Number
EP 24 20 9480

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	10 April 2025	Martínez, Felipe

CATEGORY OF CITED DOCUMENTS

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