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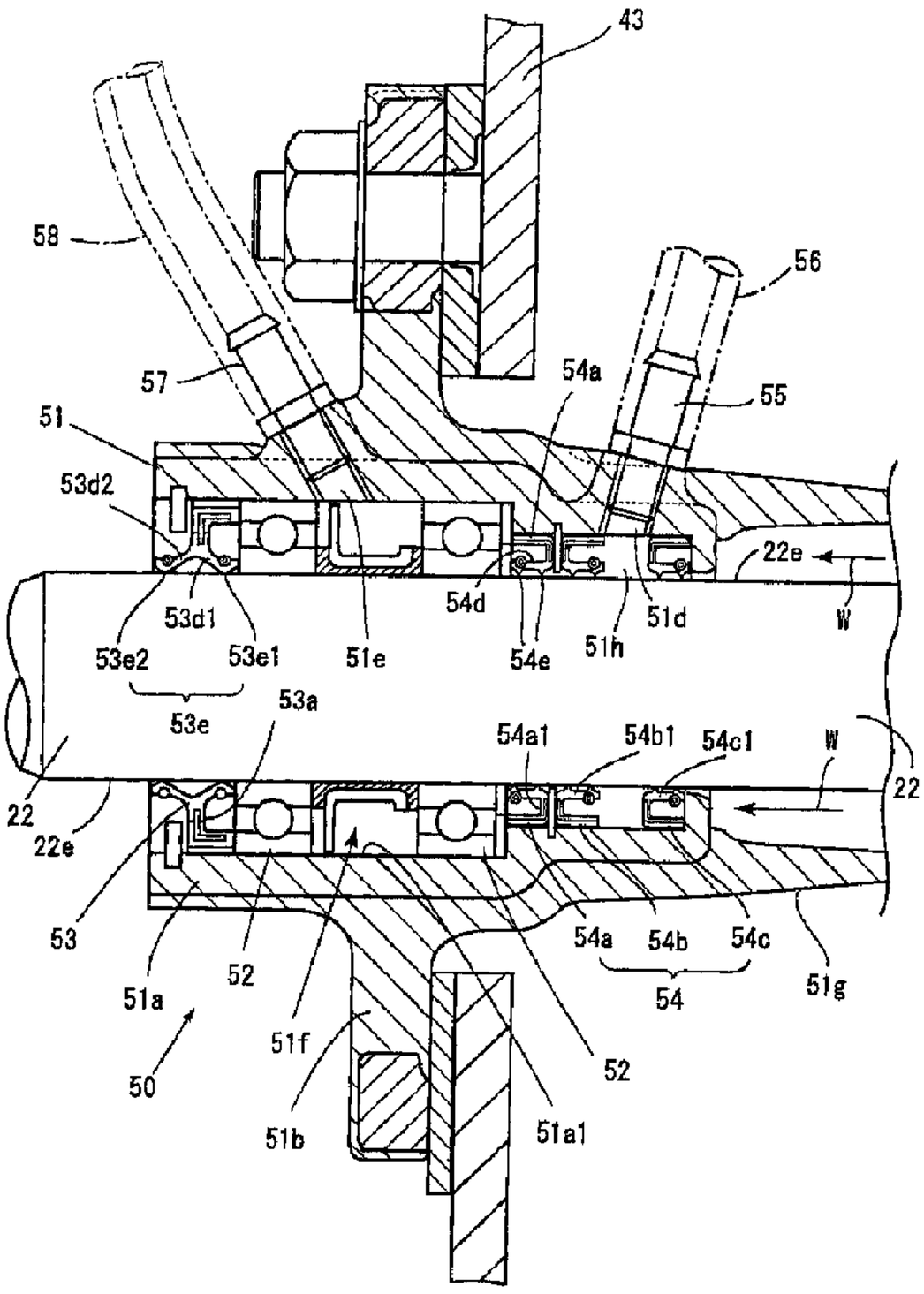
(54) Titre : PALIER D'ARBRE DE TRANSMISSION POUR VEHICULE MARIN
(54) Title: DRIVE SHAFT BEARING STRUCTURE FOR WATERCRAFT



(57) Abrégé/Abstract:
To unnecessitate maintenance of supplying grease to a drive shaft bearing portion, or at least to reduce the frequency of the maintenance. A bearing body 50 for rotatably supporting a drive shaft 22 for driving an impeller on a watercraft body comprises a

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(57) Abrégé(suite)/Abstract(continued):
bearing chamber 51f for containing bearing members 52, 52 rotatably supporting the drive shaft, and seal members 53, 54a disposed on both sides of the bearing members and partitioning the bearing chamber by making contact with the outside circumferential surface of the drive shaft, the seal members 53, 54a are so disposed that the grease in the bearing chamber 51f does not leak out through the contact portions between the seal members and the outside circumferential surface of the drive shaft, and a breather passage 58 is communicated with the bearing chamber. Two bearing members 52 are disposed at a spacing in the bearing chamber to form a grease reservoir between the bearing members.

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ABSTRACT OF THE DISCLOSURE

To unnecessitate maintenance of supplying grease to a drive shaft bearing portion, or at least to reduce the frequency of the maintenance. A bearing body 50 for rotatably supporting a drive shaft 22 for driving an impeller on a watercraft body comprises a bearing chamber 51f for containing bearing members 52, 52 rotatably supporting the drive shaft, and seal members 53, 54a disposed on both sides of the bearing members and partitioning the bearing chamber by making contact with the outside circumferential surface of the drive shaft, the seal members 53, 54a are so disposed that the grease in the bearing chamber 51f does not leak out through the contact portions between the seal members and the outside circumferential surface of the drive shaft, and a breather passage 58 is communicated with the bearing chamber. Two bearing members 52 are disposed at a spacing in the bearing chamber to form a grease reservoir between the bearing members.

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TITLE: Drive Shaft Bearing Structure for Watercraft

FIELD OF THE INVENTION

The present invention relates to a drive shaft bearing structure for watercraft.

BACKGROUND OF THE INVENTION

As a conventional drive shaft bearing structure for watercraft, there is known that which is shown in FIG. 7 (Japanese Patent Laid-open No. Hei 7-112697).

In the figure, numeral 1 denotes a drive shaft, a driven-side coupler 2 connected to a driving-side coupler of an engine not shown is fixed to the front end of the drive shaft 1, an impeller not shown is fixed to the rear end of the drive shaft 1, and power from the engine is transmitted to the impeller, whereby the impeller is rotationally driven.

The bearing structure includes a bearing body 4 for rotatably supporting the drive shaft 1 relative to a watercraft body 3.

The bearing body 4 includes a bearing member (in the structure shown, a ball bearing) 5 rotatably supporting the drive shaft 1, a bearing chamber 6 for containing the bearing member 5, and seal members 7, 7 disposed on both sides (front and rear sides in the axial direction) of the bearing member 5 and partitioning the bearing chamber 6 by making contact with the outside circumferential surface (in the structure shown, the outside circumferential surface of a sleeve 1' rotated together with the shaft 1) 1a of the drive shaft 1.

In such a bearing structure, generally, the bearing body 4 is mounted on the watercraft body 3 in the condition where the bearing chamber 6 is filled with grease. This is for smoothening the rotation of the bearing member 5.

In the condition where the bearing body 4 and the drive shaft 1 are mounted on the watercraft body 3,

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the seal members 7, 7 make contact with the outside circumferential surface 1a of the drive shaft 1 to partition the bearing chamber 6, as described above, so that the bearing chamber 6 is basically maintained airtight. Therefore, unless the drive shaft 1 is rotated (hence, the watercraft runs), basically, the grease charged in the bearing chamber 6 will not leak out of the bearing chamber 6 easily.

Actually, however, the drive shaft 1 is rotated by the driving of the engine, and the impeller is rotated to move the watercraft, so that the temperature inside the bearing chamber 6 is raised due to the rotation of the drive shaft 1 and the bearing member 5.

When the temperature in the bearing chamber 6 is raised, the grease or air in the bearing chamber 6 expands.

According to the conventional bearing structure as mentioned above, an end portion 7a of the seal member 7 is disposed toward the outside of the bearing chamber 6. Therefore, when the grease or air in the bearing chamber 6 expands over a predetermined level, the grease or air in the bearing chamber 6 leaks out to the exterior through a gap formed between the contact portion 7b for the outside circumferential surface 1a of the shaft 1 of the seal member 7 and the outside circumferential surface 1a of the shaft 1 due to deformation of the seal member 7 arising from the rise of the inside pressure in the bearing chamber 6.

Accordingly, even when the grease or air in the bearing chamber 6 expands, excessive deformation of the seal member 7 due to this expansion is obviated.

However, according to such a conventional bearing structure, there is the problem that the grease in the bearing chamber 6 leaks out of the bearing chamber 6 due to the temperature rise in the bearing chamber 6 and the attendant expansion of the grease and air in the bearing chamber 6.

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Generally, a watercraft repeats running and stopping, whereby rise and fall of the temperature in the bearing chamber 6 (and hence expansion and contraction of the grease or air in the bearing chamber 6) are repeated. When the temperature is lowered, air penetrates into the bearing chamber 6 through minute gaps, and when the temperature is raised, the air expands to push out the grease to the exterior of the bearing chamber 6. In the conventional bearing structure, therefore, there is the problem that the grease in the bearing chamber 6 is reduced in amount in a comparatively short time as the watercraft repeats running and stopping.

Accordingly, in the conventional bearing structure, it is necessary to charge the grease into the bearing chamber 6 at comparatively short interval, depending on the running situations of the watercraft. Thus, maintenance has been bothersome.

It is an object of the present invention to provide a drive shaft bearing structure for watercraft by which the above-mentioned problems are solved, and the above-mentioned maintenance is desirably unnecessitated or at least the frequency of such maintenance can be reduced.

SUMMARY OF THE INVENTION

In order to attain the above object, this present invention provides for a drive shaft bearing structure for watercraft including a bearing body for rotatably supporting a drive shaft for driving an impeller on a watercraft body, the bearing body including a bearing member rotatably supporting the drive shaft, a bearing chamber for containing the bearing member, and seal members disposed on both sides of the bearing member and partitioning the bearing chamber by making contact with the outside circumferential surface of the drive shaft, a breather passage is communicated with the bearing chamber.

In another aspect of the invention there is provided a drive shaft bearing structure for watercraft as set forth above, in a structure including a bearing body for rotatably supporting a drive shaft for driving an impeller on a watercraft body, the bearing body including a bearing member rotatably supporting the drive shaft, a bearing chamber for containing the bearing member, and seal members disposed on both sides of the bearing member and partitioning the bearing chamber by making contact with the outside circumferential surface of the drive shaft, the seal members are so disposed that a grease in the bearing chamber does not leak out through the contact portions between the seal members and the outside circumferential surface of the drive shaft, and a breather passage is communicated with the bearing chamber.

In another aspect of the invention there is provided a drive shaft bearing structure for watercraft as set forth above, wherein an end portion on the opposite side of the bearing chamber, of the breather passage, is opened into the inside of the watercraft body on the upper side of the bearing chamber.

In yet another aspect of the invention there is provided a drive shaft bearing structure for watercraft as set forth above, wherein the end portion on the opposite side of the bearing chamber, of the breather passage, is disposed on the upper side of a watercraft inside opening port of a duct for communication between the inside of the watercraft and the outside air.

In yet another aspect of the invention there is provided a drive shaft bearing structure for watercraft as set forth above, wherein at least a portion of the breather passage is formed of an extendable-contractable elastic member, and an end portion on the opposite side of the bearing chamber, of the breather passage, is closed.

In yet another aspect of the invention there is provided a drive shaft bearing structure for watercraft

as set forth above, wherein the breather passage includes a breather hose detachably fitted to the bearing body, and the grease can be poured into the bearing chamber by detaching the breather hose.

In yet another aspect of the invention there is provided a drive shaft bearing structure for watercraft as set forth above, wherein a plurality of the bearing members are disposed at a spacing or spacings in the bearing chamber, and a grease reservoir is formed between the bearing members

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are shown in the drawings, wherein:

FIG. 1 is a partially cutout general side view of one example of a personal watercraft using the first embodiment of a drive shaft bearing structure for watercraft according to the present invention.

FIG. 2 is a general plan view of the same.

FIG. 3 is a sectional view showing mainly a jet pump 30 and a bearing structure of a drive shaft 22.

FIG. 4 is a partial enlarged view of FIG. 3.

FIG. 5 is a partial enlarged view of FIG. 4.

FIG. 6 is a view showing the second embodiment of the drive shaft bearing structure for watercraft according to the present invention.

FIG. 7 is an illustration of the prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, a mode for carrying out the present invention will be described below referring to the drawings.

FIG. 1 is a partially cutout general side view showing one example of a small-type planing watercraft using a first embodiment of a drive shaft bearing

structure for watercraft according to the present invention, FIG. 2 is a general plan view of the same.

As shown in these figures (mainly FIG. 1), the small-type planing watercraft 10 is a saddle ride type small-type watercraft, a passenger is seated on a seat 12 on a watercraft body 11, and the watercraft can be operated by gripping a rudder handle 13 provided with a throttle lever.

The watercraft body 11 is a buoyancy structure in which a hull 14 and a deck 15 are jointed to each other to form a space 16 inside. In the inside of the space 16, an engine 20 is mounted on the hull 14, and a jet pump (jet propulsion pump) 30 as a propelling means driven by the engine 20 is provided at a rear portion of the hull 14.

The jet pump 30 (See FIG. 3) includes an impeller 32 disposed in a conduit 18 extending from a water intake port 17 opening at the bottom of the watercraft to a nozzle port 31c2 opening at the rear end of the watercraft body and a deflector 38, and a shaft (drive shaft) 22 for driving the impeller 32 is connected to an output shaft 21 (See FIGS. 1 and 4) of the engine 20 through a coupler 23 (a driving-side coupler 23a and a driven-side coupler 23b). Therefore, when the impeller 32 is rotationally driven by the engine 20 through the coupler 23 and the shaft 22, water taken in through the water intake port 17 is jetted from the nozzle port 31c2 through the deflector 38, whereby the watercraft body 11 is propelled. The driving rotational frequency of the engine 20, namely, the propulsion force of the jet pump 30 is operated by a turning operation of the throttle lever 13a (See FIG. 2) of the operating handle 13. The deflector 38 is connected to the operating handle 13 by an operating wire not shown, and is turned by the operation of the handle 13, whereby the course of the watercraft body 11 can be changed.

In FIG. 1, numeral 19 denotes a towing hook utilized at the time of towing an object to be towed (a

rubber watercraft or the like), which is fixed to a rear portion of the watercraft body 11.

FIG. 3 is a sectional view showing mainly the jet pump 30 and the bearing structure of the shaft 22, FIG. 4 is a partial enlarged view of FIG. 3, and FIG. 5 is further a partial enlarged view of FIG. 4.

As shown in FIG. 3, the jet pump 30 includes a duct 31 forming the conduit 18 communicated to the water intake port 17 provided at a bottom portion of the watercraft body 11, the impeller 32 disposed in the duct 31, a bearing portion 33 of the impeller provided in the duct 31, and a cap 34 for closing the rear end of the bearing portion 33.

The jet pump 30 is detachably fitted to the hull 14 by fixing a flange portion 31d formed at a front portion of the duct 31 to the hull 14 by bolts not shown.

The duct 31 includes an impeller containing portion 31a, a bearing containing portion 31b, and a nozzle portion 31c, in which the impeller containing portion 31a and the bearing containing portion 31b are formed as one body with each other. The bearing portion 33 is integrally formed in the bearing containing portion 31b through a stationary vane 31b1.

Of the impeller 32, a front portion of a boss portion 32a is engaged with a spline 22b formed at the rear end of the drive shaft 22, and the impeller 32 is rotated together with the drive shaft 22. The shaft 22 has its tip end portion 22a connected to the output shaft 21 of the engine 20 mounted on the watercraft body 11 through the coupler 23 (See FIG. 4).

On the other hand, a support shaft 35 for supporting a rear portion 32b of the boss portion 32a of the impeller 32 is rotatably supported on the bearing portion 33 through a ball bearing 33a. The support shaft 35 is provided at its tip with a male screw 35a, which is mated with a female screw formed at a boss portion rear portion 32b of the impeller 32, whereby the impeller 32 and the support shaft 35 are connected.

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Therefore, of the impeller 32, a front portion of the boss portion 32a is connected to the shaft 22, and the rear portion 32b of the boss portion is connected to the support shaft 35, so that the impeller 32 is rotated together with the shaft 22 and the support shaft 35.

A front portion of the cap 34 is provided with an insertion portion (tubular portion) 34b for insertion into a rear portion of the bearing portion 33, and is provided with three insertion holes 34c (only one of them is shown) for screws 36 (See FIG. 3). The tubular insertion portion 34b is provided with a fitting groove for an O-ring (not shown).

Therefore, of the cap 34, the O-ring is fitted into the insertion portion 34b, the insertion portion 34b is inserted (pressed) into a rear portion of the bearing portion 33 as shown in FIG. 3, and the cap 34 is fitted to the rear portion of the bearing portion 33 by the screws 36.

A surface for contact with the bearing portion 33 of the cap 34 is provided with a partial cutout 34d; at the time of maintenance, the screws 36 are removed, and the tip of a tool (for example, screw driver) is put into the cutout 34d, whereby the cap 34 can be easily detached.

A portion facing to the cap 34, of the inside circumferential surface of the nozzle portion 31c, is provided with a stationary vane 31c1 toward the cap 34.

A bilge pipe 37 for discharging bilge water present at the bottom of the watercraft is inserted in the nozzle portion 31c. The bilge pipe 37 is connected to a bilge pipe 60 in the watercraft body through conduits 31e, 31f provided at an upper portion of the duct 31 and a joint pipe 31g. The joint pipe 31g on the side of the jet pump 30 and the bilge pipe 60 are detachably connected to each other by pressing-in, and the bilge pipe 60 can be detached from the joint pipe 31g at the time of removing the jet pump 30 from the hull 14.

In addition, the above-mentioned deflector 38 is turnably fitted to a rear portion of the nozzle portion 31c.

As shown in FIGS. 3 to 5, a bearing cover 43 is fixed to the hull 14, and a bearing body 50 provided with a rubber damper as a bearing body is fixed to the bearing cover 43.

The bearing body 50 is for rotatably supporting an intermediate portion of the shaft 22 to the watercraft body 11.

The bearing body 50 includes a rubber-made main body 51 constituting a rubber damper portion, a plurality of bearing members (in the structure shown, two ball bearings) 52, 52 contained in the main body 51 and disposed at a spacing therebetween for rotatably supporting the shaft 22, a seal member 53 mounted on the engine side of the bearings 52, and a seal member 54 (in this embodiment, three seal members 54a, 54b, 54c as shown in FIG. 5) mounted on the jet pump 30 side (the conduit 18 side) of the bearings 52.

The main body 51 includes a tubular portion 51a, and a flange portion 51b integral with the tubular portion 51a, and the bearings 52, the seal members 53 and 54 are mounted in the tubular portion 51a.

As shown in FIG. 5, the seal members disposed on both sides of the bearings 52, namely, the seal member 53 disposed on the engine side and the seal member 54a disposed on the jet pump 30 side make contact with an outside circumferential surface 22e of the drive shaft 22, thereby partitioning a bearing chamber 51f for containing the bearing member 52. Namely, the bearing chamber 51f is formed as a space surrounded by an inside circumferential surface 51a1 of the tubular portion 51a, the outside circumferential surface 22e of the shaft 22, an inside surface 53a of the seal member 53, and an inside surface 54a1 of the seal member 54a. Besides, the space (51f) forms a grease reservoir between the bearings 52, 52.

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The seal members 53, 54a disposed on both sides of the bearing 52 are so disposed that grease (not shown) in the bearing chamber 51f does not leak through contact portions 53e, 54e of these seal members and the outside circumferential surface 22e of the drive shaft 22.

In this embodiment, the seal member 53 is a ring-shaped seal member roughly Y-shaped in cross section, and includes ring pieces 53d1, 53d2 bifurcated in cross section, and two ring-shaped edge line portions 53e1, 53e2; the edge line portions 53e1, 53e2 make contact with the outside circumferential surface 22e of the shaft 22, and one ring piece 53d1 of the ring pieces 53d1, 53d2 is disposed to come into the bearing chamber 51f. Therefore, when the inside pressure in the bearing chamber 51f is raised, the pressure energizes the ring piece 53d1 coming into the bearing chamber 51f toward the shaft 22, namely, so acts as to strongly press the edge line portion 53e1 against the shaft 22. Therefore, even when the inside pressure in the bearing chamber 51f is raised, basically a gap is not generated between the edge line portion 53e1 and the outside circumferential surface 22e of the shaft, and, accordingly, the grease or air in the bearing chamber 51f does not leak out through a gap between the edge line portion 53e1 and the outside circumferential surface 22e of the shaft.

Besides, the seal member 54a is a ring-shaped seal member roughly U-shaped in cross section, and includes two ring-shaped edge portions 54e, 54e on the shaft 22 side of the ring piece 54d on the inside in the radial direction; the edge line portions 54e, 54e are constituted to make contact with the outside circumferential surface 22e of the shaft 22, and the ring piece 54d is so disposed to come into the bearing chamber 51f. Therefore, when the inside pressure in the bearing chamber 51f is raised, the pressure energizes the ring piece 54d coming into the bearing chamber 51f toward the shaft 22, namely, so acts as to strongly press the edge portion 54e against the shaft 22. Therefore, even when

the inside pressure in the bearing chamber 51f is raised, basically a gap is not generated between the edge portion 54e and the outside circumferential surface 22e of the shaft, and, accordingly, the grease or air in the bearing chamber 51f does not leak out through a gap between the edge portion 54e and the outside circumferential surface 22e of the shaft.

On the other hand, the seal members 54b, 54c are mainly for sealing water W which would come from the exterior of the watercraft into the watercraft, and a grease chamber 51h is formed between the seal members 54b, 54c. The constitution of the seal members 54b, 54c is the same as that of the above-mentioned seal member 54a. The seal member 54b is so disposed that its ring piece 54b1 comes into the grease chamber 51h, and the seal member 54c is do disposed that its ring piece 54c1 is directed toward the outside of the grease chamber 51h. Therefore, when the inside pressure in the grease chamber 51h is raised, the grease in the grease chamber 51h displaces or deforms the ring piece 54c1 of the seal member 54c so as to come away from the shaft 22, whereby the grease leaks out to the exterior of the grease chamber 51h through a gap formed between the ring piece 54c1 and the outside circumferential surface 22e of the shaft.

The seal member 54b on the bearing chamber 51f side is so disposed that its ring piece 54b1 comes into the inside of the grease chamber 51h. Therefore, even if the inside pressure in the grease chamber 51h is raised, penetration of the grease or air in the grease chamber 51h into the bearing chamber 51f does not occur. Accordingly, even if water has penetrated into the grease chamber 51h, penetration of the water into the bearing chamber 51f does not occur.

As shown in FIG. 4, the tubular portion 51a of the bearing body 50 forms a rubber cylindrical portion 51g extending toward a cylindrical portion 46a on the side of the watercraft body described later.

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In addition, the flange portion 51b of the bearing body 50 is provided integrally with a metallic reinforcing member 51c.

On the other hand, a front wall 43a of the bearing cover 43 is provided with a hole 43b for inserting the tubular portion 51a of the bearing body 50, and a metallic ring-shaped base 44 is closely adhered to the periphery of the hole 43b by an adhesive. A bolt 44b is integrally planted in the base 44.

The bearing body 50 is fixed to the bearing cover 43 (and therefore, the watercraft body 11) by inserting the rubber cylindrical portion 51g in the hole 43b of the bearing cover 43, inserting the bolt 44b in the reinforcing member 51c of the flange portion 51b, and mating a nut 45 to the bolt 44b from the inside of the watercraft body and fastening the flange portion 51b (and therefore, the reinforcing member 51c).

The rear end of the rubber cylindrical portion 51g is connected to the cylindrical portion 46a of a joint rubber 46 fitted to the hull 14 by close adhesion with an adhesive from the side of the conduit 18, by a ring-shaped clamp 47.

As shown in FIGS. 4 and 5, the cylindrical portion 51a of the bearing body 50 is provided with a grease supply hole 51d communicated to the grease chamber 51h, and a breather hole 51e communicated to the bearing chamber 51f.

A grease supply hose 56 is connected to the grease supply hole 51d through a connecting pipe 55, and a grease nipple 56a is provided at the tip end of the grease supply hose 56. The grease nipple 56a is fixed to the deck 15 by co-fastening with the above-mentioned towing hook 19 (See FIG. 1) by a fitting fixture 56b, near an opening 15a formed upon opening the seat 12.

Therefore, by opening the seat 12, grease can be easily supplied from the grease nipple 56a into the grease chamber 51h through the grease supply hose 56.

A breather hose (for example, a rubber tube) 58 included of an extendable-contractable elastic member (for example, rubber) is detachably connected to the breather hole 51e through a connecting pipe 57. The tip end 58a of the breather hose 58 is fixed to an appropriate portion of the watercraft body 11 (the hull 14 or the deck 15) by a fitting fixture 58b.

Therefore, when the grease or air in the bearing chamber 51f is expanded due to a temperature rise in the bearing chamber 51f, the expanded portion of the grease or air is released into the breather hole 51e, the connecting pipe 57 and the breather hose 58. Therefore, notwithstanding the seal members 53, 54a disposed on both sides of the bearing 52 are so disposed that the grease (not shown) in the bearing chamber 51f does not leak out through the contact portions 53e, 54e with the outside circumferential surface 22e of the drive shaft 22, the seal members 53, 54a would not be excessively deformed or broken due to the rise in the inside pressure in the bearing chamber 51f.

As shown in FIG. 4, the tip end 58a of the breather hose 58 is opened into the watercraft inside 16 on the upper side of the bearing chamber 51f. The tip end 58a is disposed on the upper side of a watercraft inside opening port 48a of an intake duct 48 for communication between the watercraft inside 16 and the outside air.

Since the breather hose 58 is detachably connected to the connecting pipe 57, the breather hose 58 can be detached and grease can be charged into the bearing chamber 51f through the connecting pipe 57 at the time of maintenance.

As is clear from the above description, in this embodiment, the breather passage is constituted of the breather hole 51e, the connecting pipe 57 and the breather hose 58.

According to the drive shaft bearing structure for watercraft as described above, the following actions or effects can be obtained.

(a) The bearing body 50 for rotatably supporting the drive shaft 22 for driving the impeller 32 on the watercraft body 11 is provided, the bearing body 50 including the bearing member 52 rotatably supporting the drive shaft 22, the bearing chamber 51f for containing the bearing member 52, and the seal members 53, 54a disposed on both sides of the bearing member 52 and partitioning the bearing chamber 51f by making contact with the outside circumferential surface 22e of the drive shaft 22, and the breather passage (51e, 57, 58) is communicated with the bearing chamber 51f. Therefore, even when the temperature in the bearing chamber 51f is raised and the grease or air in the bearing chamber 51f expands, the expanded portion of the grease or air is released into the breather passage (51e, 57, 58), whereby rise of the inside pressure in the bearing chamber 51f is prevented or markedly suppressed.

Therefore, the seal members 53, 54a are basically not deformed by the inside pressure in the bearing chamber 51f, and hence no gap is generated between the seal members 53, 54a and the outside circumferential surface 22e of the shaft, so that the grease or air in the bearing chamber 51f will not leak to the exterior through a gap between the seal members 53, 54a and the outside circumferential surface 22e of the shaft.

In addition, the grease or air released into the breather passage due to the rise of the temperature in the bearing chamber 51f returns into the bearing chamber 51f when the running of the watercraft 10 is stopped and the temperature inside the bearing chamber 51f is lowered.

Therefore, according to this drive shaft bearing structure for watercraft, excessive deformation of the seal members 53, 54a due to the rise of the inside

pressure in the bearing chamber 51f is prevented, and, at the same time, even when the running and stopping of the watercraft are repeated and the rise and fall of the temperature in the bearing chamber (and hence expansion and contraction of the grease or air in the bearing chamber 51f) are repeated, the amount of the grease in the bearing chamber 51f is basically not reduced, and even if it is reduced, the extent of reduction is extremely restrained.

As a result, according to this bearing structure, the maintenance required in the prior art mentioned above is basically unnecessary, and even if the maintenance is to be conducted, the frequency of the maintenance can be extremely low.

(b) Since the seal members 53, 54a are so disposed that the grease in the bearing chamber 51f does not leak out through the contact portions between the seal members 53, 54a and the outside circumferential surface 22e of the drive shaft 22, leakage of the grease from the bearing chamber 51f is prevented more securely (at least, it is more difficult for the grease to leak out).

In the case of such a constitution, if no measures are provided, there may be the risk that the seal members 53, 54a might be excessively deformed due to the rise of the inside pressure in the bearing chamber 51f. However, in the bearing structure according to this embodiment, the breather passage (51e, 57, 58) is communicated with the bearing chamber 51f, and, therefore, such a situation of excessive deformation is obviated.

Namely, according to this bearing structure, the seal members 53, 54a are so disposed that the grease in the bearing chamber 51f does not leak out through the contact portions between the seal members 53, 54a and the outside circumferential surface 22e of the drive shaft 22, whereby leakage of the grease in the bearing chamber 51f is prevented more securely, and, in spite of such a

structure, excessive deformation of the seal members 53, 54a due to the rise of the inside pressure in the bearing chamber 51f is prevented.

As a result, even if maintenance is to be conducted, the frequency of the maintenance can be further reduced.

(c) The end portion 58a on the opposite side of the bearing chamber 51f, of the breather passage, is opened. Therefore, even when the temperature inside the bearing chamber 51f is raised and the grease or air in the bearing chamber 51f expands, the expanded portion of the grease or air is smoothly released toward the breather passage, whereby rise of the inside pressure in the bearing chamber 51f is restrained more securely.

Besides, the end portion 58a on the opposite side of the bearing chamber 51f, of the breather passage, is opened into the watercraft inside 16 on the upper side of the bearing chamber 51f. Therefore, the grease released into the breather passage due to the rise of the temperature inside the bearing chamber 51f will not flow over from the end portion 58a of the breather passage, and returns into the bearing chamber 51f securely when the running of the watercraft 10 is stopped and the temperature inside the bearing chamber 51f is lowered.

(d) Since the end portion 58a on the opposite side of the bearing chamber 51f, of the breather passage, is disposed on the upper side of the watercraft inside opening port 48a of the duct 48 for communication between the watercraft inside 16 and the outside air, the water which may be sucked into the watercraft inside 16 through the intake duct 48 together with air and be scattered will not easily enter into the breather passage through the end portion 58a of the breather passage. Therefore, there is little risk that water drops might enter into the bearing chamber 51f through the breather passage.

(e) Since the breather passage includes the breather hose 58 detachably fitted to the bearing body 50 and grease can be poured into the bearing chamber 51f by

detaching the breather hose 58, the grease can be charged into the bearing chamber 51f without drawing out the drive shaft 22 from the bearing body 50.

Therefore, even if maintenance (charging of grease) is necessary, the maintenance can be performed easily.

(f) Since two bearing members 52, 52 are disposed with a spacing therebetween in the bearing chamber 51f and the grease reservoir is formed between the bearing members 52, 52, a large amount of grease can be charged in the bearing chamber 51f due to the presence of the grease reservoir.

Therefore, even if maintenance is to be conducted, the frequency of the maintenance can be further reduced.

FIG. 6 shows a second embodiment of the drive shaft bearing structure for watercraft according to the present invention. In the figure, the portions which are the same with or equivalent to those in the first embodiment are denoted by the same symbols.

The present embodiment differs from the first embodiment mainly and only in that the end portion 58a on the opposite side of the bearing chamber 58, of the breather passage, is closed.

Numeral 49 denotes a tray for fitting electrical equipments 61 to the watercraft body 11, and a plug 49a formed integrally with the tray 49 is detachably fitted to the opening 58a of the breather hose 58, whereby the opening 58a of the breather hose 58 is closed.

According to this embodiment also, the same actions or effects with the first embodiment above can be obtained.

Further, since the end portion 58a on the opposite side of the bearing chamber, of the breather passage, is closed, penetration of water into the breather passage can be prevented securely.

In addition, since the end portion 58a is closed, the expansion of the grease or air released into the breather passage is absorbed by the extension of the breather hose 58 constituting a part of the breather passage, and leakage of the grease through the end portion 58a of the breather passage is obviated.

Therefore, the grease released into the breather passage due to the rise of the temperature inside the bearing chamber 51f returns securely into the bearing chamber 51f when the running of the watercraft is stopped and the temperature inside the bearing chamber 51f is lowered.

Incidentally, since at least a portion (in this case, the breather hose 58) of the breather passage is formed of an extendable-contractable elastic member (for example, rubber tube), though the end portion 58a of the breather passage is closed, the breather hose 58 extends or contracts according to the inside pressure in the bearing chamber 51f. Therefore, the release of the grease or air contained in the bearing chamber 51f into the breather passage and the return thereof from the breather passage are not hampered.

The drive shaft bearing structure for watercraft as set forth above resides in that, in a structure including a bearing body for rotatably supporting a drive shaft for driving an impeller on a watercraft body, the bearing body including a bearing member rotatably supporting the drive shaft, a bearing chamber for containing the bearing member, and seal members disposed on both sides of the bearing member and partitioning the bearing chamber by making contact with the outside circumferential surface of the drive shaft, a breather passage is communicated with the bearing chamber. According to this drive shaft bearing structure for watercraft, even when the temperature in the bearing chamber is raised and the grease or air in the bearing chamber expands, the expanded portion of the grease or air is released into the breather passage, whereby rise

of the inside pressure in the bearing chamber is prevented or markedly suppressed.

Therefore, the seal member basically is not deformed due to the inside pressure in the bearing chamber, and hence no gap is generated between the seal member and the outside circumferential surface of the shaft, so that there is no risk that the grease or air in the bearing chamber might leak out to the exterior through a gap between the seal member and the outside circumferential surface of the shaft.

In addition, the grease or air released into the breather passage due to the rise of the temperature in the bearing chamber is returned into the bearing chamber when the running of the watercraft is stopped and the temperature in the bearing chamber is lowered.

Therefore, according to the drive shaft bearing structure for watercraft as set forth above, excessive deformation of the seal member due to the rise of the inside pressure in the bearing chamber is prevented. At the same time, even when the running and stopping of the watercraft are repeated and the rise and fall of the temperature in the bearing chamber (and hence expansion and contraction of the grease or air in the bearing chamber) are repeated, the amount of the grease in the bearing chamber is basically not reduced, and even if it is reduced, the extent of the reduction is extremely suppressed.

As a result, according to the drive shaft bearing structure for watercraft as set forth above, the maintenance required in the prior art as mentioned above is basically unnecessary, and even if the maintenance is to be conducted, the frequency of the maintenance may be extremely low.

The drive shaft bearing structure for watercraft as set forth above resides in that, in a structure including a bearing body for rotatably supporting a drive shaft for driving an impeller on a watercraft body, the bearing body including a bearing

member rotatably supporting the drive shaft, a bearing chamber for containing the bearing member, and seal members disposed on both sides of the bearing member and partitioning the bearing chamber by making contact with the outside circumferential surface of the drive shaft, the seal members are so disposed that a grease in the bearing chamber does not leak out through the contact portions between the seal members and the outside circumferential surface of the drive shaft, and a breather passage is communicated with the bearing chamber. According to this drive shaft bearing structure for watercraft as set forth above, also, the same actions or effects as those of the drive shaft bearing structure for watercraft as set forth above can be obtained.

Further, according to the drive shaft bearing structure for watercraft as set forth above, the seal members are so disposed that the grease in the bearing chamber does not leak out through the contact portions between the seal members and the outside circumferential surface of the drive shaft, whereby leakage of the grease from the bearing chamber is prevented more securely (at least, it is more difficult for the grease to leak out).

In the case of such a constitution, if no measures are provided, there may be the risk that the seal members might be excessively deformed due to the rise of the inside pressure in the bearing chamber. According to the bearing structure as set forth in claim 2, however, the breather passage is communicated with the bearing chamber, so that such situation of excessive deformation is prevented.

Namely, according to the bearing structure as set forth above, the seal members are so disposed that the grease in the bearing chamber does not leak out through the contact portions between the seal members and the outside circumferential surface of the drive shaft, and leakage of the grease from the bearing chamber is thus prevented more securely, and, in spite of this structure, excessive deformation of the seal members due

to the rise of the inside pressure in the bearing chamber is prevented.

As a result, even if maintenance is to be conducted, the frequency of the maintenance can be further reduced.

According to the drive shaft bearing structure for watercraft as set forth above, in the drive shaft bearing structure for watercraft as set forth above, an end portion on the opposite side of the bearing chamber, of the breather passage, is opened. Therefore, even when the temperature in the bearing chamber is raised and the grease or air in the bearing chamber expands, the expanded portion of the grease or air is smoothly released toward the breather passage, whereby the rise of the inside pressure in the bearing chamber is restrained securely.

Besides, the end portion on the opposite side of the bearing chamber, of the breather passage, is opened into the inside of the watercraft body on the upper side of the bearing chamber. Therefore, the grease released into the breather passage due to the rise of the temperature in the bearing chamber is securely returned into the bearing chamber when the running of the watercraft is stopped and the temperature inside the bearing chamber is lowered.

According to the drive shaft bearing structure for watercraft as set forth above, in the drive shaft bearing structure for watercraft as set forth above, the end portion on the opposite side of the bearing chamber, of the breather passage, is disposed on the upper side of a watercraft inside opening port of a duct for communication between the inside of the watercraft and the outside air. Therefore, the water which may be sucked into the inside of the watercraft through the intake duct together with air and be scattered will not easily enter into the breather passage through the end portion of the breather passage. Therefore, there is

scarcely the risk that water drops might enter into the bearing chamber through the breather passage.

According to the drive shaft bearing structure for watercraft as set forth above, in the drive shaft bearing structure for watercraft as set forth above, at least a portion of the breather passage is formed of an extendable-contractable elastic member, and an end portion on the opposite side of the bearing chamber, of the breather passage, is closed. Therefore, the expansion of the grease or air released into the breather passage is absorbed by the extension of the elastic member of the breather passage, so that the grease is prevented from leaking out through the end portion of the breather passage.

Accordingly, the grease released into the breather passage due to the rise of the temperature inside the bearing chamber is securely returned into the bearing chamber when the running of the watercraft is stopped and the temperature inside the bearing chamber is lowered.

Besides, since the end portion on the opposite side of the bearing chamber, of the breather passage, is closed, penetration of water into the breather passage can be securely prevented.

Incidentally, since at least a portion of the breather passage is formed of an extendable-contractable elastic member, the elastic member extends and contracts according to the inside pressure in the bearing chamber, though the end portion of the breather passage is closed. Therefore, the release of the grease or air contained in the bearing chamber into the breather passage and the return of the grease or air from the breather passage are not hampered.

According to the drive shaft bearing structure for watercraft as set forth above, in the drive shaft bearing structure for watercraft as set forth above, the breather passage includes a breather hose detachably fitted to the bearing body, and the grease can be poured

into the bearing chamber by detaching the breather hose. Therefore, the grease can be charged into the bearing chamber without drawing out the drive shaft from the bearing body.

Accordingly, even if maintenance (charging of grease) is necessary, the maintenance can be carried out easily.

According to the drive shaft bearing structure for watercraft as set forth above, in the drive shaft bearing structure for watercraft as set forth above, a plurality of the bearing members are disposed at a spacing or spacings in the bearing chamber, and a grease reservoir is formed between the bearing members. Therefore, a large amount of grease can be charged in the bearing chamber due to the presence of the grease reservoir.

Accordingly, even if maintenance is to be conducted, the frequency of the maintenance can be further reduced.

While the mode for carrying out the present invention and the embodiments of the invention have been described above, the present invention is not limited to or by the above mode or embodiments, and modifications can be made as required within the gist of the invention.

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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A drive shaft bearing structure for watercraft, comprising a bearing body for rotatably supporting a drive shaft for driving an impeller on a watercraft body, said bearing body comprising a bearing member rotatably supporting said drive shaft, a bearing chamber for containing said bearing member, and seal members disposed on both sides of said bearing member and partitioning said bearing chamber by making contact with the outside circumferential surface of said drive shaft, wherein

a breather passage is communicated with said bearing chamber.

2. A drive shaft bearing structure for watercraft, comprising a bearing body for rotatably supporting a drive shaft for driving an impeller on a watercraft body, said bearing body comprising a bearing member rotatably supporting said drive shaft, a bearing chamber for containing said bearing member, and seal members disposed on both sides of said bearing member and partitioning said bearing chamber by making contact with the outside circumferential surface of said drive shaft, wherein

said seal members are so disposed that a grease in said bearing chamber does not leak out through the contact portions between said seal members and said outside circumferential surface of said drive shaft, and a breather passage is communicated with said bearing chamber.

3. A drive shaft bearing structure for watercraft as set forth in claim 1 or 2, wherein an end portion on the opposite side of said bearing chamber, of said breather passage, is opened into the inside of said watercraft body on the upper side of said bearing chamber.

4. A drive shaft bearing structure for watercraft as set forth in claim 3, wherein said end portion on the opposite side of said bearing chamber, of said breather passage, is disposed on the upper side of a watercraft inside opening port of a duct for communication between the inside of the watercraft and the outside air.

5. A drive shaft bearing structure for watercraft as set forth in claim 1 or 2, wherein at least a portion of said breather passage is formed of an extendable-contractable elastic member, and an end portion on the opposite side of said bearing chamber, of said breather passage, is closed.

6. A drive shaft bearing structure for watercraft as set forth in any one of claims 1 to 5, wherein said breather passage comprises a breather hose detachably fitted to said bearing body, and the grease can be poured into said bearing chamber by detaching said breather hose.

7. A drive shaft bearing structure for watercraft as set forth in any one of claims 1 to 6, wherein a plurality of said bearing members are disposed at a spacing or spacings in said bearing chamber, and a grease reservoir is formed between said bearing members.

FIG. 1

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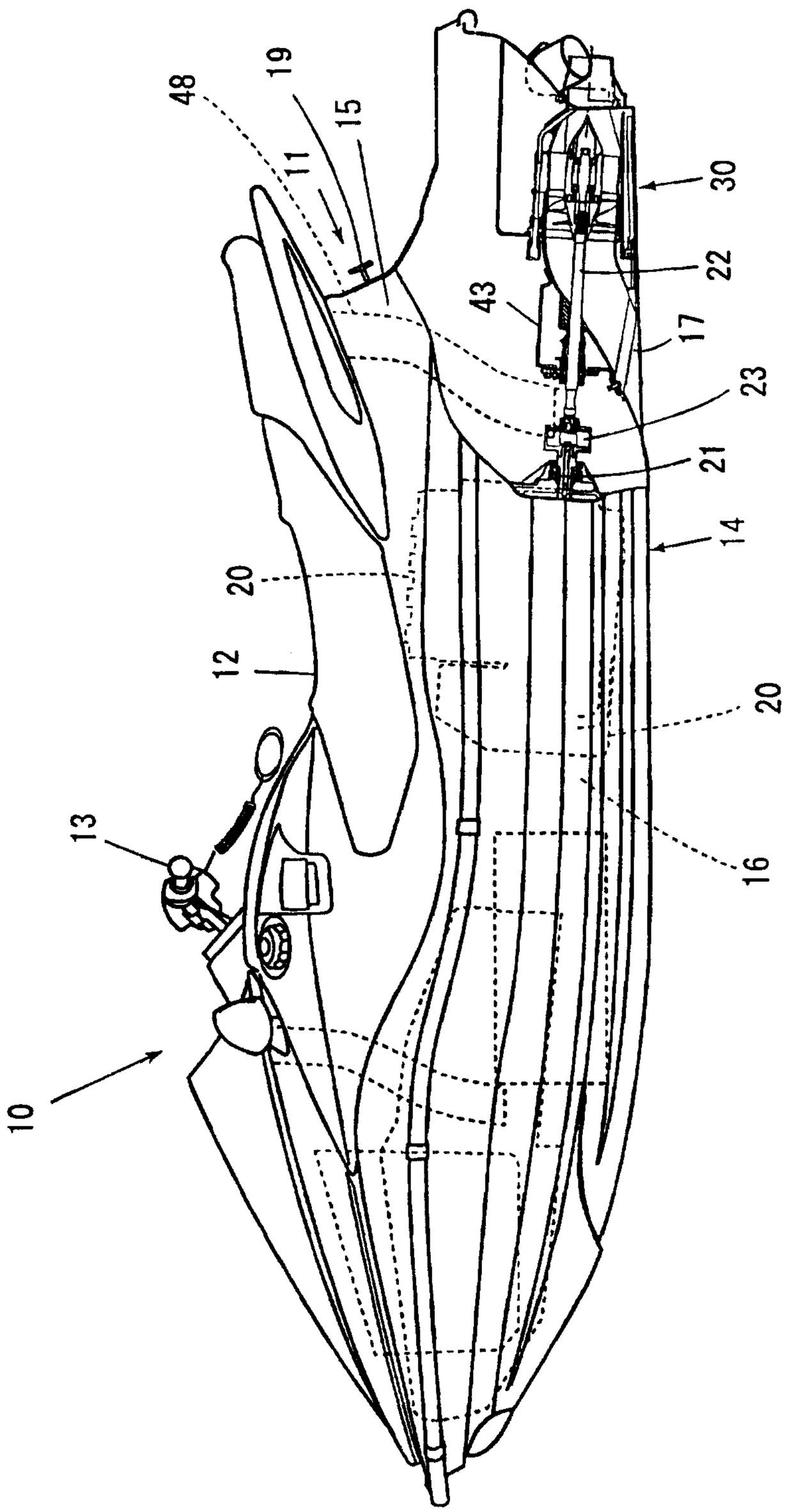

Proof - 2001/09/19

FIG. 2

H101-2685-02

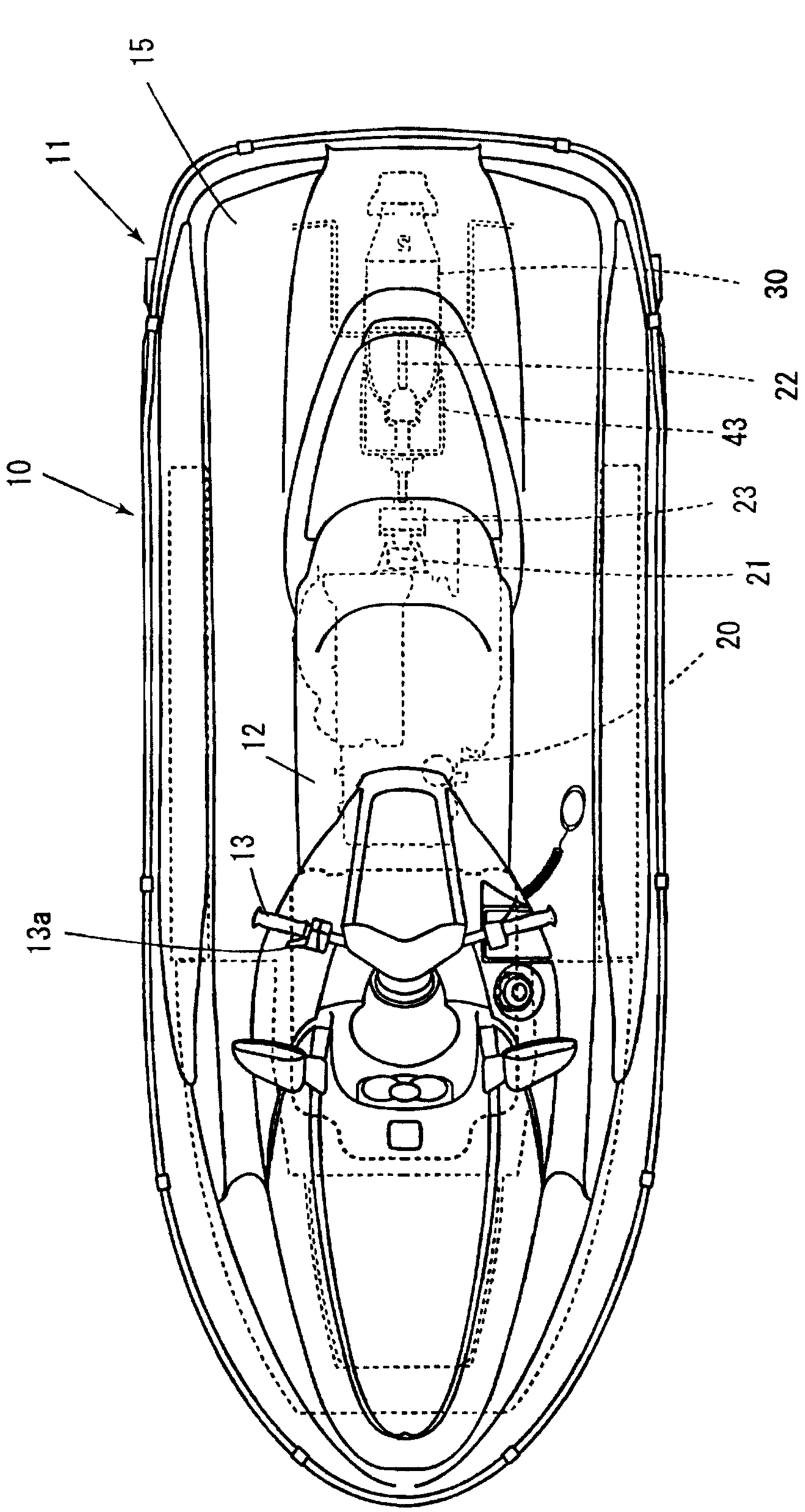

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FIG. 3

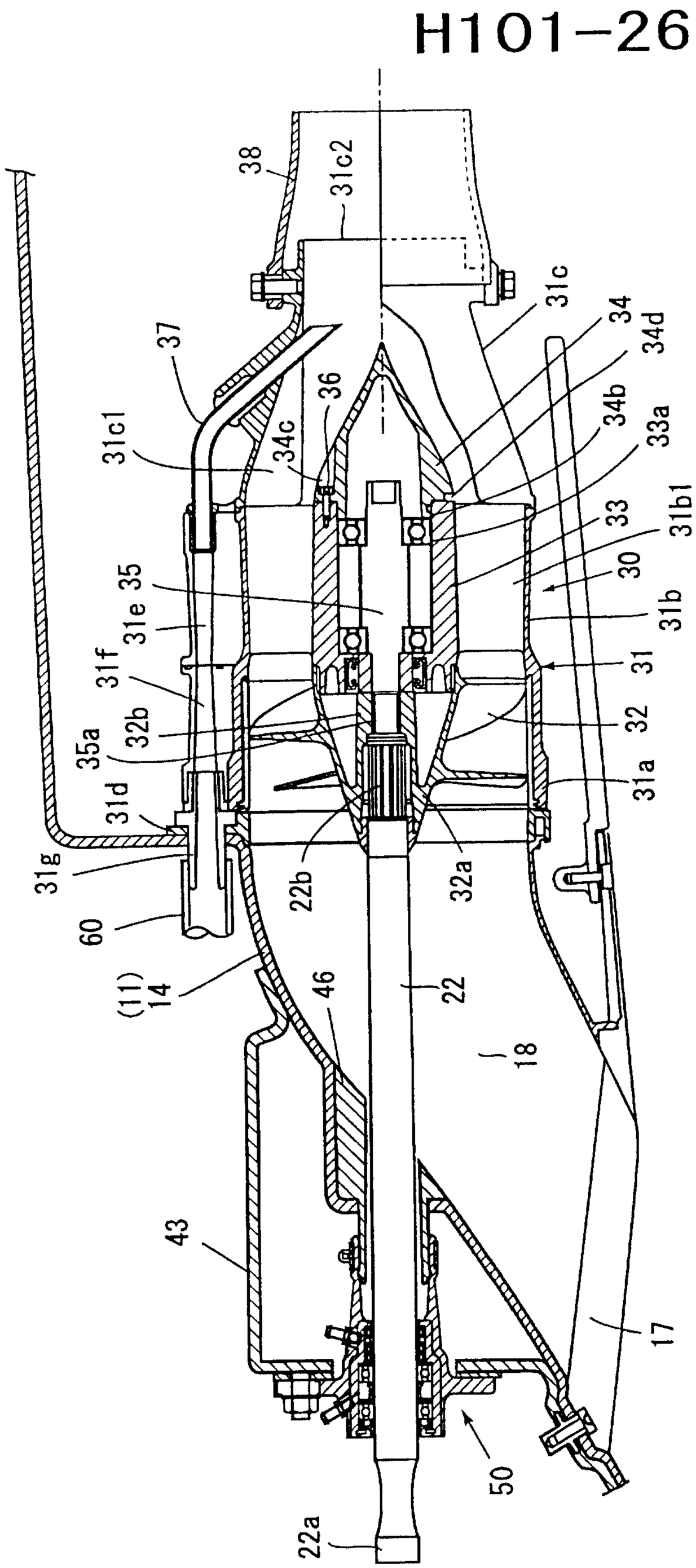

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FIG. 4

H101-2685-04

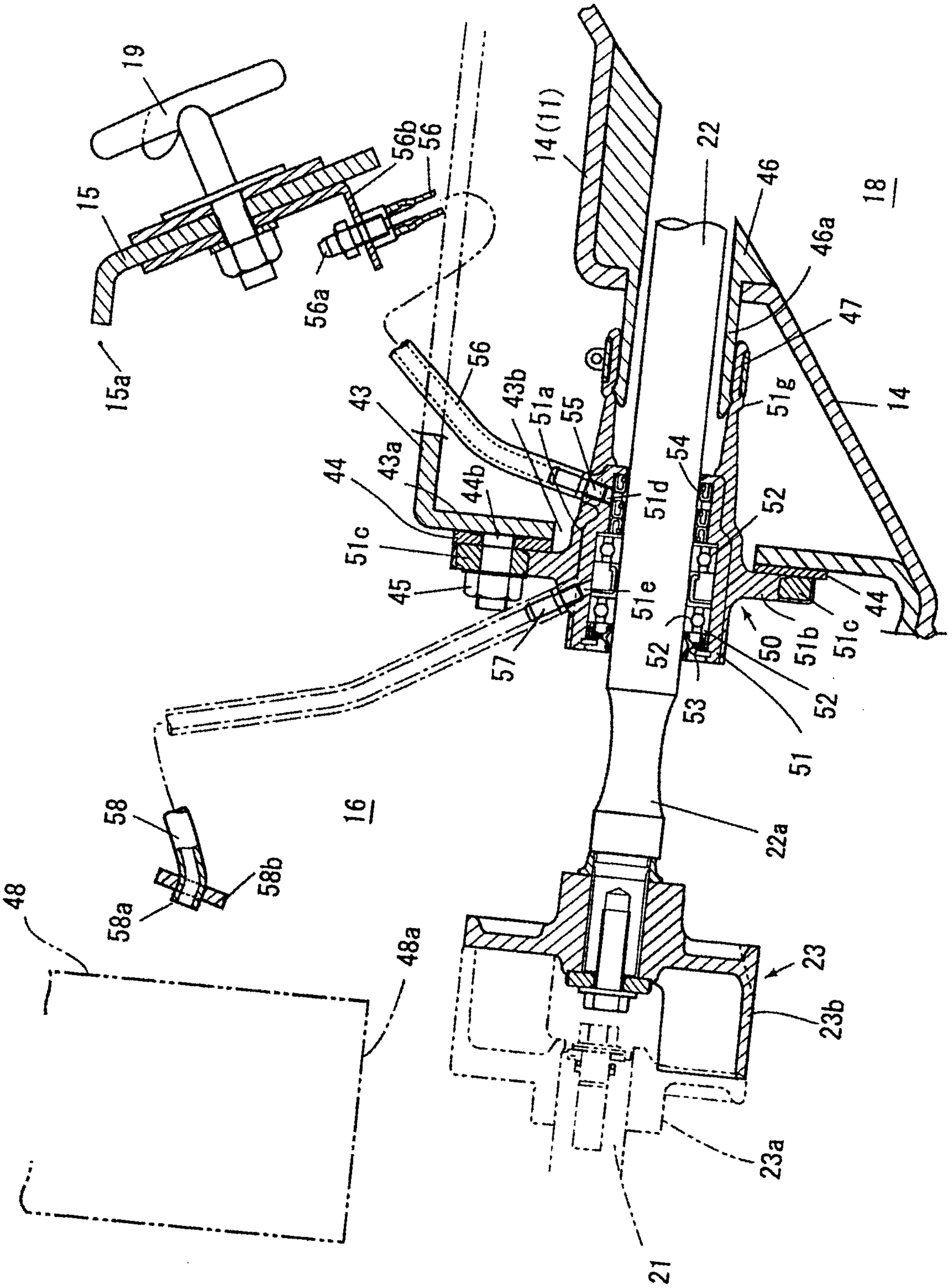

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FIG. 5

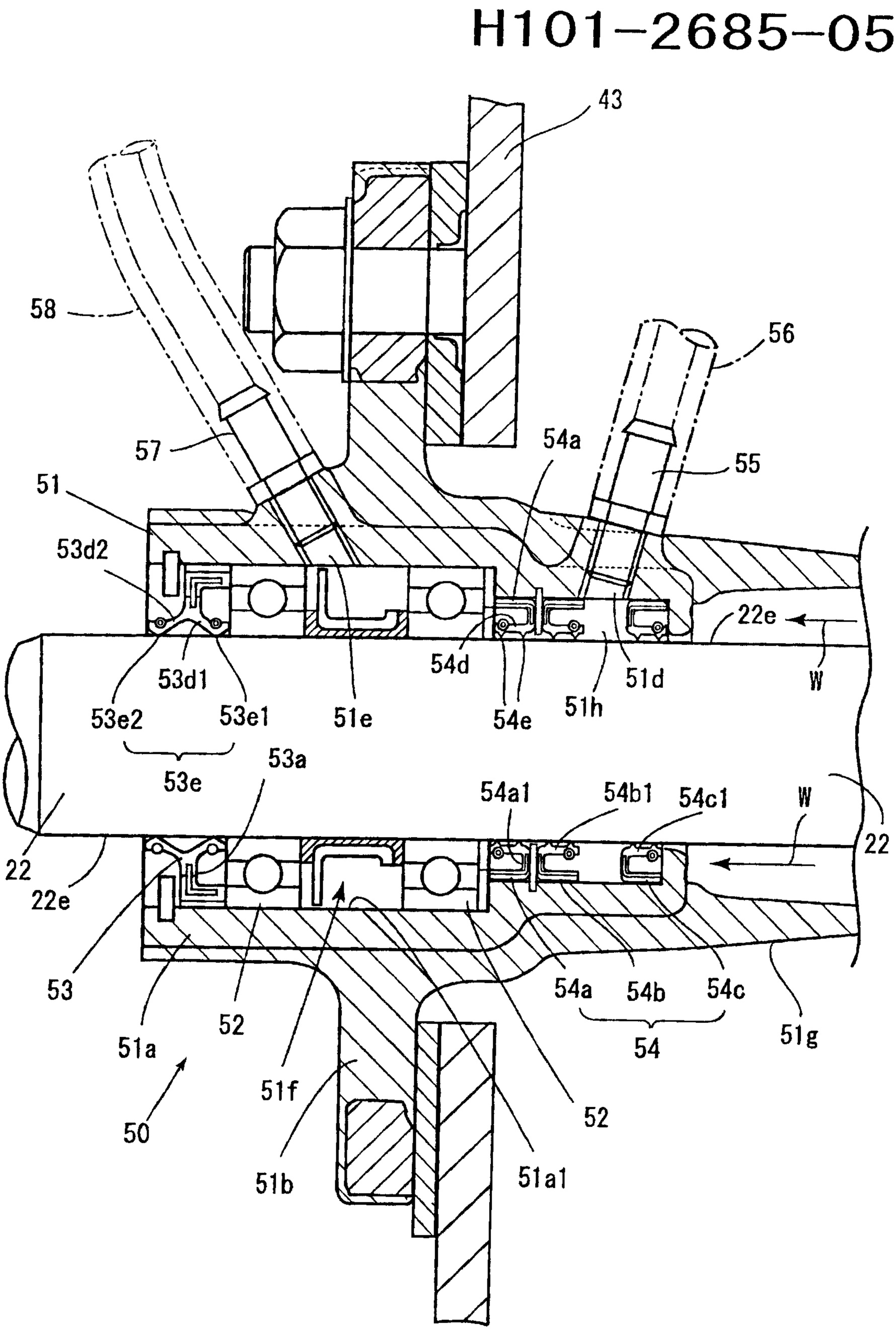
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FIG. 6

H101-2685-06

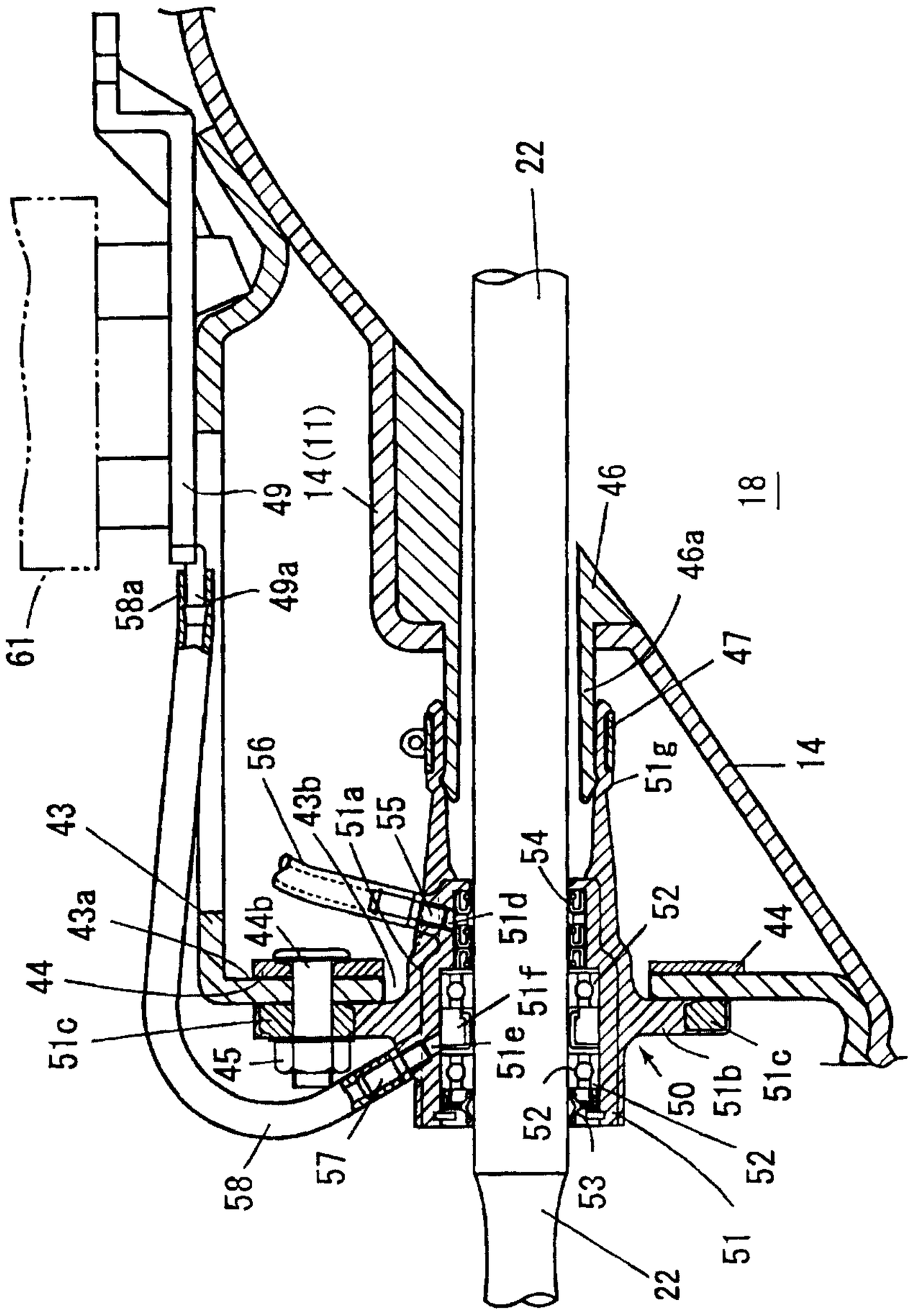
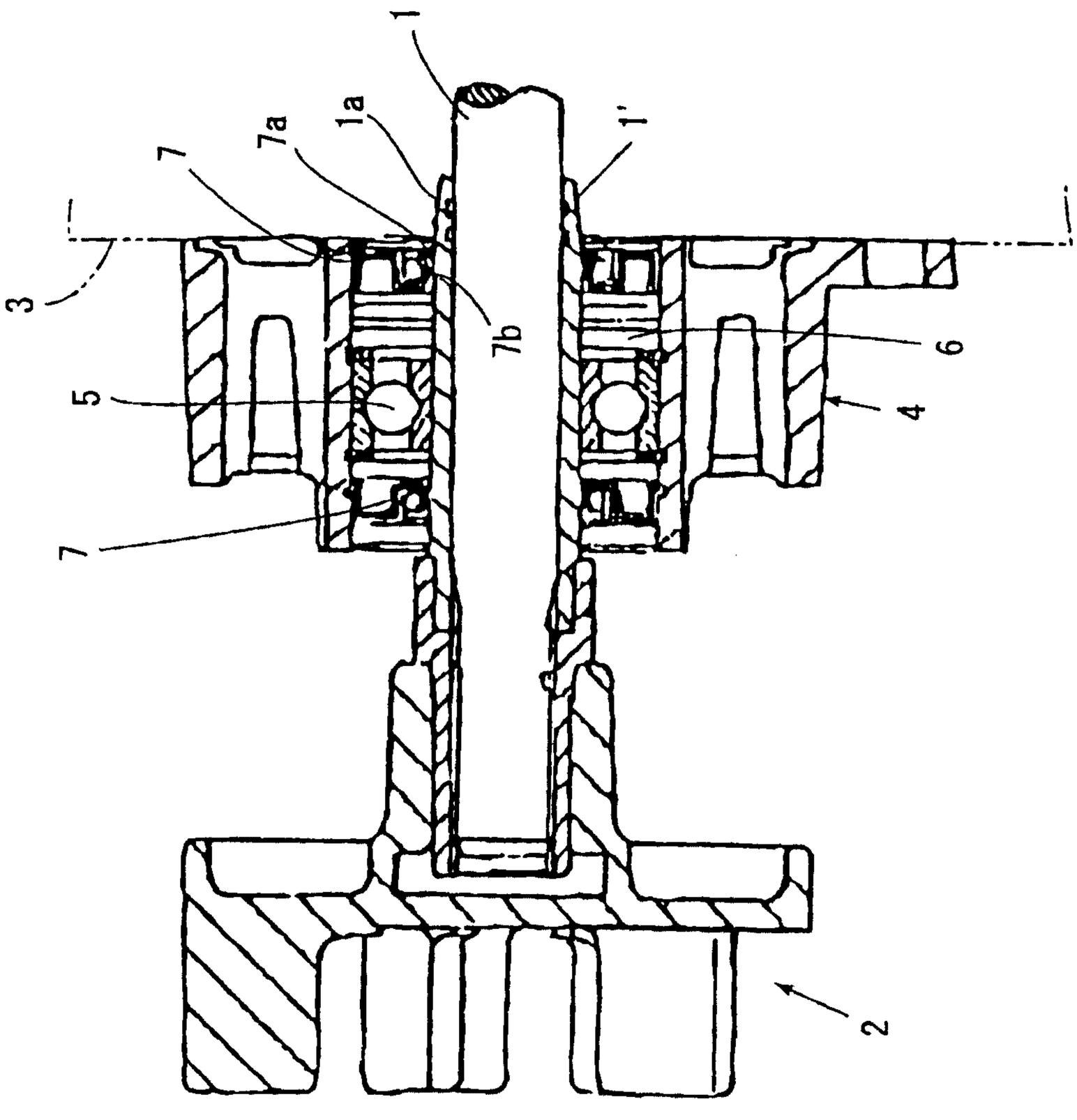
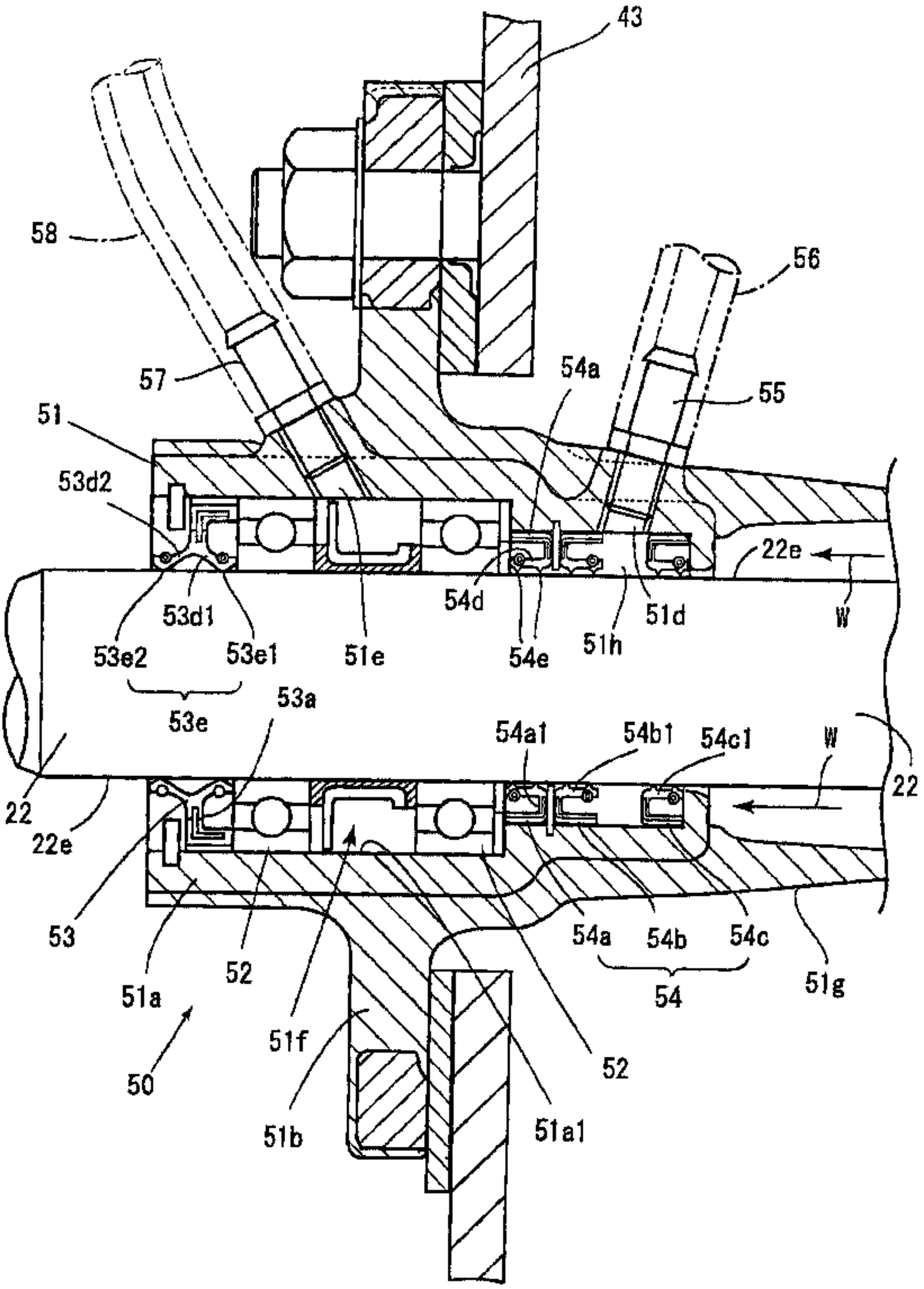


FIG. 7

H101-2685-07

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