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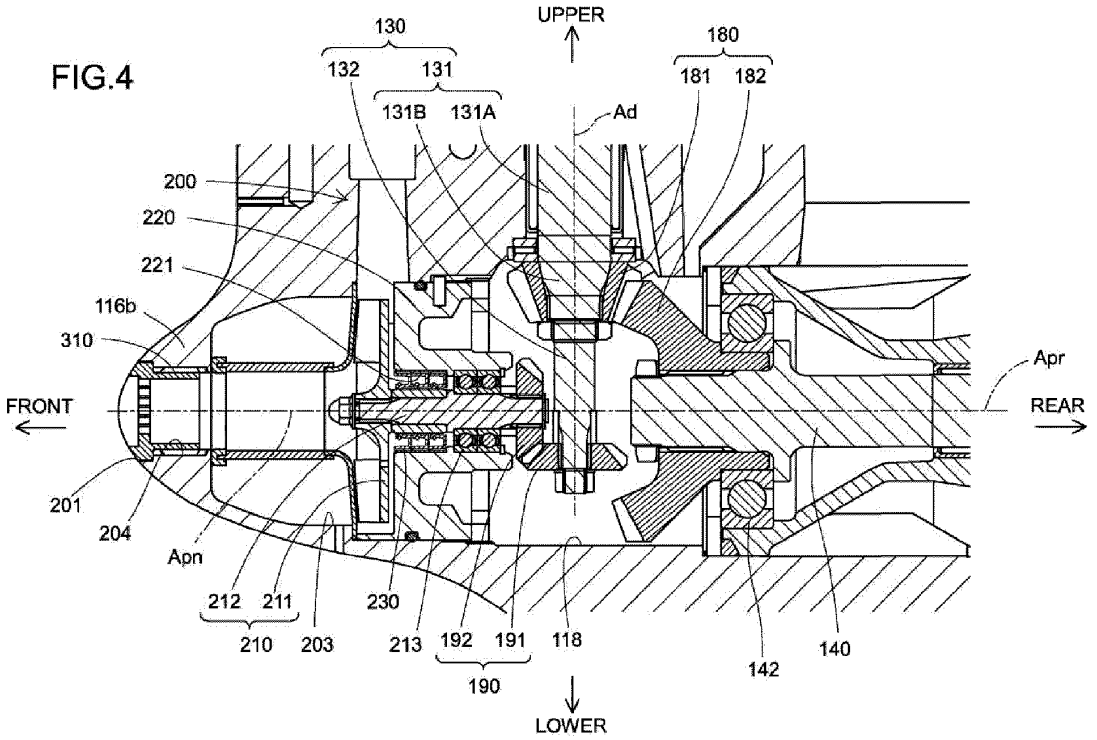
(54) BOAT PROPULSION DEVICE AND OUTBOARD MOTOR

(57) The outboard motor 100 includes a cooling water flow path 200 having an intake port 201 for taking in cooling water from the outside and through which cooling water flows; and a water pump 210 including an impeller 211 and a pump shaft 212 rotating together with the impeller 211 to pump the cooling water into the cooling water flow path 200, wherein the inlet channel 204 of the cooling water flow path 200 from the intake port 201 to the water pump 210 is located in front of the water pump 210 and extends along the rotation axis Apn of the pump shaft 212, and the inlet 310 that allows the passage of the cooling water and inhibits entry of foreign objects is placed inside the inlet channel 204.

FIG.4



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Description

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

[0002] Generally, outboard motors are equipped with a water pump for pumping cooling water to cool the engine. The water pump consists of an impeller or the like attached to a drive shaft. When the engine is driven, the impeller rotates together with the rotation of the drive shaft, and cooling water is pumped into the engine (see JP 2015-145137 A).

[0003] In the water pump of the above configuration, because the impeller is directly attached to the drive shaft, the rotational speed of the impeller depends on the rotational speed of the drive shaft. Therefore, it is difficult to adjust the rotational speed of the impeller according to the required amount of cooling water to be transported, which may hinder efficient cooling water transport.

[0004] It is the object of the present invention to provide a boat propulsion device that can provide efficient cooling water transport. According to the present invention said object is solved by a boat propulsion device having the features of independent claim 1. Preferred embodiments are laid down in the dependent claims.

[0005] An outboard motor according to an aspect of the present disclosure is an outboard motor to be mounted on a hull, the outboard motor including: a cooling water flow path having an intake port for taking in cooling water from the outside and through which cooling water flows; and a water pump including an impeller and a pump shaft rotating together with the impeller to pump the cooling water into the cooling water flow path, wherein an inlet channel of the cooling water flow path from the intake port to the water pump extends along the rotation axis of the pump shaft in front of the water pump, and a filter member that allows the passage of the cooling water and inhibits entry of foreign objects is placed inside the inlet channel.

[0006] According to the above configuration, the cooling water taken from outside flows from the front to the impeller attached to the pump shaft so that the cooling water can be pumped efficiently. This configuration also suppresses damage to the water pump caused by foreign objects colliding with the water pump.

[0007] The outboard motor may further include a drive unit, a drive shaft rotationally driven by the drive unit, a propeller, and a propeller shaft that rotates together with the propeller, the drive shaft may be rotatable in both a forward direction (first rotation direction) and a reverse direction (second rotation direction), which is opposite to the forward direction, and the water pump may be a non-volumetric pump.

[0008] The drive shaft, which can rotate in both forward and reverse directions, eliminates the need for a clutch mechanism such as a dog clutch, thereby providing a relatively large space around the propeller shaft. This space can be used to accommodate the water pump, eliminating the need for a larger outboard motor and optimizing the arrangement of the components necessary to transport cooling water. In addition, since the non-volumetric pump has no restriction on the direction of rotation, it is suitable as a pump connected to a drive shaft that can rotate in both the forward and reverse directions.

[0009] In the outboard motor, the drive unit may be an electric motor driven by electricity supplied from a power source.

[0010] In the outboard motor, the water pump may be a centrifugal pump.

[0011] In the outboard motor, the water pump may be located on the rotation axis of the propeller shaft.

[0012] This configuration allows the water pump to be positioned without protruding sideways from the rotation axis of the propeller shaft, thereby avoiding a reduction in the propulsive force of the hull.

[0013] In the outboard motor, the filter member may be made of resin.

[0014] According to this configuration, compared to the case where the filter member is made of metal, it is possible to suppress the filter member from corroding and adhering to the member constituting the inlet channel.

[0015] In the outboard motor, the filter member may be made of glass fiber reinforced plastic.

[0016] According to this configuration, compared to the case where the filter member is made of resin that does not contain glass fibers, the filter member can be made stronger, and thus the filter member can be suppressed from being damaged by collisions with foreign objects while cruising, collisions with a shore while anchoring, and the like.

[0017] In the outboard motor, the filter member may include a holding member having a through hole and fixed inside the inlet channel, and a filter body held inside the through hole that allows the passage of the cooling water and inhibits entry of foreign objects, and the holding member may made of resin, and the filter body may be made of metal.

[0018] According to this configuration, since the holding member of the filter member that is in contact with the member constituting the inlet channel is made of resin, it is possible to suppress the filter member from corroding and adhering to the member constituting the inlet channel. In addition, since the filter body is made of metal, the filter portion can be made stronger compared to the case where the whole of the filter member is made of resin, and thus the filter portion can be suppressed from being damaged by collisions with foreign objects while cruising, collisions with a shore while anchoring, and the like.

[0019] An boat propulsion device according to an aspect of the present disclosure is a boat propulsion device provided on a hull, the boat propulsion device including: a cooling water flow path having an intake port for taking in cooling water from the outside and through which cooling water flows; and a water pump including an impeller and a pump shaft rotating together with the impeller to

pump the cooling water into the cooling water flow path, wherein a filter member that allows the passage of the cooling water and inhibits entry of foreign objects is placed at the intake port, and the filter member is placed on the rotation axis of the pump shaft in front of the water pump.

[0020] In this configuration, cooling water taken in from the outside flows in from the front to the impeller attached to the pump shaft, thus enabling efficient pumping of the cooling water. This configuration also suppresses damage to the water pump caused by foreign objects colliding with the water pump.

[0021] According to the technology disclosed herein, it is possible to provide an outboard motor or a boat propulsion device capable of efficiently transporting cooling water.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

FIG. 1 is a perspective view schematically illustrating a configuration of a boat of Embodiment 1.
FIG. 2 is a side view schematically illustrating a configuration of an outboard motor of Embodiment 1.
FIG. 3 is a partially enlarged cross-sectional view of the outboard motor of Embodiment 1, showing a partially enlarged cross-section cut at the position indicated by line III-III in FIG. 1.
FIG. 4 is an enlarged cross-sectional view of the part indicated by frame F1 in FIG. 3.
FIG. 5 is an enlarged cross-sectional view of the part indicated by frame F2 in FIG. 3.
FIG. 6 is a front view of the inlet of Embodiment 1.
FIG. 7 is a partially enlarged cross-sectional view of the outboard motor of Embodiment 2, showing the same area as in FIG. 5 enlarged.
FIG. 8 is a front view of the inlet of Embodiment 2.
FIG. 9 is a partially enlarged cross-sectional view of the outboard motor of Embodiment 3, showing the same area as in FIG. 5 enlarged.
FIG. 10 is a front view of the inlet of Embodiment 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] Specific examples of the technology disclosed by this specification are described below with reference to the drawings.

[0024] Embodiment 1 will be described with reference to FIGS. 1 to 4. A boat 1 of Embodiment 1 is equipped with a hull 10 and an outboard motor 100 (an example of the boat propulsion device), as shown in FIG. 1. FIG. 1 and other drawings described below show arrows representing each direction with respect to the position of the boat 1. More specifically, each figure shows arrows representing front (FRONT), rear (REAR), left (LEFT), right (RIGHT), upper (UPPER), and lower (LOWER) directions, respectively. The front-rear direction, left-right direction, and upper-lower direction (vertical direction) are orthogonal to each other.

[0025] The hull 10 is a part of the boat 1 for occupants to ride. As shown in FIG. 1, the hull 10 has a hull body 12 having a living space 11, a pilot seat 16 installed in the living space 11, and an operating device 17 installed near the pilot seat 16. The operating device 17 is a device for maneuvering the boat and includes, e.g., a steering wheel, a shift throttle lever, a joystick, a monitor, and an input device. The hull 10 also has a partition wall 13 that partitions the rear end of the living space 11 and a transom 14 positioned at the rear end of the hull 10. In the front-rear direction, there is a space 15 between the transom 14 and the partition wall 13.

[0026] The outboard motor 100 is a device that generates thrust to propel the boat 1. The outboard motor 100 in this embodiment is an electric outboard motor driven by an electric motor 120 (an example of a drive unit). The outboard motor 100 in the reference attitude will be described below unless otherwise specified. The reference attitude is the attitude of the outboard motor 100 when the boat 1 is cruising (attitude shown in FIG. 1), in which the rotation axis Ad of the drive shaft 130 (described below) extends in the upper-lower direction and the rotation axis Apr of the propeller shaft 140 extends in the front-rear direction. The front-rear direction, the left-right direction, and the upper-lower direction are defined based on the outboard motor 100 in the reference attitude.

[0027] As shown in FIG. 1, the outboard motor 100 is attached to the transom 14 located at the rear (stern) of the hull 10. The outboard motor 100 has an outboard motor main body 110 and a suspension device 150.

[0028] As shown in FIGS. 2 and 3, the outboard motor main body 110 includes a cowl 114, a casing 116, an electric motor 120, a drive shaft 130, a propeller 141, a propeller shaft 140, a cooling water flow path 200, a water pump 210, a first gear mechanism 180, a second gear mechanism 190, and an inlet 310 (an example of the filter member).

[0029] As shown in FIG. 2, the cowl 114 is a housing located on top of the outboard motor main body 110. The casing 116 includes an upper case 116a and a lower case 116b, as shown in FIG. 2. The upper case 116a is a housing located below the cowl 114. The lower case 116b is a housing located below the upper case 116a.

[0030] The lower case 116b has a gear chamber 118 that stores oil therein and houses the first gear mechanism 180 and the second gear mechanism 190, as shown in FIG. 4.

[0031] The electric motor 120 is driven by electric power supplied from a battery (power source). The electric motor 120 includes a rotor including a permanent magnet, a stator including a coil to which the battery power is supplied, and a motor housing that houses the rotor and stator. The electric motor 120 is located inside the cowl 114. The battery may be located inside the cowl 114 or inside the hull 10.

[0032] The drive shaft 130 is a rod-shaped member extending downward from the electric motor 120 and housed within the casing 116, as shown in FIG. 2. The drive shaft 130 is arranged in an attitude in which its rotation axis Ad extends in the upper-lower direction.

[0033] As shown in FIG. 4, the drive shaft 130 has a rod-shaped main shaft 131 and an extension shaft 132 extending from the tip of the main shaft 131 opposite to the electric motor 120 (lower end in FIG. 4). The main shaft 131 includes a constant-diameter shaft 131A extending from the electric motor 120, which is a round rod of constant thickness, and a reduced-diameter shaft 131B connecting the constant-diameter shaft 131A and the extension shaft 132. The extension shaft 132 extends coaxially with the main shaft 131 and has a round rod shape with a smaller diameter than the constant-diameter shaft 131A. The constant-diameter shaft 131A, the reduced-diameter shaft 131B, and the extension shaft 132 are arranged coaxially.

[0034] The drive shaft 130 rotates around the rotation axis Ad by the rotational driving force of the electric motor 120. Since the electric motor 120 can rotate in both forward and reverse directions, the drive shaft 130 can also rotate around the rotation axis line Ad in both forward direction (first rotation direction) to move the boat 1 forward and reverse direction (second rotation direction) to move the boat 1 backward, which is opposite to the forward direction, according to the rotational driving direction of the electric motor 120.

[0035] The propeller 141 is a rotating body having a plurality of blades. The propeller 141 generates thrust by rotation.

[0036] The propeller shaft 140 is a rod-shaped member and extends in the front-rear direction inside the lower case 116b, as shown in FIGS. 2, 3, and 4. The propeller shaft 140 is rotatably supported by the lower case 116b via a bearing 142. The rear end of the propeller shaft 140 protrudes rearwardly from the lower case 116b, and the propeller 141 is attached to this rear end. As the propeller shaft 140 rotates around the rotation axis Apr, the propeller 141 also rotates.

[0037] The cooling water flow path 200 is located inside the outboard motor main body 110. The cooling water flow path 200 is a channel through which cooling water (seawater, lake water, and river water, among others) taken from outside the outboard motor 100 flows. The cooling water flow path 200 has an intake port 201 that opens on the outer surface of the lower case 116b for taking cooling water into the interior and a drain port 202 that also opens on the outer surface of the lower case 116b for discharging cooling water to the exterior; the cooling water flow path 200 extends from the intake port 201 through the periphery of the electric motor 120 to the drain port 202. The intake port 201 is located below the waterline when the boat 1 is cruising, i.e., when the outboard motor 100 is in the reference attitude. The intake port 201 is open at the front end of the lower case 116b.

[0038] As shown in FIG. 4, a portion of the cooling water flow path 200 is a pump chamber 203. The pump chamber 203 is located in front of the gear chamber 118 in the lower case 116b and is separated from the gear chamber 118 by a partition member 220. The partition member 220 has a shaft hole 221 that is connected to the pump chamber 203 and the gear chamber 118.

[0039] The water pump 210 is a non-volumetric pump having an impeller 211 and a pump shaft 212 that rotates together with the impeller 211, as shown in FIG. 4. In this embodiment, a centrifugal pump is exemplified as the water pump 210.

[0040] The impeller 211 is a rotating body having a plurality of blades and is located inside the pump chamber 203. The pump shaft 212 is a rod-shaped member and extends in a front-rear direction. The pump shaft 212 is inserted into the shaft hole 221 and is supported by the partition member 220 in a rotatable manner via a bearing 213. The rotation axis Apn of the pump shaft 212 coincides with the rotation axis Apr of the propeller shaft 140. The front end of the pump shaft 212 is located inside the pump chamber 203, where the impeller 211 is mounted. In other words, the water pump 210 (specifically, the pump shaft 212 and impeller 211) is located on the rotation axis Apr of the propeller shaft 140. As the pump shaft 212 rotates around the rotation axis Apn, the impeller 211 also rotates. The rear end of the pump shaft 212 is located inside the gear chamber 118.

[0041] Inside the shaft hole 221, as shown in FIG. 4, a plurality of seal members 230 are arranged on the outer surface of the pump shaft 212 to fill the gap between the inner surface of the shaft hole 221 and the pump shaft 212. Each seal member 230 is circular in shape, is composed of a material such as rubber having rubber elasticity, and encircles the pump shaft 212 all the way around. The plurality of seal members 230 are arranged in line along the rotation axis Apn of the pump shaft 212. These seal members 230 prevent cooling water flowing into the pump chamber 203 from entering the gear chamber 118 through the gap between the inner circumferential surface of the shaft hole 221 and the pump shaft 212.

[0042] The portion of the cooling water flow path 200 from the intake port 201 to the water pump 210, i.e., the portion located between the intake port 201 and the pump chamber 203 (inlet channel 204), is located in front of the water pump 210 and extends along the rotation axis Apn of the pump shaft 212, as shown in FIG. 4.

[0043] As shown in FIG. 5, one portion of the inlet channel 204 adjacent to the intake port 201 (enlarged-diameter channel 205) has a larger inner diameter than the remaining portion adjacent to the pump chamber 203 (constant-diameter channel 206). On the inner surface of a member (e.g., a pipe) constituting the inlet channel 204, a first stepped surface 207 is provided, which connects the inner surface of the enlarged-diameter channel 205 to the inner surface of the constant-diameter channel 206. The first stepped surface 207 is arranged to face toward the intake port 201 and is perpendicular to the rotation axis Apn of the pump shaft 212. A threaded

groove for fixing the inlet 310 is formed on the inner surface of the constant-diameter channel 206.

[0044] The first gear mechanism 180 is a mechanism for transmitting the rotation of the drive shaft 130 to the propeller shaft 140, and the second gear mechanism 190 is a mechanism for transmitting the rotation of the drive shaft 130 to the pump shaft 212. The first gear mechanism 180 and the second gear mechanism 190 have different gear ratios.

[0045] The first gear mechanism 180 has a first gear 181 and a second gear 182, as shown in FIG. 4. The first gear 181 is coaxially mounted to the main shaft 131 of the drive shaft 130 (more specifically, the reduced-diameter shaft 131B) and rotates together with the drive shaft 130. The second gear 182 is coaxially mounted to the propeller shaft 140 and rotates together with the propeller shaft 140. The second gear 182 meshes with the first gear 181. The first gear 181 and the second gear 182 are, e.g., bevel gears.

[0046] The second gear mechanism 190 has a third gear 191 and a fourth gear 192, as shown in FIG. 4. The third gear 191 is a gear that is coaxially mounted to the extension shaft 132 of the drive shaft 130 and rotates together with the drive shaft 130. The third gear 191 has a smaller outer diameter than the first gear 181 and is located farther from the electric motor 120 than the first gear 181. The fourth gear 192 is coaxially mounted to the pump shaft 212 and rotates together with the pump shaft 212. The fourth gear 192 meshes with the third gear 191. The third gear 191 and the fourth gear 192 are, e.g., bevel gears.

[0047] The first gear mechanism 180 and the second gear mechanism 190 are located inside the gear chamber 118. The four gears 181, 182, 191, and 192 are lubricated by oil provided inside the gear chamber 118.

[0048] The inlet 310 is a member that is located inside the inlet channel 204 and prevents foreign objects contained in the cooling water taken from the intake port 201 from entering the cooling water flow path 200 and has a filter plate 311 and a mounting cylinder 315, as shown in FIGS. 5 and 6.

[0049] The filter plate 311 is disc-shaped and has a number of passage holes 312. The passage holes 312 are holes that penetrate from one side to the other and allow the passage of cooling water. The size of each passage hole 312 is sufficient to allow the cooling water to pass smoothly but to prevent the entering of foreign objects of a size that could clog the cooling water flow path 200, such as algae or pebbles, e.g., a hole having an inner diameter of 2.5 mm.

[0050] The mounting cylinder 315 is a cylindrical portion extending from one side of the filter plate 311 (right side of FIG. 5) and has an outer diameter smaller than the outer diameter of the filter plate 311. The outer surface of the mounting cylinder 315 has threads corresponding to the grooves threaded on the inner surface of the constant-diameter channel 206.

[0051] A circular attachment/detachment ring 313 arranged along the outer circumferential edge protrudes from the other side of the filter plate 311 (left side of FIG. 5). The recess defined by the attachment/detachment ring 313 and filter plate 311 has a hexagonal inner circumferential edge and is an attachment/detachment recess 314 that fits a hexagonal wrench.

[0052] When the inlet 310 is located within the inlet channel 204, the filter plate 311 is disposed near the intake port 201 and perpendicular to the rotation axis Apn of the pump shaft 212 to separate the interior space of the inlet channel 204 from the exterior space. The outer circumferential edge of the filter plate 311 abuts the first stepped surface 207 to position the inlet 310. The mounting cylinder 315 is located on the rotation axis Apn of the pump shaft 212. Cooling water flows into the pump chamber 203 through the passage hole 312 and the interior of the mounting cylinder 315. By turning the inlet 310 around the rotation axis Apn using a hexagonal wrench, the inlet 310 can be attached to or removed from the pipe constituting the inlet channel 204.

[0053] Since the inlet 310 of this embodiment is made of resin, adhesion of the inlet 310 to the pipe constituting the inlet channel 204 due to corrosion can be suppressed compared to the case where the inlet 310 is made of metal. Examples of the material for the inlet 310 may include nylon and polyacetal.

[0054] The suspension device 150 is a device for suspending the outboard motor main body 110 on the hull 10. The suspension device 150 includes a pair of left and right clamp brackets 152, a tilt shaft 160, and a connection bracket 156, as shown in FIG. 2.

[0055] The pair of left and right clamp brackets 152 are disposed behind the hull 10 in a state separated from each other in the left-right direction and are fixed to the transom 14 of the hull 10 by using, e.g., bolts. Each clamp bracket 152 has a cylindrical supporting portion 152a provided with a through-hole extending in the left-right directions.

[0056] The tilt shaft 160 is a rod-shaped member. The tilt shaft 160 is rotatably supported in the through-hole of the supporting portion 152a of the clamp bracket 152. The tilt axis At, which is the center line of the tilt shaft 160, constitutes an axis in the horizontal direction (left-right direction) in the tilting action of the outboard motor 100.

[0057] The connection bracket 156 is disposed so as to be sandwiched between the pair of clamp brackets 152 and is supported by the supporting portion 152a of the clamp bracket 152 via the tilt shaft 160 in such a manner that the connection bracket 156 can rotate around the tilt axis At. The connection bracket 156 is fixed to the outboard motor main body 110. The connection bracket 156 is rotationally driven around the tilt axis At with respect to the clamp bracket 152 by a tilt device (not shown) including an actuator such as, e.g., a hydraulic cylinder.

[0058] When the connection bracket 156 rotates about the tilt axis At with respect to the clamp bracket 152, the

outboard motor main body 110 fixed to the connection bracket 156 also rotates about the tilt axis At. This achieves the tilting action of rotating the outboard motor main body 110 in the upper-lower direction with respect to the hull 10. By this tilting action, the outboard motor 100 can change the angle around the tilt axis At of the outboard motor main body 110 in the range from the tilt-down state in which the propeller 141 is located under the waterline (the state in which the outboard motor 100 is in the reference attitude: the state shown in FIG. 1) to the tilt-up state in which the propeller 141 is above the waterline. Trimming action to adjust the attitude of the boat 1 during cruising can also be performed by adjusting the angle around the tilt axis At of the outboard motor main body 110.

[0059] When the boat 1 is cruising, the outboard motor 100 is placed in the tilt-down state, and the lower case 116b and the propeller 141 are positioned below the waterline. The intake port 201, inlet channel 204, pump chamber 203, and water pump 210 located inside the lower case 116b are also below the waterline, and cooling water flows into the pump chamber 203 from outside through the intake port 201 and inlet channel 204. At this time, the inlet 310, which is located in the inlet channel 204, prevents the entering of foreign objects of a size that could clog the cooling water flow path 200, such as algae and pebbles.

[0060] When the electric motor 120 is driven, the drive shaft 130 rotates around the rotation axis Ad by the rotational driving force of the electric motor 120.

[0061] The rotation of the drive shaft 130 is transmitted to the propeller shaft 140 via the first gear mechanism 180. When the first gear mechanism 180 transmits the forward rotation of the drive shaft 130 to the propeller shaft 140, the propeller 141 rotating together with the propeller shaft 140 generates thrust in the forward direction. When the first gear mechanism 180 transmits the reverse rotation of the drive shaft 130 to the propeller shaft 140, the propeller 141 rotating together with the propeller shaft 140 generates thrust in the rearward direction.

[0062] The rotation of the drive shaft 130 is transmitted to the pump shaft 212 via the second gear mechanism 190, and the impeller 211 rotates together with the pump shaft 212. Cooling water taken in from the intake port 201 is pumped through the cooling water flow path 200 by centrifugal force generated by the rotation of the impeller 211, and is supplied around the electric motor 120 to cool the electric motor 120. In addition to the electric motor 120, the cooling water may also cool the battery, inverter, and reduction gears, among others, located inside the outboard motor main body 110. After being used for cooling, the cooling water is discharged to the outside through the drain port 202.

[0063] The intake port 201 and the inlet channel 204 are located on the rotation axis Apn of the pump shaft 212 and in front (bow side) of the water pump 210, so that when the boat 1 moves forward, the cooling water flows through the intake port 201 and the inlet channel 204 from the front to the impeller 211. This allows the cooling water to be pumped efficiently, especially when the boat 1 is moving forward. In this configuration, there is concern that foreign objects contained in the cooling water may also flow in with great force and collide with the impeller 211. To suppress this, the inlet 310 is arranged in the inlet channel 204 in this configuration. The inlet 310 prevents foreign objects from entering the cooling water flow path 200 and suppresses damage to the impeller 211.

[0064] As the drive shaft 130 rotates in both the forward and reverse directions, the pump shaft 212 also rotates around the rotation axis Apn in both the direction of rotation associated with the forward direction of the drive shaft 130 and the direction of rotation associated with the reverse direction of the drive shaft 130; the water pump 210, which is a non-volumetric pump with no restriction on the direction of rotation, operates normally no matter which direction the drive shaft 130 rotates.

[0065] As described above, the outboard motor 100 of this embodiment is an outboard motor 100 to be mounted on the hull 10 and includes a cooling water flow path 200 having an intake port 201 for taking in cooling water from the outside and through which cooling water flows; and a water pump 210 including an impeller 211 and a pump shaft 212 rotating together with the impeller 211 to pump the cooling water into the cooling water flow path 200, wherein the inlet channel 204 of the cooling water flow path 200 from the intake port 201 to the water pump 210 is located in front of the water pump 210 and extends along the rotation axis Apn of the pump shaft 212, and the inlet 310 that allows the passage of the cooling water and inhibits entry of foreign objects is placed inside the inlet channel 204.

[0066] According to the above configuration, the cooling water taken from outside flows from the front to the impeller 211 attached to the pump shaft 212 so that the cooling water can be pumped efficiently. This configuration also suppresses damage to the water pump 210 caused by foreign objects colliding with the water pump 210.

[0067] The outboard motor 100 further includes the electric motor 120, the drive shaft 130 rotationally driven by the electric motor 120, the propeller 141, and the propeller shaft 140 rotating together with the propeller 141. The drive shaft 130 is capable of rotating in both the forward direction and the reverse direction, which is opposite to the forward direction, and the water pump 210 is a non-volumetric pump.

[0068] According to this configuration, the drive shaft 130, which can rotate in both forward and reverse directions, eliminates the need for a clutch mechanism such as a dog clutch, thereby providing a relatively large space around the propeller shaft 140. This space can be used to accommodate the water pump 210, avoiding increasing the size of the outboard motor 100 and optimizing the arrangement of the components necessary to transport

cooling water. In addition, since the non-volumetric water pump 210 has no restrictions on the direction of rotation, it is suitable as a pump, the rotation of which is transmitted from the drive shaft 130 that can rotate in both forward and reverse directions.

[0069] In addition, the water pump 210 is located on the rotation axis Apr of the propeller shaft 140.

[0070] This configuration allows the water pump 210 to be positioned without protruding sideways from the rotation axis Apr of the propeller shaft 140, thereby avoiding a reduction in the propulsive force of the hull 10.

[0071] In addition, since the inlet 310 is made of resin, compared to the case where the inlet 310 is made of metal, adhesion of the inlet 310 to the member constituting the inlet channel 204 due to corrosion can be suppressed.

[0072] Embodiment 2 will now be explained with reference to FIGS. 7 and 8. In this embodiment, the material and shape of the inlet 320 (an example of the filter member) are different from those of Embodiment 1. In this embodiment, the same configuration as in Embodiment 1 will be marked with the same symbol, and the explanation will be omitted.

[0073] The inlet 320 is a member that is located inside the inlet channel 204 and prevents foreign objects contained in the cooling water taken from intake port 201 from entering the cooling water flow path 200, as in Embodiment 1. The inlet 320 has a filter plate 321 and a mounting cylinder 315.

[0074] The filter plate 321 is disc-shaped with an outer diameter larger than that of the mounting cylinder 315 and has a number of passage holes 322. The passage holes 322 are holes that penetrate from one side of the filter plate 321 to the other side and allow the passage of cooling water. At the center position of the filter plate 311, there is an attachment/detachment hole 323 with a hexagonal inner circumferential edge that fits a hexagonal wrench. As in Embodiment 1, the mounting cylinder 315 is a cylindrical portion extending from one side of the filter plate 311 (right side in FIG. 7) and having threads formed on the outer surface.

[0075] When the inlet 320 is attached to the inside of the inlet channel 204, as in Embodiment 1, the filter plate 321 is disposed near the intake port 201 and perpendicular to the rotation axis Apn of the pump shaft 212 to separate the interior space of the inlet channel 204 from the exterior space. The outer circumferential edge of the filter plate 321 abuts the first stepped surface 207 to position the inlet 320. The cooling water can flow into the interior of the pump chamber 203 through the passage hole 322 and the mounting cylinder 315. The mounting cylinder 315 is located on the rotation axis Apn of the pump shaft 212. By turning the inlet 320 around the rotation axis Apn using a hexagonal wrench, the inlet 320 can be attached to or removed from the pipe constituting the inlet channel 204.

[0076] Since the inlet 320 of this embodiment is made of glass fiber reinforced plastic, adhesion of the inlet 320 to the pipe constituting the inlet channel 204 due to corrosion can be suppressed compared to the case where the inlet 320 is made of metal. In addition, since the glass fiber reinforced plastic is stronger than resin that does not contain glass fibers, the inlet 320 can be suppressed from being damaged by collisions with foreign objects while cruising, collisions with a shore while anchoring, and the like.

[0077] Next, Embodiment 3 will be described with reference to FIGS. 9 and 10. This embodiment differs from Embodiment 1 in that inlet 330 (an example of the filter member) is composed of two members, a filter body 340 and a holding member 350. In this embodiment, the same configuration as in Embodiment 1 will be marked with the same symbol, and the explanation will be omitted.

[0078] The inlet 330 is a member that is located inside the inlet channel 204 and prevents foreign objects contained in the cooling water taken from intake port 201 from entering the cooling water flow path 200, as in Embodiment 1. The inlet 330 has a filter body 340 and a holding member 350 that holds the filter body 340 and is fixed to the interior of the inlet channel 204.

[0079] The filter body 340 is a metal plate having a hexagonal outline and a curved shape that matches the curved shape of the front end surface of the lower case 116b. The filter body 340 has a number of passage holes 341. The passage holes 341 are holes that penetrate the filter body 340 from one surface to the other surface and allow the passage of cooling water. Two parallel sides of the six sides constituting the outer circumference of the filter body 340 respectively have a locking projection 343 projecting therefrom. On the inner surface of one passage hole 341A located at the center of the filter body 340, two attachment/detachment grooves 342 are provided, which are recessed outwardly. The two attachment/detachment grooves 342 are arranged to face each other.

[0080] The holding member 350 is made of resin, is cylindrical in shape as a whole, and has through holes 351 open at both ends. At one end of the holding member 350, an outwardly protruding flange 352 is provided. The outer surface of the holding member 350 has threads corresponding to the grooves threaded on the inner surface of the constant-diameter channel 206, except for the portion where the flange 352 is provided.

[0081] A portion of the through hole 351 on the flange 352 side has a hexagonal inner circumferential edge and is a filter receiving hole 351A for receiving the filter body 340. Two parallel sides of the six sides constituting the inner circumferential edge of the filter receiving hole 351A are respectively provided with a locking groove 353 which is recessed outwardly to receive the locking projection 343.

[0082] When the inlet 330 is attached to the inside of the inlet channel 204, the holding member 350 is disposed on the rotation axis Apn of the pump shaft 212. The filter body 340 is disposed near the intake port 201 and perpendicular to the rotation axis Apn of the pump

shaft 212 to separate the interior space of the inlet channel 204 from the exterior space. The flange 352 abuts the first stepped surface 207 to position the inlet 330. The cooling water can flow into the interior of the pump chamber 203 through the passage holes 341 and the through hole 351.

[0083] The inlet 330 is attached to the interior of the inlet channel 204 by first inserting a hexagonal wrench into the filter receiving hole 351A to rotate the holding member 350 around the rotation axis Apn, thereby screwing the holding member 350 to the pipe constituting the inlet channel 204. Next, the filter body 340 is fitted into the interior of the filter receiving hole 351A. The filter body 340 is secured to the interior of the filter receiving hole 351A by the locking projection 343 inserted into the locking groove 353.

[0084] The inlet 330 is detached from the inlet channel 204 by first inserting a removal jig into the interior of the attachment/detachment groove 342, hooking the jig onto the filter body 340 and then pulling the jig to pull the filter body 340 out of the filter receiving hole 351A. Next, the holding member 350 is removed from the pipe constituting the inlet channel 204 by inserting a hexagonal wrench inside the filter receiving hole 351A and rotating the holding member 350 around the rotation axis Apn.

[0085] Since the holding member 350 of the inlet 330 that contacts the pipe constituting the inlet channel 204 is made of resin, adhesion of the holding member 350 to the pipe due to corrosion can be suppressed compared to the case where the holding member 350 is made of metal. Examples of the material for the holding member 350 may include nylon and polyacetal. In addition, since the filter body 340 is made of metal, the filter body 340 can be made stronger compared to the case where the whole of the inlet is made of resin, and thus the filter body 340 can be suppressed from being damaged by collisions with foreign objects while cruising, collisions with a shore while anchoring, and the like. The material of the filter body 340 is preferably a metal that is resistant to corrosion, e.g., aluminum, which forms an oxide film on its surface, is suitable.

(1) In the above embodiment, as an example, the electric outboard motor 100 is driven by the electric motor 120, but the drive unit of the outboard motor does not have to be an electric motor and may be, e.g., an internal combustion engine.

(2) In the above embodiment, the drive shaft 130 is rotatable in both forward and reverse directions according to the rotational drive direction of the electric motor 120, but the outboard motor may include an internal combustion engine as a drive unit and a shift mechanism for switching the rotational direction of the drive shaft.

(3) In the above embodiment, circular holes are illustrated as the passage holes 312, 322, and 341, but the shape of the passage holes is freely selectable, e.g., the shape may be polygonal.

(4) In the above embodiment, the inlets 310, 320, and 330 have threads and are screwed to the pipe constituting the inlet channel 204, but the method of mounting the filter member inside the inlet channel is freely selectable and may be, e.g., by a bolt and nut.

(5) In the above embodiment, the inlets 310 and 320 are made of resin and glass fiber reinforced plastic, respectively, but the material of the filter member is freely selectable and may be, e.g., metal.

Claims

1. A boat propulsion device configured to be provided on a hull (10), the boat propulsion device comprising:

   a cooling water flow path (200) having an intake port (201) for taking in cooling water from the outside and configured for cooling water to flow through; and
   a water pump (210) including an impeller (211) and a pump shaft (212) configured to rotate around a rotation axis (Apn) together with the impeller (211) to pump the cooling water into the cooling water flow path (200), wherein
   a filter member (310, 320, 330) that allows the passage of the cooling water and is configured to inhibit entry of foreign objects is placed at the intake port (201), and
   the filter member (310, 320, 330) is placed on a rotation axis (Apn) of the pump shaft (212).

2. The boat propulsion device according to claim 1, wherein an inlet channel (204) of the cooling water flow path (200) from the intake port (201) to the water pump (210) extends along the rotation axis (Apn) of the pump shaft (212), and
   the filter member (310, 320, 330) is placed inside the inlet channel (204).

3. The boat propulsion device according to claim 1 or 2, further comprising

   a propeller (141); and
   a propeller shaft (140) configured to rotate together with the propeller (141), wherein the water pump (210) is arranged between the intake port (201) and the propeller (141) with regard to the rotation axis (Apn) of the pump shaft (212).

4. The boat propulsion device according to claim 3, further comprising,

   a drive unit (120);
   a drive shaft (130) configured to be rotationally driven by the drive unit (120), wherein the drive shaft (130) is rotatable in both a first rotation

direction and a second rotation direction, which is opposite to the first rotation direction, and the water pump (210) is a non-volumetric pump.

5. The boat propulsion device according to claim 4, wherein the drive unit is an electric motor (120) configured to be driven by electric power supplied from a power source.

6. The boat propulsion device according to claim 4 or 5, wherein the water pump (210) is located on a rotation axis (Apr) of the propeller shaft (140).

7. The boat propulsion device according to any one of claims 1 to 6, wherein the water pump (210) is a centrifugal pump.

8. The boat propulsion device according to any one of claims 1 to 7, wherein the filter member (310) is made of resin.

9. The boat propulsion device according to any one of claims 1 to 7, wherein the filter member (320) is made of glass fiber reinforced plastic.

10. The boat propulsion device according to any one of claims 1 to 7, wherein the filter member (330) comprises:

a holding member (350) having a through hole (351) and fixed inside the inlet channel (204); and
a filter body (340) held inside the through hole (351) that allows the passage of the cooling water and is configured to inhibit entry of foreign objects, wherein
the holding member (350) is made of resin, and the filter body (340) is made of metal.

11. An outboard motor (100) configured to be mounted on a transom (14) positioned at a rear end of the hull (10), wherein the outboard motor (100) comprises a boat propulsion device according to any one of claims 1 to 10.

12.

13. A boat (1) having a hull (10) and an outboard motor (100) according to claim 11 attached to the transom (14) positioned at the rear end of the hull (10).

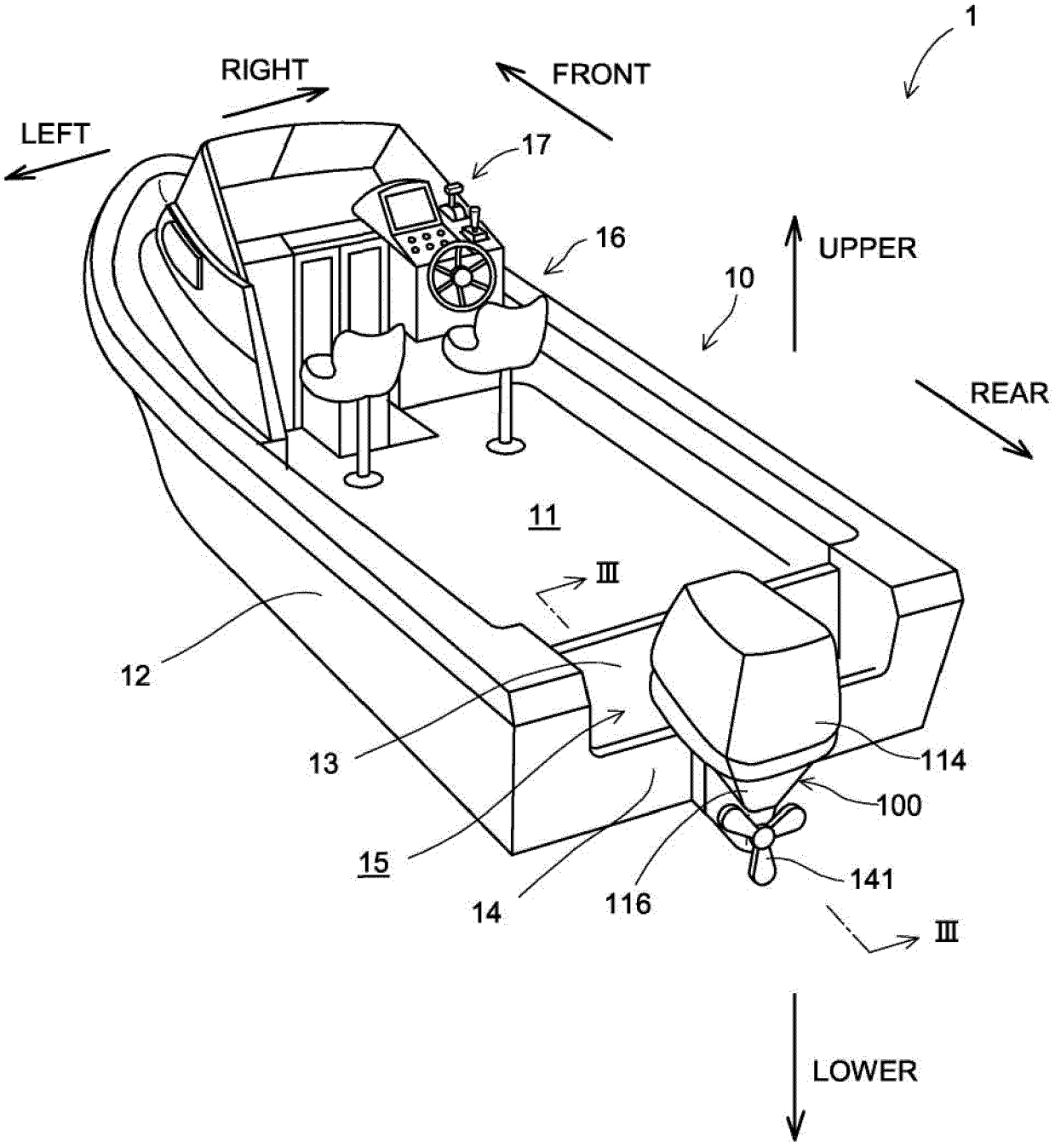
1
RIGHT
FRONT
LEFT
17
16
10
UPPER
REAR
11
III
12
13
114
100
15
14
116
141
III
LOWER

FIG.1

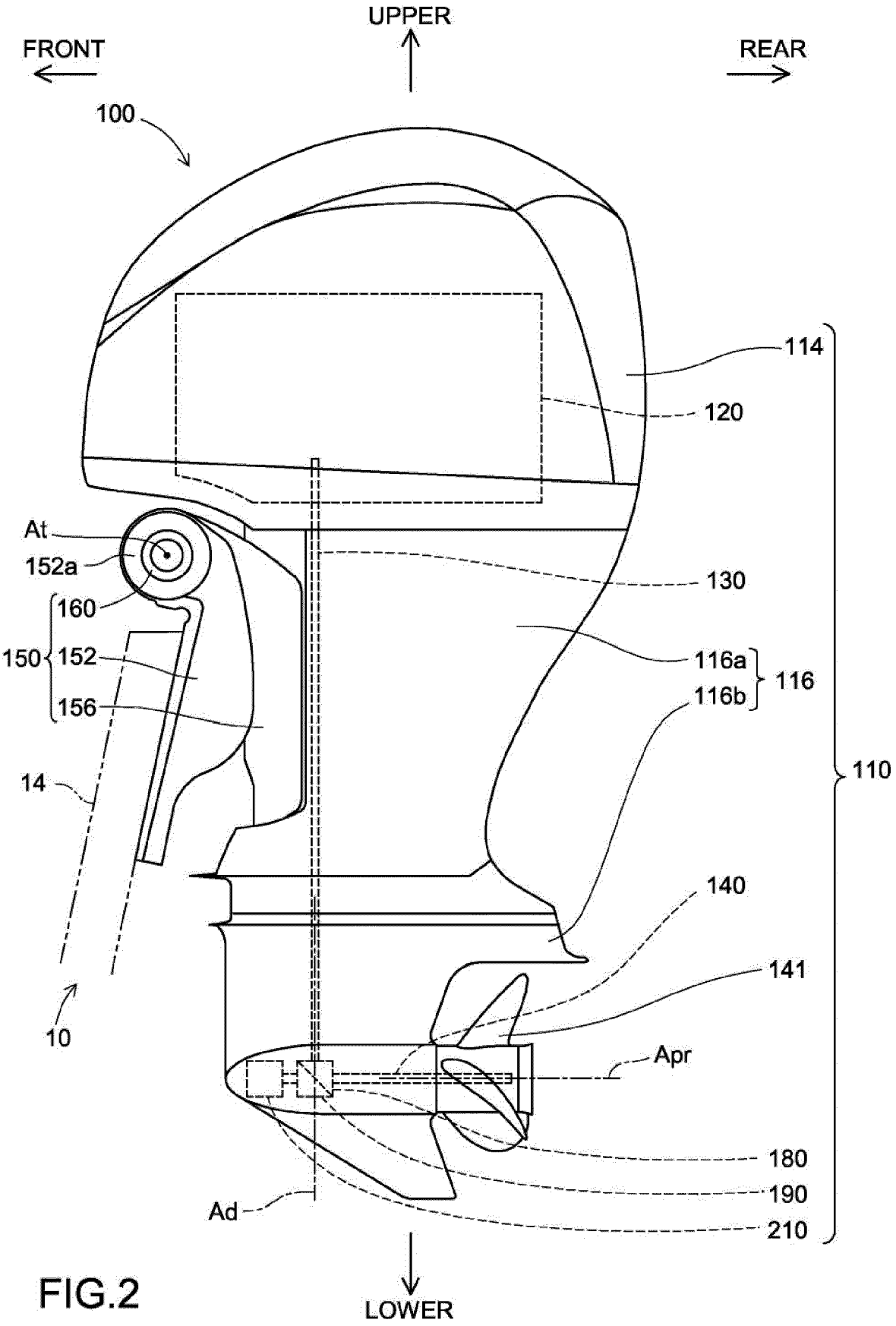
UPPER
FRONT
REAR
100
114
120
At
152a
130
160
150
152
116a
116
116b
156
110
14
140
141
10
Apr
180
190
Ad
210
LOWER

FIG.2

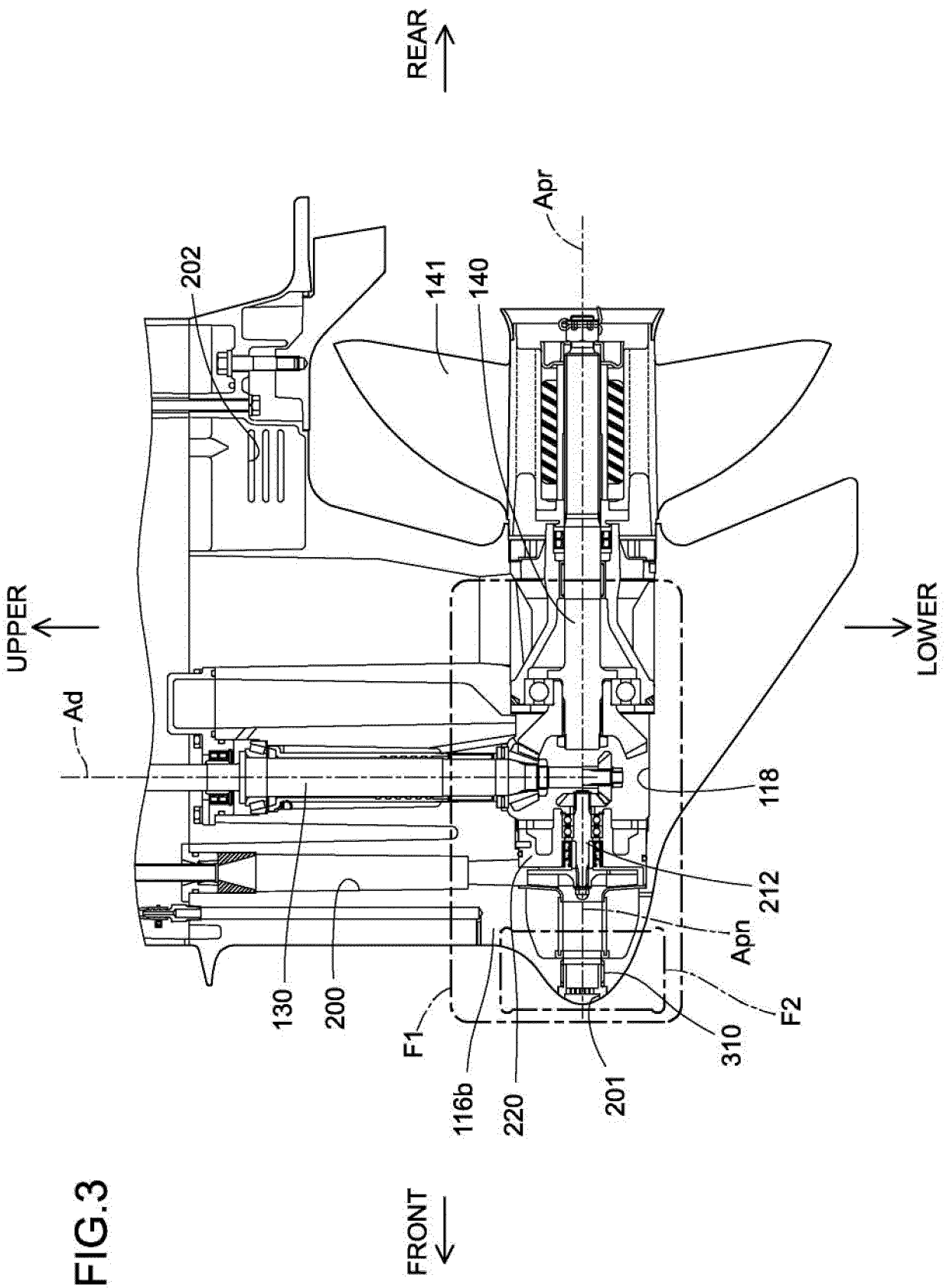
REAR
FRONT
UPPER
LOWER
Ad
Apr
Apn
202
141
140
130
200
F1
116b
220
201
310
F2
212
118

FIG.3

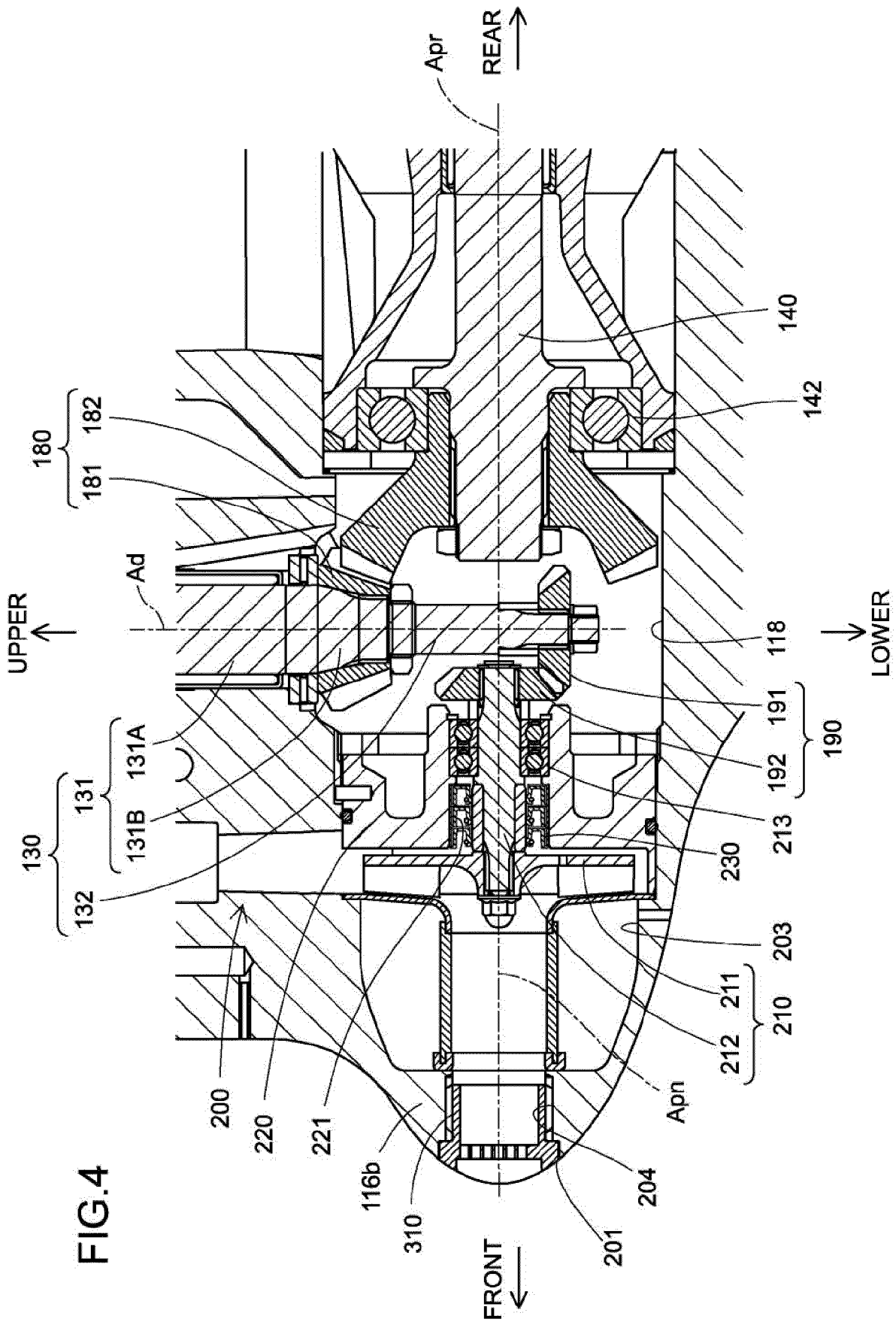
Apr
REAR
140
142
180
182
181
Ad
UPPER
LOWER
118
191
190
192
213
230
203
211
210
212
130
131
131A
131B
132
200
220
221
116b
310
Apn
204
201
FRONT

FIG.4

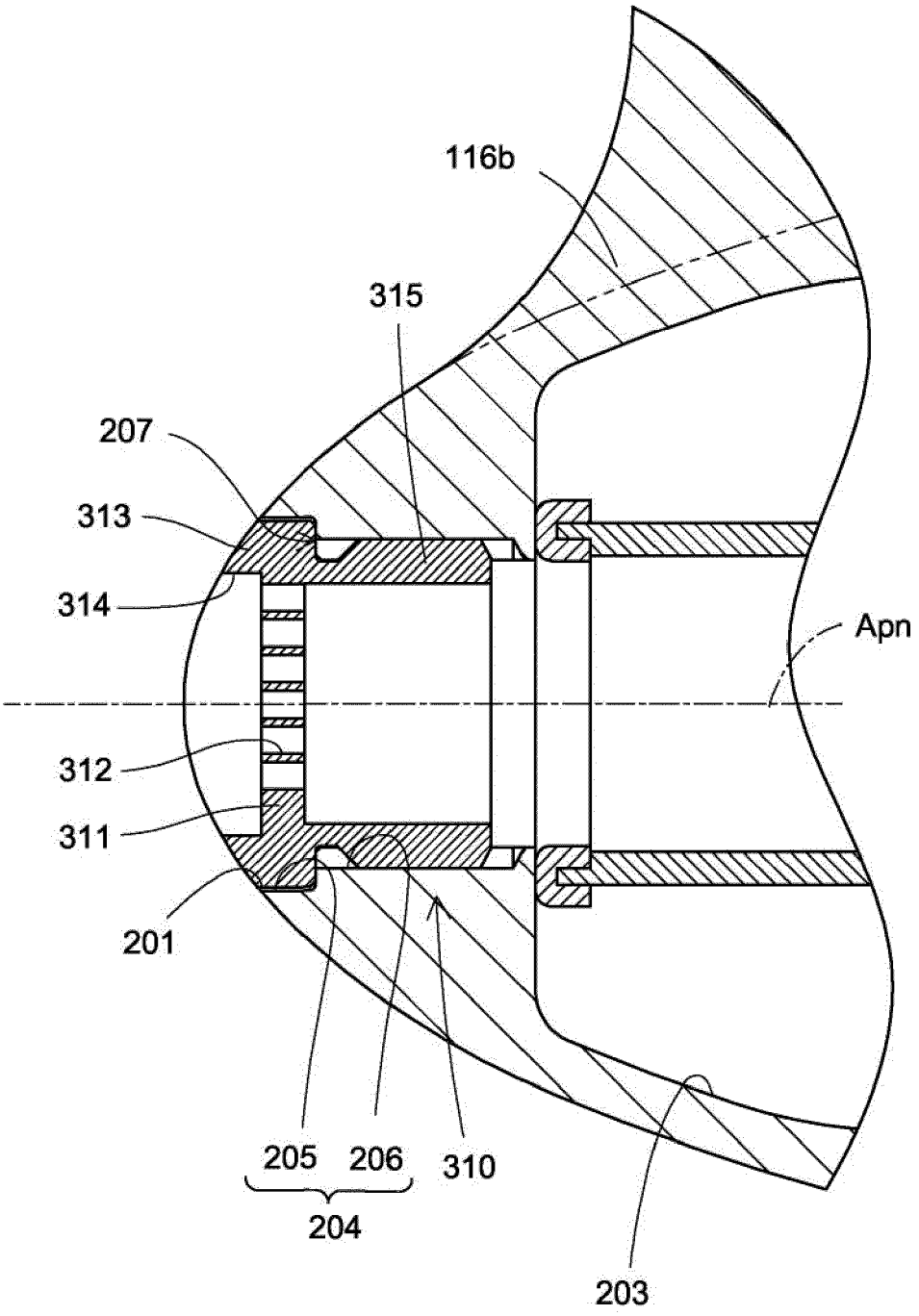

FIG.5

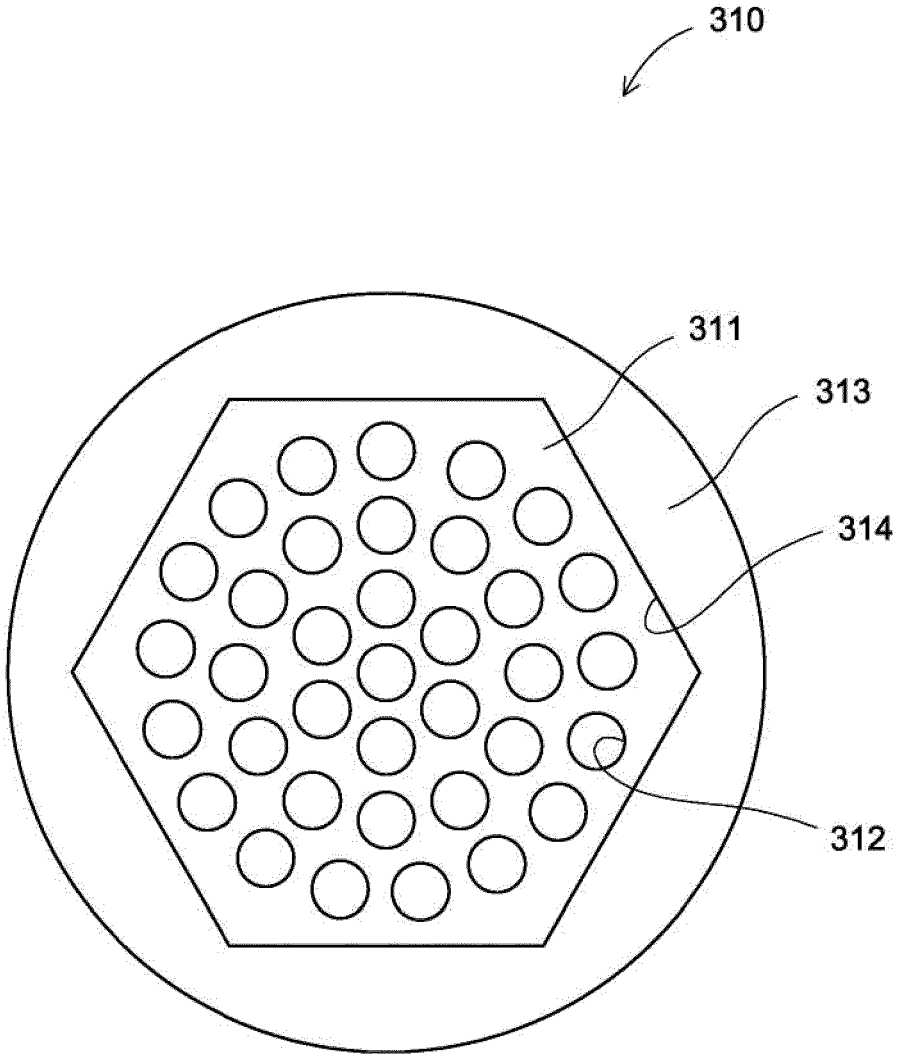

FIG.6

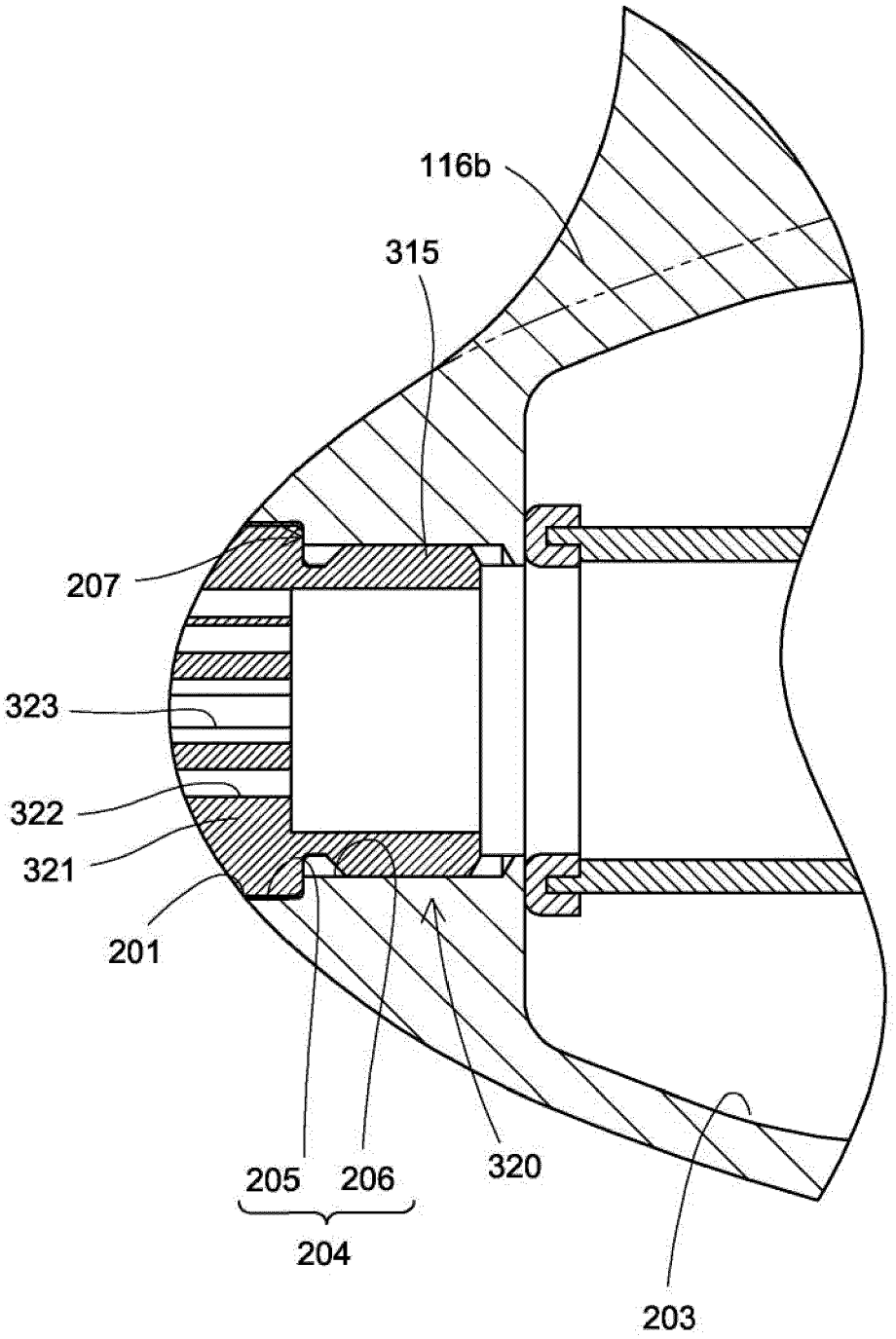

FIG.7

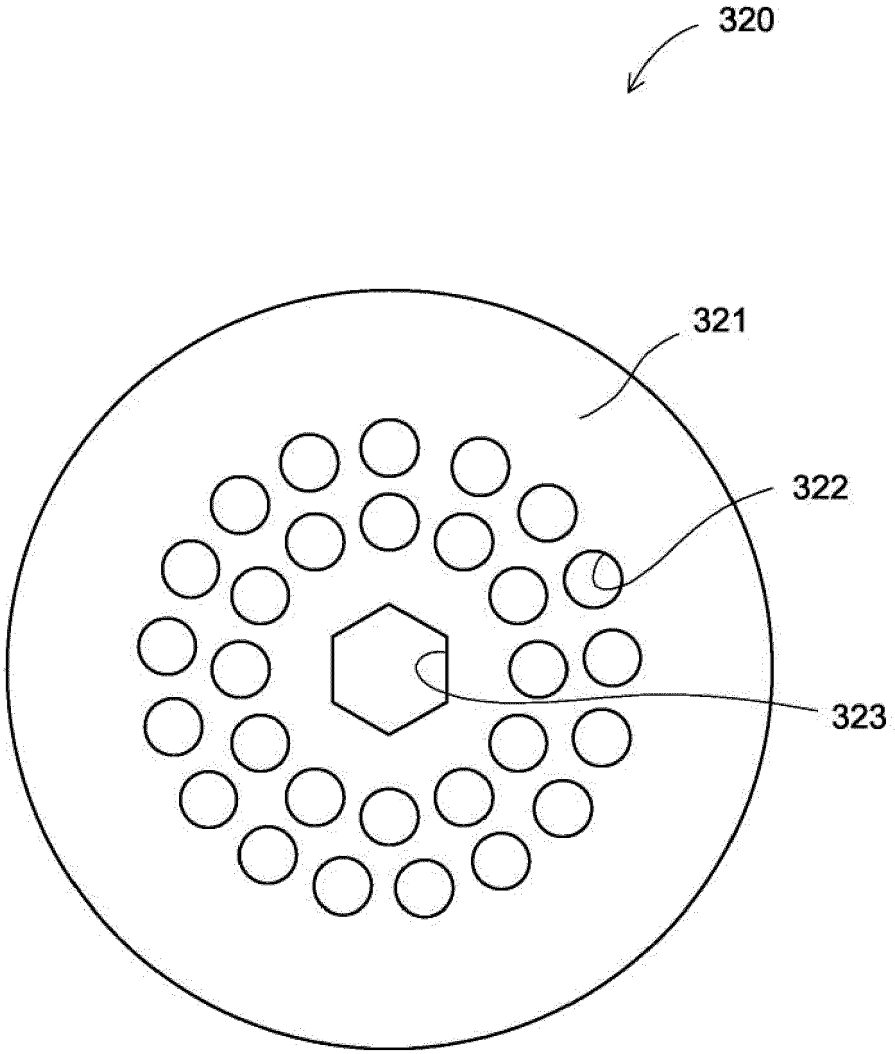

FIG.8

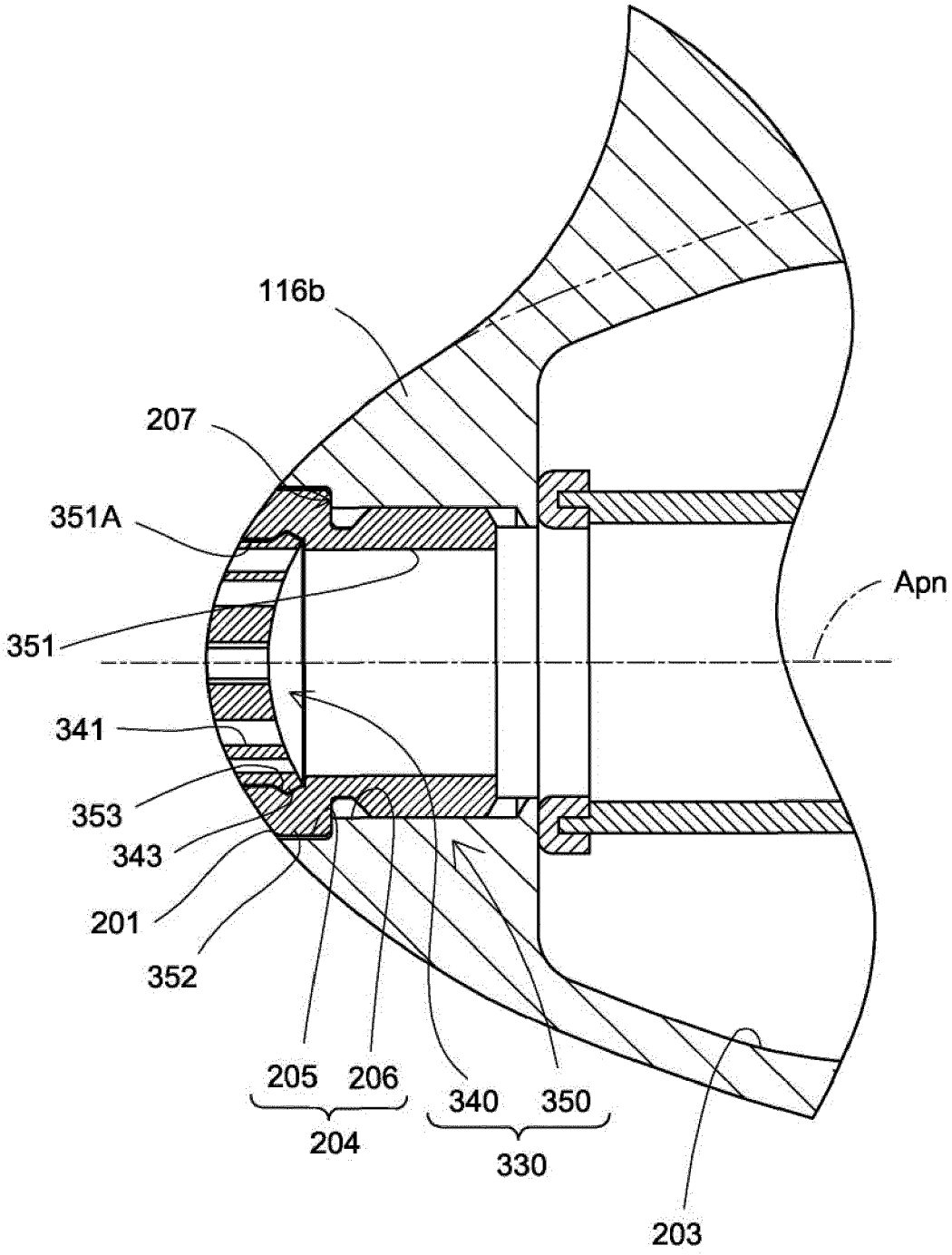
116b
207
351A
351
Apn
341
353
343
201
352
205
206
204
340
350
330
203

FIG.9

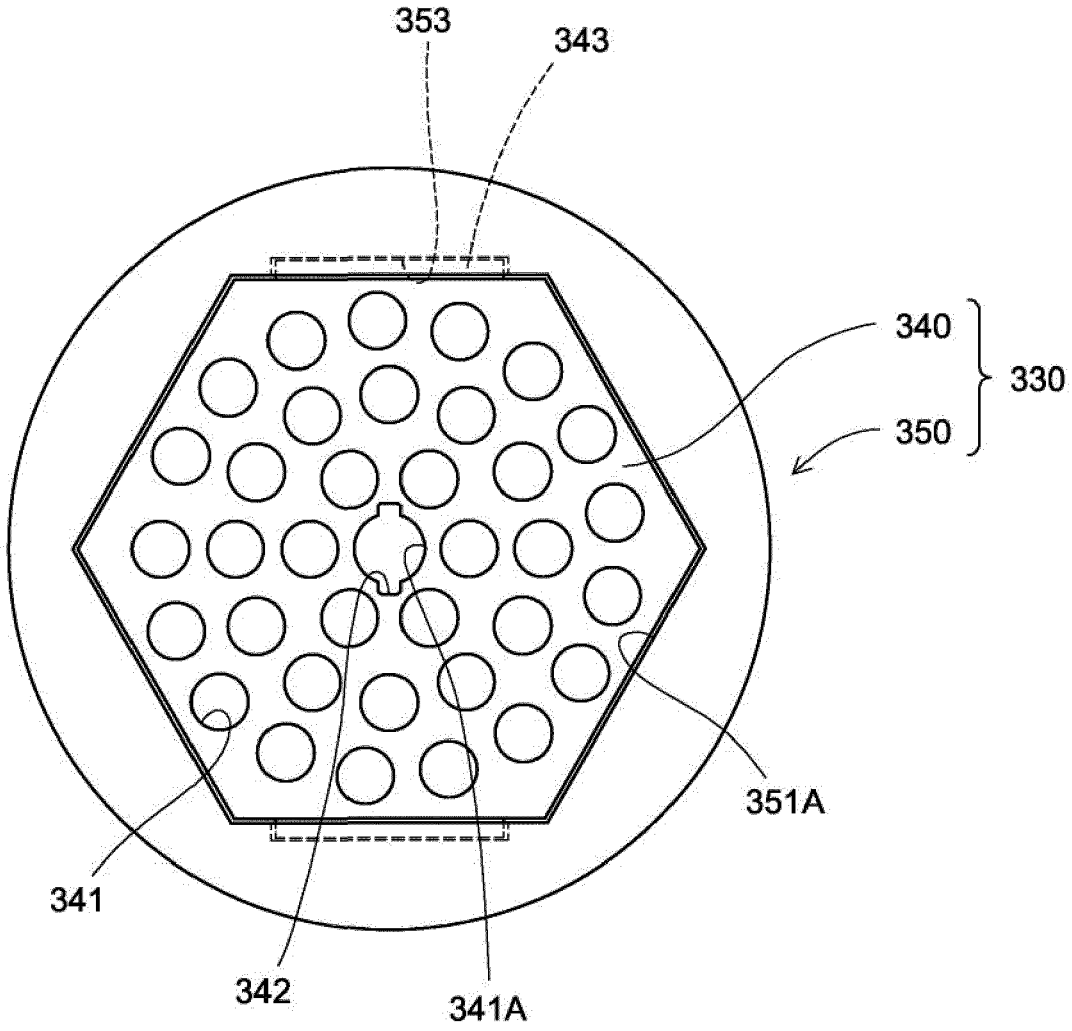

FIG.10

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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