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(54) **A PROPELLER FOR A MARINE VESSEL AND A METHOD OF INSTALLING THE HUB CAP TO THE HUB**

PROPELLER FÜR EIN WASSERFAHRZEUG UND VERFAHREN ZUR INSTALLATION DER NABENBLENDE AN DER NABE

HÉLICE POUR NAVIRE ET PROCÉDÉ D'INSTALLATION DE CHAPEAU DE MOYEU SUR LE MOYEU

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Description

Technical field

[0001] The present invention relates to a novel propeller for a marine vessel and a method of installing the hub cap to the hub. More specifically, the present invention relates to hub caps for use in connection with both fixed pitch and controllable pitch propellers.

Background art

[0002] The propulsion unit of a marine vessel comprises normally a hub and propeller blades arranged to the hub. The hub comprises drive means, which may, for instance, be a drive shaft, an angle gear, a transmission or an electric or hydraulic drive. The propeller may be a so called fixed pitch propeller (FPP) or a controllable pitch propeller (CPP). The former one has blades fastened to an annular hub body, and the latter one has blades arranged to means for controlling the pitch of the blades, the control means being located within the hub of the propulsion unit.

[0003] The means for controlling the pitch of the propeller blades comprise actual mechanical turning arrangement arranged in the hub, and means for actuating the mechanical turning arrangement. The mechanical turning arrangement comprises a crank ring for each propeller blade.

[0004] There are basically two types of actuating means, i.e. a mechanical one and a hydraulic one. The mechanical one comprises a rod extending along a central bore in the drive shaft from the drive means to the inside of the hub. With regard to the hydraulic actuating means the movable member inside the hub is arranged to work as a piston in a hydraulic cylinder.

[0005] A problem concerning the propellers is the relatively large diameter the roots of the propeller blades are arranged. The large diameter of the hub results in that the propeller hub forms a hydrodynamically inefficient object, as the flow exiting the propeller blades has to fill the open cavity downstream of the hub. In other words, the hub terminating to a substantially radial surface having a diameter corresponding to the hub diameter creates, downstream of the hub, an area of reduced pressure, which, in practice, means the creation of a force directed opposite to the thrust of the propeller, i.e. reducing the net thrust of the propeller. While water fills the open cavity a so called hub vortex is created. The hub vortex is visible in its more intense form, when the vortices start cavitating, i.e. form gas bubbles in the vortex. The practical problem with the hub vortex is that it reduces considerably the applicable thrust of the propeller. Naturally, the problem may be seen in a larger scale in the controllable pitch propellers, due to their larger hub diameter.

[0006] The problem relating to the hub vortex has been attempted to be solved by arranging a hub cap to the

downstream end of the hub, and fins on the hub cap, both the hub cap and the fins rotating together with the propeller. By such an arrangement the thrust of the propeller has been increased, or fuel consumption reduced, on average 2 to 3%. The hub cap may be a cylindrical extension of the hub, but normally it is a converging extension. The convergence may be either conical or curved. One example of a hub cap positioned on the downstream end of a propeller is disclosed in KR 10-2015-0102851.

[0007] When the propeller is of the fixed pitch type, or sometimes even a controllable pitch type, the hub cap may be easily fastened from inside thereof to the end of the hub as discussed in a co-pending patent application PCT/EP2016/058311. But when the propeller is a controllable pitch propeller having hydraulic actuating means with their hydraulic cylinder arranged at the aft end of the propeller hub, i.e. the end opposite the drive or forward end of the hub, either as an integral part of the hub or as a separate part attached to the aft end of the hub a further problem may be seen. Now that the hub radius at the roots of the blades is clearly larger than the outer radius of the hydraulic cylinder, the hub cap is preferably arranged to cover the radial difference by means of a more or less streamlined surface converging from the maximal diameter of the hub backwards. However, as it is hydrodynamically efficient to bring the hub cap at a close proximity of the outer surface or the end of the hydraulic cylinder, there is no room for fastening the hub cap from inside, but the fastening has to be arranged from outside the hub cap. The same problem may be seen also in controllable pitch propellers having mechanical actuating means. In other words, the hub body has an axial extension at its aft end with a diameter smaller than that of the rest of the hub body, the axial extension filling the interior of the hub cap.

[0008] In accordance with an exemplary prior art construction (see for instance Fig. 1) the hub cap is formed of the converging section provided with fins on its outer surface. The converging section of the hub cap has, at its end facing the aft end of the hub, an inwardly extending flange provided with holes for bolts or screws used for fastening the hub cap to the hub. Thus the fastening of the hub cap is easy to perform from inside the hub cap. However, when the interior of the hub cap is more or less filled with the axial extension of the hub body, the fastening of the hub cap from inside is impossible.

[0009] Therefore, an object of the present invention is to design a novel hub cap, which has a simple construction resulting in low costs of manufacture.

[0010] Another object of the present invention is to design a novel hub cap, which has a light construction and easy installation.

[0011] A further object of the present invention is to design a novel hub cap that may be fastened at the aft end of the hub from outside of the hub cap.

[0012] A still further object of the invention is to offer a possibility to provide existing propellers with a modern

hub cap.

Disclosure of the Invention

[0013] At least one of the objects of the invention is substantially met by a propeller for a marine vessel, the propeller comprising a hub with a hub body, propeller blades, and a hub cap attached to an aft end of the hub body, the hub cap having an outer surface provided with fins, wherein the hub cap is fastened to the hub body by means of a separate circular connection ring coaxial with the hub body, the connection ring is fastened to the inside of the hub cap by means of dowels pressed in coaxial radial holes in the hub cap and in the connection ring, respectively, the hole in the hub cap has a threaded section and the hole is closed and sealed by means of a plug threaded in the threaded section of the hole.

[0014] At least one of the objects of the invention is substantially met by a method of installing a hub cap on an aft end of a hub of a propeller, the propeller comprising a hub with a hub body, propeller blades and a hub cap, the hub cap having an outer surface provided with fins and an inner surface having an inner diameter, the method comprising the steps of

- a) producing a circular connection ring to have an outer diameter equaling the inner diameter of the hub cap,
- b) providing the hub cap with radial through holes,
- c) providing the connection ring with radially extending blind holes,
- d) providing the connection ring with axial through holes,
- e) providing threaded holes in connection with the hub body,
- f) fastening the connection ring to the aft end of the hub body by means of bolts threaded in the threaded holes,
- g) mounting the hub cap on the connection ring, and
- h) pressing dowels into the holes for fastening the hub cap on the circular connection ring.

[0015] Other characteristic features of the present invention may be seen in the appended claims.

[0016] The present invention brings about the following advantages, among others

- simple and thereby cheap construction,
- light construction whereby the installation is easier, and
- easy installation due to easy separate installation steps.

Brief Description of Drawings

[0017] In the following, the present invention will be described with reference to the accompanying exemplary, schematic drawings, in which

Figure 1 illustrates an axial cross sectional view of a hub of a prior art propulsion unit of a marine vessel,

Figure 2a illustrates an axial cross sectional view of a hub of a propeller of a marine vessel in accordance with a first preferred embodiment of the present invention,

Figure 2b illustrates an enlarged partial view of the hub of Figure 2a, and

Figure 3a illustrates an axial cross sectional view of a hub of a propeller of a marine vessel in accordance with a second preferred embodiment of the present invention, and

Figure 3b illustrates an enlarged partial view of the hub of Figure 3a.

Detailed Description of Drawings

[0018] Figure 1 illustrates an axial cross sectional view of a hub 10 of a prior art controllable pitch propeller of a marine vessel. In the following description definitions 'aft' and 'forward' have been used such that 'aft' refers to an element or part of an element facing or pointing towards the aft end or stern of a vessel, and 'forward' refers to an element or part of an element facing or pointing towards the front end or bow of a vessel. The hub 10 comprises a hub body 12, an aft end cover 14 at an aft end of the hub body 12, a forward end cover 16 at a forward end of the hub body 12, a cylinder yoke 18, crank rings 20, propeller blades 22 and a hub cap 24. The forward end cover 16 at the forward end of the hub body 12 has an opening for receiving the drive shaft that extends to the central cylindrical opening 26 in the cylinder yoke 18. The drive shaft (not shown) is provided with a flange that is bolted to the threaded holes 28 at the forward end of the hub body 12 for rotating the hub body 12. The drive shaft is provided with means fastened to the opening 30 in the cylinder yoke 18 for moving the cylinder yoke 18 axially. While the cylinder yoke 18 is moved axially, it cooperates with the crank rings 20 for controlling the pitch of the propeller blades 22. The aft end cover 14 is fastened to the aft end of the hub body 12 by means of bolts 32.

[0019] The hub cap 24 of the prior art hub 10 is formed, between its forward and aft axial ends, of a converging section 34 to the outer surface of which fins 36 are fastened. The converging section 34 of the hub cap 24 is provided at its forward end with a flange 38 extending radially inwardly along the aft end cover 14 of the hub and fastened thereon by means of bolts or screws 40.

[0020] Now that the interior of the hub cap is open at its aft end the fastening of the hub cap to the aft end of the hub body is easy. However, as discussed already earlier, when the interior of the hub cap is filled with the hub components, for instance the hydraulic means for controlling the pitch of the propeller, there is no access

to the interface between the hub cap and the hub body or the aft end cover of the hub from inside the hub cap, whereby the fastening of the hub cap has to be performed by some other manner from outside the hub cap. Thus, for fastening the hub cap to the aft end of the hub body or to the aft end cover of the hub the following two embodiments are proposed.

[0021] Figure 2 illustrates schematically an axial cross section of a hub in accordance with a first preferred embodiment of the present invention. The hub 40 comprises a hub body 42, which is, for instance, fastened to a flange 44 arranged at an end of the drive shaft 46. The hub has a plurality of propeller blades 48 rotatably arranged by means of attaching each blade 48 via its blade foot 50 to a rotatable crank ring 52 of its own, preferably by means of bolts. The blade foot 50 and/or the crank ring 52 has/have been sealed in relation to the hub body 42 such that oil used for lubricating the interior of the hub, i.e. the mechanical pitch control means, does not leak to the water surrounding the hub, when in operation.

[0022] The interior of the hub 40 is provided with hydraulic means for controlling the pitch or for changing the blade angle of the propeller, i.e. for changing the blade angle position between an ahead and an astern position as was already mentioned in connection with Figure 1. At an end opposite to the drive shaft 46, the hub 40 is provided with an axial extension, i.e. an aft end cover 54, fastened via a radially extending flange 56 thereof to the aft end of the hub body 42. The interior of the aft end cover 54 is provided with a piston 58 dividing the cylindrical interior volume of the aft end cover 54 to two chambers, i.e. an astern oil chamber 60 and an ahead oil chamber 62. The piston 58 is fastened to an end of a cylinder yoke 64 such that moving the piston 58 turns the crank rings 52, which on their part change the pitch of the propeller blades 48. Figure 2a also shows the hub cap 66 having fins 68, the hub cap 66 being fastened by fastening means 70 to the hub body 42.

[0023] Figure 2b illustrates Detail A, i.e. the fastening means 70, of Figure 2a in an enlarged scale. For fastening the hub cap 66 to the hub body 42 the bolts 76 fastening the aft end cover 54 to the hub body 42 are used. The fastening means 70 are formed of a circular connection ring 72 attached coaxially to the hub body 42 by means of stud bolts 74 screwed to blind threaded axial holes 78 in the heads of the bolts 76. The outer diameter of the circular connection ring 72 is equal with the inner diameter of the hub cap 66 and the circular connection ring has a radial width and an axial thickness appropriate for its function, i.e. for supporting the hub cap on the aft end of the hub body. In place of headless stud bolts also ordinary bolts, like for instance bolts with a hexagonal head may be used. In case the heads of the bolts 76 are arranged below the aft end surface of the aft end cover 54 distance rings 80 are used to raise the position of the connection ring 72 to the support of the stud bolts 74 and distance rings 80 only. The connection ring 72 is pressed against the distance rings 80 and the heads of the bolts

76 by means of locking rings 82 and nuts 84 screwed on the stud bolts 74. The connection ring 72 has radial holes 86, preferably, but not necessarily blind holes, extending from the outer circumference of the connection ring 72 towards the inner circumference thereof. The hub cap 66 is provided with through holes 88 arranged such that their axes coincides with those of the holes 86 in the connection ring 72. In other words the distance of the axes of the holes 86 and 88 from the aft end surface of the hub body 42 is the same, and the number and position of the holes 86 and 88 in the circumference of the hub cap 66 and the connection ring 72 are the same. The hub cap 66 is attached to the connection ring 72 by means of dowels 90 pressed in the holes 88 and 86. The hole 88 in the hub cap 66 is provided with a threaded section 92 for a threaded plug 94, which is threaded in the threaded section 92 of the hole 88. The plugs 94 are needed to prevent the dowels from exiting the holes due to centrifugal force acting on the dowels when the propeller is running.

[0024] When preparing for the installation of the hub cap 66 to the aft end of the hub body 42, a part or all of the bolts 76 are provided with threaded blind holes 78 for fastening bolts 74, preferably but not necessarily stud bolts. The connection ring 72 having an outer diameter corresponding to the inner diameter of the hub cap 66 and a radial dimension extending to cover the bolts 76 is provided with axial holes 96 having the same dimensioning (the same number of holes with the same spacing on the same circumference) with the blind holes 78 in the bolts 76. The connection ring 72 is also provided with radial holes 86, preferably but not necessarily, in the same drilling phase with the radial holes 88 of the hub cap 66.

[0025] Figure 3a illustrates schematically the hub 40' and the hub cap 42' in accordance with a second preferred embodiment of the present invention. Here the basic construction of the hub is, in relation to the present invention, quite the same as in the first embodiment discussed in Figures 2a and 2b. In fact, the only difference in view of the present invention may be seen in the hub body 42' as the hub body of this embodiment does not have the axial extension as a separate aft end cover but such, i.e. the part of the hub containing the hydraulic cylinder, is an integral part of the hub body 42'. Anyway, the hub cap 66' is fastened to the aft end of the hub body by fastening means 70', which are shown in Detail B, illustrated in an enlarged scale in Figure 3b.

[0026] When preparing for the installation of a hub cap 66' on the aft end of the hub body 42' of Figure 3a, a connection ring 72' is manufactured such that its outer diameter corresponds to the inner diameter of the hub cap 66' and that it has sufficient thickness in both radial and axial directions. Thereafter the connection ring 72' is provided with a desired number of axial through holes 96' arranged, preferably but not necessarily, at equal intervals, for instance 20 holes arranged 18 degrees apart from one another on the same radius from the axis of the

connection ring. Next, the distance ring 72' is provided with radial blind holes 84' in its outer circumference. Again the holes 86' are, preferably but not necessarily, at equal intervals in the distance ring 72'. Next, the connection ring 72' is brought into communication with the hub body 42' to be used as a drilling template. The connection ring 72' is provided with at least three specific alignment tools for centralizing the ring 72' in relation to the hub body 42', and blind axial holes 78' are drilled in the hub body 42', whereby it is ensured that the holes 96' in the connection ring 72' and the holes 78' in the hub body match one another. And finally the blind holes 78' in the hub body 42' are threaded.

[0027] To start the installation of the hub cap 66' the connection ring 72' is fastened to the hub body 42' by means of bolts 74', if desired together with locking rings. Next, the hub cap 66', which is provided with radial through holes 88', possibly simultaneously with the drilling of the blind radial holes 86' in the connection ring 72', is positioned on the connection ring 72' and dowels 90 are pressed in the holes 88' and 86'. Thereafter the hole 88' in the hub cap 66', which is provided with a threaded section 92', is closed with a threaded plug 94', and preferably sealed in relation to the aft hub cap 66' with an O-ring. The plugs 94' are needed, on the one hand, to prevent any water from entering the holes and corroding the holes and/or the dowels therein and, on the other hand, to prevent the dowels from exiting the holes due to centrifugal force acting on the dowels when the propeller is running.

[0028] The hub cap is installed to the aft end of the hub body such that its opposite end, i.e. the aft end thereof, facing away from the hub body is not closed at all but the hub cap has a general shape of a truncated converging shell having an open interior. However, the interior of the hub cap is, for the most part thereof, closed by means of the axial extension, i.e. the aft end cover of the hub body or the hub body itself. In accordance with a first option the axial length of the hub cap is smaller than that of the axial extension. In other words, the hub cap covers the axial extension only partially, whereby the hub cap leaves, at its aft end, a gap between itself and the axial extension, the gap being, preferably but not necessarily, of the order of 10 - 30 mm, preferably approximately 20 mm. The main reason for such a gap is that at least the axial extension, maybe also the hub cap, is made by casting whereby the surface quality does not allow any closer gap. Furthermore such a gap is considered appropriate to ensure free water circulation, i.e. efficient flushing of the interior of the hub cap.

[0029] In accordance with a second option the hub cap extends to the full axial length of the axial extension, whereby a similar gap as above is left between the axial extension and the hub cap. In accordance with a third option the hub cap extends farther away from the hub than the axial extension. In such a case, again a similar gap is left between the interior surface of the hub cap and the outermost edge of the axial extension.

[0030] As to the various optional constructions it should be understood that the stud bolts used for fastening the connection ring 72 of Figures 2a and 2b to the aft end of the hub body 42, i.e. to the fastening bolts 76 may be replaced with ordinary hexagonal head bolts, whereby the use of one or more separate guide pins for facilitating the installation of the connection ring on the aft end of the hub body is preferred. Naturally the guide pins may be used in connection with the use of the stud bolts, too. Also, it should be understood that the dowels 90 and 90' are preferably provided with a central threaded blind hole, or some other appropriate means, facilitating the dismounting of the dowels when the hub cap is to be removed from the hub. Yet another alternative is to use bolts in place of the dowels and the plugs for tightening the hub gap against the connection ring. In such a case it is preferable to use a thread in the connection ring. In accordance with a further embodiment of the present invention the connection ring may be replaced with ring sectors comprising at least two holes for the fastening bolts, or with separate connection members, one for each fastening bolt. However, in view of positioning the connection ring, the sectors or separate connection members, or in fact the outer circumferential surface thereof, coaxial with the hub body, the use of a full one-part ring is the most preferred option due to the easy positioning thereof.

[0031] While the invention has been described herein by way of examples in connection with what are, at present, considered to be the most preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but is intended to cover various combinations or modifications of its features, and several other applications included within the scope of the invention, as defined in the appended claims. The details mentioned in connection with any embodiment above may be used in connection with another embodiment when such combination is technically feasible.

Claims

1. A propeller for a marine vessel, the propeller comprising a hub (40, 40') with a hub body (42, 42'), propeller blades (48), and a hub cap (66, 66') attached to an aft end of the hub body (42, 42'), the hub cap having an outer surface provided with fins (68), **characterized in that** the hub cap (66, 66') is fastened to the hub body (42, 42') by means of a separate circular connection ring (72, 72') coaxial with the hub body (42, 42'), that the connection ring (72, 72') is fastened to the inside of the hub cap (66, 66') by means of dowels (90, 90') pressed in coaxial radial holes (88, 86; 88', 86') in the hub cap (66, 66') and in the connection ring (72, 72'), respectively, and that the hole (88, 88') in the hub cap (66, 66') has a threaded section (92, 92') and that the hole (88, 88')

is closed and sealed by means of a plug (94, 94') threaded in the threaded section (92, 92') of the hole (88, 88').

2. The propeller as recited in claim 1, **characterized in that** the connection ring (72, 72') is fastened to the inside of the hub cap (66, 66') from outside the hub cap (66, 66').
3. The propeller as recited in any one of the preceding claims, **characterized in that** the connection ring (72, 72') is fastened to the hub body (42, 42') by means of bolts (74, 74').
4. The propeller as recited in any one of the preceding claims, **characterized in that** the hub (40) comprising an aft end cover (54) attached to the aft end of the hub body (42) by means of fastening bolts (76), at least a part of the fastening bolts (76) being provided with an axial threaded hole (78) and the bolts (74) fastening the hub cap (66) to the hub body (42) being threaded in the threaded holes (78) in the at least a part of the fastening bolt (76).
5. The propeller as recited in claim 4, **characterized in that** distance rings (80) positioned on the bolts (74) between the heads of the fastening bolts (76) and the connection ring (72).
6. The propeller as recited in claims 4 or 5, **characterized in that** the bolts (74) are stud bolts.
7. The propeller as recited in any one of the preceding claims 1 - 5, **characterized in that** the connection ring (72') being fastened directly to the hub body (42') by means of bolts (74') extending through axial holes (96') in the connection ring (72') into threaded holes (78') in the hub body (42').
8. The propeller as recited in any one of the preceding claims, **characterized in that** the hub cap (66, 66') is converging in a direction away from the hub body (42, 42').
9. The propeller as recited in claim 8, **characterized in that** the hub cap (66, 66') has a generally rotationally symmetrical, truncated converging shape.
10. The propeller as recited in claim 8 or 9, **characterized in that** the hub body (42, 42') has an axial extension (54), the hub cap (66, 66') covering at least partially the axial extension (54).
11. The propeller as recited in claim 10, **characterized in that** the hub cap (66, 66') leaves, at its aft end, a radial gap to the axial extension (54).
12. The propeller as recited in claim 10 or 11, **characterized in that** the axial extension has an axial length and that the hub cap (66, 66') extends to the full axial length of the axial extension (54).

terized in that the axial extension has an axial length and that the hub cap (66, 66') extends to the full axial length of the axial extension (54).

13. The propeller as recited in claim 10 or 11, **characterized in that** the axial extension (54) extends farther from the hub body (42, 42') than the hub cap (66, 66').
14. The propeller as recited in any one of the preceding claims, **characterized in that** the propeller is one of a fixed pitch propeller and a controllable pitch propeller.
15. A method of installing a hub cap on an aft end of a hub of a propeller, the propeller comprising a hub (40, 40') with a hub body (42, 42'), propeller blades (48) and a hub cap (66, 66'), the hub cap (62) having an outer surface provided with fins (68) and an inner surface having an inner diameter, **characterized by** the steps of
 - a) producing a circular connection ring (72, 72') to have an outer diameter equaling the inner diameter of the hub cap (66, 66'),
 - b) providing the hub cap (66, 66') with radial through holes (88, 88'),
 - c) providing the connection ring (72, 72') with radially extending blind holes (86, 86'),
 - d) providing the connection ring (72, 72') with axial through holes (96, 96'),
 - e) providing threaded holes (78, 78') in connection with the hub body (42, 42'),
 - f) fastening the connection ring (72, 72') to the aft end of the hub body (42, 42') by means of bolts (74, 74') threaded in the threaded holes (78, 78'),
 - g) mounting the hub cap (66, 66') on the connection ring (72, 72'), and
 - h) pressing dowels (90, 90') into the holes (88, 88'; 88', 86') for fastening the hub cap (66, 66') on the circular connection ring (72, 72').
16. The method as recited in claim 15, **characterized by** providing, after step b), the holes (88, 88') with a threaded section (92, 92'), and after step h) providing plugs (94, 94') into the threaded sections (92, 92').
17. The method as recited in claim 15, **characterized by** performing steps b) and c) simultaneously.
18. The method as recited in claim 15, **characterized by**, in step e), providing the threaded holes (78) in at least a part of bolts (76) used for fastening an aft end cover (54) to the aft end of the hub body (42).
19. The method as recited in claim 18, **characterized by**, after step e), threading stud bolts (74) in the

threaded holes (78, 78').

20. The method as recited in claim 19, **characterized by** inserting distance rings (80) on the stud bolts (74) prior to step f).

Patentansprüche

1. Propeller für ein Wasserfahrzeug, wobei der Propeller eine Nabe (40, 40') mit einem Nabenkörper (42, 42'), Propellerblätter (48) und eine Nabenkappe (66, 66'), die an einem hinteren Ende des Nabenkörpers (42, 42') angebracht ist, umfasst, wobei die Nabenkappe eine mit Rippen (68) bereitgestellte Außenfläche aufweist, **dadurch gekennzeichnet, dass** die Nabenkappe (66, 66') mittels eines separaten kreisförmigen Verbindungsrings (72, 72'), der koaxial zu dem Nabenkörper (42, 42') ist, an dem Nabenkörper (42, 42') befestigt ist, dass der Verbindungsring (72, 72') mittels Dübeln (90, 90'), die jeweils in koaxialen Bohrungen (88, 88'; 88', 86') in der Nabenkappe (66, 66') und in dem Verbindungsring (72, 72') eingepresst sind, an der Innenseite der Nabenkappe (66, 66') befestigt ist, und dadurch, dass die Bohrung (88, 88') in der Nabenkappe (66, 66') einen Gewindeabschnitt (92, 92') aufweist, und dass die Bohrung (88, 88') mittels eines in den Gewindeabschnitt (92, 92') der Bohrung (88, 88') eingeschraubten Stopfens (94, 94') verschlossen und abgedichtet ist.
2. Propeller nach Anspruch 1, **dadurch gekennzeichnet, dass** der Verbindungsring (72, 72') von der Außenseite der Nabenkappe (66, 66') aus an der Innenseite der Nabenkappe (66, 66') befestigt ist.
3. Propeller nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Verbindungsring (72, 72') mittels Bolzen (74, 74') an dem Nabenkörper (42, 42') befestigt ist.
4. Propeller nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Nabe (40) eine hintere Endabdeckung (54) umfasst, die mittels Befestigungsbolzen (76) an dem hinteren Ende des Nabenkörpers (42) angebracht sind, wobei mindestens ein Teil der Befestigungsbolzen (76) mit einer axialen Gewindebohrung (78) bereitgestellt ist und die Bolzen (74), die die Nabenkappe (66) an dem Nabenkörper (42) befestigen, in die Gewindebohrungen (78) in dem mindestens einen Teil des Befestigungsbolzens (76) eingeschraubt sind.
5. Propeller nach Anspruch 4, **gekennzeichnet durch** Abstandsringe (80), die auf den Bolzen (74) zwischen den Köpfen der Befestigungsbolzen (76) und dem Verbindungsring (72) angeordnet sind.
6. Propeller nach Anspruch 4 oder 5, gekennzeichnet, dass die Bolzen (74) Stehbolzen sind.
7. Propeller nach einem der vorhergehenden Ansprüche 1-5, **dadurch gekennzeichnet, dass** der Verbindungsring (72') mittels Bolzen (74'), die sich durch axiale Bohrungen (96') in dem Verbindungsring (72') hindurch in Gewindebohrungen (78') in dem Nabenkörper (42') hinein erstrecken, direkt an dem Nabenkörper (42') befestigt ist.
8. Propeller nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Nabenkappe (66, 66') in einer Richtung weg von dem Nabenkörper (42, 42') konvergiert.
9. Propeller nach Anspruch 8, **dadurch gekennzeichnet, dass** die Nabenkappe (66, 66') eine im Allgemeinen rotationssymmetrische, kegelstumpfförmige konvergierende Form aufweist.
10. Propeller nach Anspruch 8 oder 9, **dadurch gekennzeichnet, dass** der Nabenkörper (42, 42') eine axiale Erweiterung (54) aufweist, wobei die Nabenkappe (66, 66') die axiale Erweiterung (54) zumindest teilweise bedeckt.
11. Propeller nach Anspruch 10, **dadurch gekennzeichnet, dass** die Nabenkappe (66, 66'), an ihrem hinteren Ende, eine radiale Lücke zu der axialen Verlängerung (54) belässt.
12. Propeller nach Anspruch 10 oder 11, **dadurch gekennzeichnet, dass** die axiale Erweiterung eine axiale Länge aufweist, und dass sich die Nabenkappe (66, 66') über die volle axiale Länge der axialen Erweiterung (54) erstreckt.
13. Propeller nach Anspruch 10 oder 11, **dadurch gekennzeichnet, dass** sich die axiale Erweiterung (54) weiter von dem Nabenkörper (42, 42') weg erstreckt als die Nabenkappe (66, 66').
14. Propeller nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Propeller einer von einem Festpropeller und einem Verstellpropeller ist.
15. Verfahren zum Installieren einer Nabenkappe an einem hinteren Ende einer Nabe eines Propellers, wobei der Propeller eine Nabe (40, 40') mit einem Nabenkörper (42, 42'), Propellerblätter (48) und eine Nabenkappe (66, 66') umfasst, wobei die Nabenkappe (66, 66') eine Außenfläche, die mit Rippen (68) bereitgestellt ist, und eine Innenfläche mit einem Innendurchmesser aufweist, **gekennzeichnet durch** die folgenden Schritte

- a) Herstellen eines kreisförmigen Verbindungs-
rings (72, 72') so, dass er einen Außendurch-
messer aufweist, der dem Innendurchmesser
der Nabenkappe (66, 66') entspricht,
- b) Bereitstellen der Nabenkappe (66, 66') mit
radialen Durchgangsbohrungen (88, 88'),
- c) Bereitstellen des Verbindungsrings (72, 72')
mit sich radial erstreckenden Sackbohrungen
(86, 86'),
- d) Bereitstellen des Verbindungsrings (72, 72')
mit axialen Durchgangsbohrungen (96, 96'),
- e) Bereitstellen von Gewindebohrungen (78,
78') in Verbindung mit dem Nabenkörper (42,
42'),
- f) Befestigen des Verbindungsrings (72, 72') an
dem hinteren Ende des Nabenkörpers (42, 42')
mittels Bolzen (74, 74'), die in die Gewindeboh-
rungen (78, 78') eingeschraubt werden,
- g) Anbringen der Nabenkappe (66, 66') an dem
Verbindungsring (72, 72'), und
- h) Einpressen von Dübeln (90, 90') in die Boh-
rungen (88, 86; 88', 86') zum Befestigen der Na-
benkappe (66, 66') an dem kreisförmigen Ver-
bindungsring (72, 72').
16. Verfahren nach Anspruch 15, **gekennzeichnet
durch** Bereitstellen, nach Schritt b), der Bohrungen
(88, 88') mit einem Gewindeabschnitt (92, 92'), und,
nach Schritt h), Bereitstellen von Stopfen (94, 94')
in den Gewindeabschnitten (92, 92').
17. Verfahren nach Anspruch 15, **gekennzeichnet
durch** gleichzeitiges Durchführen der Schritte b) und
c).
18. Verfahren nach Anspruch 15, **gekennzeichnet
durch**, in Schritt e), Bereitstellen der Gewindeboh-
rungen (78) in mindestens einem Teil der Bolzen
(76), die zum Befestigen einer hinteren Endabde-
ckung (54) an dem hinteren Ende des Nabenkörpers
(42) verwendet werden.
19. Verfahren nach Anspruch 18, **gekennzeichnet
durch**, nach Schritt e), Einschrauben der Stehbol-
zen (74) in die Gewindebohrungen (78, 78').
20. Verfahren nach Anspruch 19, **gekennzeichnet
durch** Einsetzen von Abstandsringen (80) an den
Stehbolzen (74) vor Schritt f).
- extérieure pourvue d'ailettes (68), **caractérisée en
ce que** le chapeau de moyeu (66, 66') est fixé au
corps de moyeu (42, 42') à l'aide d'une bague de
connexion (72, 72') circulaire séparée, laquelle est
coaxiale avec le corps de moyeu (42, 42'), **en ce
que** la bague de connexion (72, 72') est fixée à l'in-
térieur du chapeau de moyeu (66, 66') à l'aide de
chevilles (90, 90') enfoncées dans des trous radiaux
coaxiaux (88, 86 ; 88', 86') dans le chapeau de
moyeu (66, 66') et dans la bague de connexion (72,
72'), respectivement, et **en ce que** le trou (88, 88')
dans le chapeau de moyeu (66, 66') comporte une
section fileté (92, 92') et **en ce que** le trou (88, 88')
est fermé et scellé à l'aide d'un bouchon (94, 94')
vissé dans la section fileté (92, 92') du trou (88, 88').
2. Hélice selon la revendication 1, **caractérisée en ce
que** la bague de connexion (72, 72') est fixée à l'in-
térieur du chapeau de moyeu (66, 66') depuis l'ex-
térieur du chapeau de moyeu (66, 66').
3. Hélice selon l'une quelconque des revendications
précédentes, **caractérisée en ce que** la bague de
connexion (72, 72') est fixée au corps de moyeu (42,
42') à l'aide de boulons (74, 74').
4. Hélice selon l'une quelconque des revendications
précédentes, **caractérisée en ce que** le moyeu (40)
comprend un couvercle d'extrémité arrière (54) at-
taché à l'extrémité arrière du corps de moyeu (42) à
l'aide de boulons de fixation (76), au moins une partie
des boulons de fixation (76) étant pourvus d'un trou
fileté axial (78) et les boulons (74) fixant le chapeau
de moyeu (66) au corps de moyeu (42) étant vissés
dans les trous filetés (78) dans ladite au moins une
partie des boulons de fixation (76).
5. Hélice selon la revendication 4, **caractérisée en ce
que** des bagues de distanciation (80) positionnées
sur les boulons (74) entre les têtes des boulons de
fixation (76) et la bague de connexion (72).
6. Hélice selon la revendication 4 ou 5, **caractérisée
en ce que** les boulons (74) sont des goujons.
7. Hélice selon l'une quelconque des revendications 1
à 5, **caractérisée en ce que** la bague de connexion
(72') est fixée directement au corps de moyeu (42')
à l'aide de boulons (74') s'étendant à travers des
trous axiaux (96') dans la bague de connexion (72')
dans des trous filetés (78') dans le corps de moyeu
(42').
8. Hélice selon l'une quelconque des revendications
précédentes, **caractérisée en ce que** le chapeau
de moyeu (66, 66') converge dans une direction op-
posée au corps de moyeu (42, 42').
- ### Revendications
1. Hélice de navire, l'hélice comprenant un moyeu (40,
40') avec un corps de moyeu (42, 42'), des pales
d'hélice (48) et un chapeau de moyeu (66, 66') atta-
ché à une extrémité arrière du corps de moyeu (42,
42'), le chapeau de moyeu présentant une surface

9. Hélice selon la revendication 8, **caractérisée en ce que** le chapeau de moyeu (66, 66') présente une forme convergente tronconique généralement symétrique en rotation.
10. Hélice selon la revendication 8 ou 9, **caractérisée en ce que** le corps de moyeu (42, 42') présente une extension axiale (54), le chapeau de moyeu (66, 66') recouvrant au moins partiellement l'extension axiale (54).
11. Hélice selon la revendication 10, **caractérisée en ce que** le chapeau de moyeu (66, 66') laisse, à son extrémité arrière, un interstice radial par rapport à l'extension axiale (54).
12. Hélice selon la revendication 10 ou 11, **caractérisée en ce que** l'extension axiale présente une longueur axiale et **en ce que** le chapeau de moyeu (66, 66') s'étend sur toute la longueur axiale de l'extension axiale (54).
13. Hélice selon la revendication 10 ou 11, **caractérisée en ce que** l'extension axiale (54) s'étend plus loin du corps de moyeu (42, 42') que le chapeau de moyeu (66, 66').
14. Hélice selon l'une quelconque des revendications précédentes, **caractérisée en ce que** l'hélice est l'une parmi une hélice à pas fixe et une hélice à pas variable.
15. Procédé pour l'installation d'un chapeau de moyeu sur une extrémité arrière d'un moyeu d'hélice, l'hélice comprenant un moyeu (40, 40') avec un corps de moyeu (42, 42'), des pales d'hélice (48) et un chapeau de moyeu (66, 66'), le chapeau de moyeu (66, 66') présentant une surface extérieure pourvue d'aillettes (68) et une surface intérieure présentant un diamètre intérieur, **caractérisé par** les étapes suivantes :
- a) production d'une bague de connexion (72, 72') circulaire pour obtenir un diamètre extérieur égal au diamètre intérieur du chapeau de moyeu (66, 66'),
- b) réalisation de trous de passage radiaux (88, 88') dans le chapeau de moyeu (66, 66'),
- c) la réalisation de trous borgnes (86, 86') s'étendant radialement dans la bague de connexion (72, 72'),
- d) réalisation de trous de passage axiaux (96, 96') dans la bague de connexion (72, 72'),
- e) réalisation de trous filetés (78, 78') en connexion avec le corps de moyeu (42, 42'),
- f) fixation de la bague de connexion (72, 72') à l'extrémité arrière du corps de moyeu (42, 42') à l'aide de boulons (74, 74') vissés dans les trous filetés (78, 78'),
- g) montage du chapeau de moyeu (66, 66') sur la bague de connexion (72, 72'), et
- h) enfonçage de chevilles (90, 90') dans les trous (88, 86 ; 88', 86') pour fixer le chapeau de moyeu (66, 66') sur la bague de connexion circulaire (72, 72').
16. Procédé selon la revendication 15, **caractérisé en ce qu'**après l'étape b), les trous (88, 88') sont pourvus d'une section filetée (92, 92') et, après l'étape h), les bouchons (94, 94') sont placés dans les sections filetées (92, 92').
17. Procédé selon la revendication 15, **caractérisé en ce que** les étapes b) et c) sont exécutées simultanément.
18. Procédé selon la revendication 15, **caractérisé en ce que** dans l'étape e), les trous filetés (78) sont réalisés dans une partie au moins des boulons (76) utilisés pour fixer un couvercle d'extrémité arrière (54) à l'extrémité arrière du corps de moyeu (42).
19. Procédé selon la revendication 18, **caractérisé en ce qu'**après l'étape e), des goujons (74) sont vissés dans les trous filetés (78, 78').
20. Procédé selon la revendication 19, **caractérisé en ce que** des bagues de distanciation (80) sont insérées sur les goujons (74) avant l'étape f).

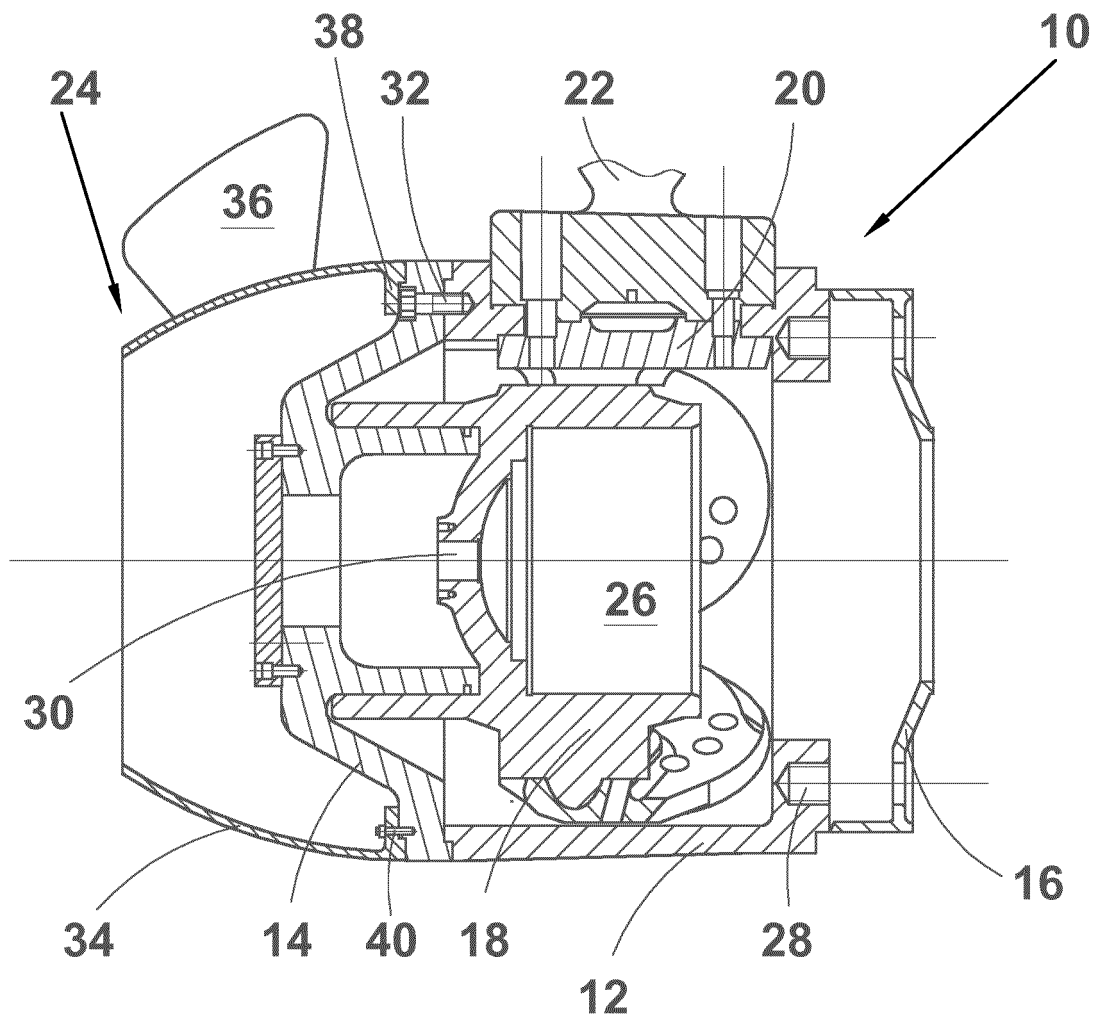


Fig. 1

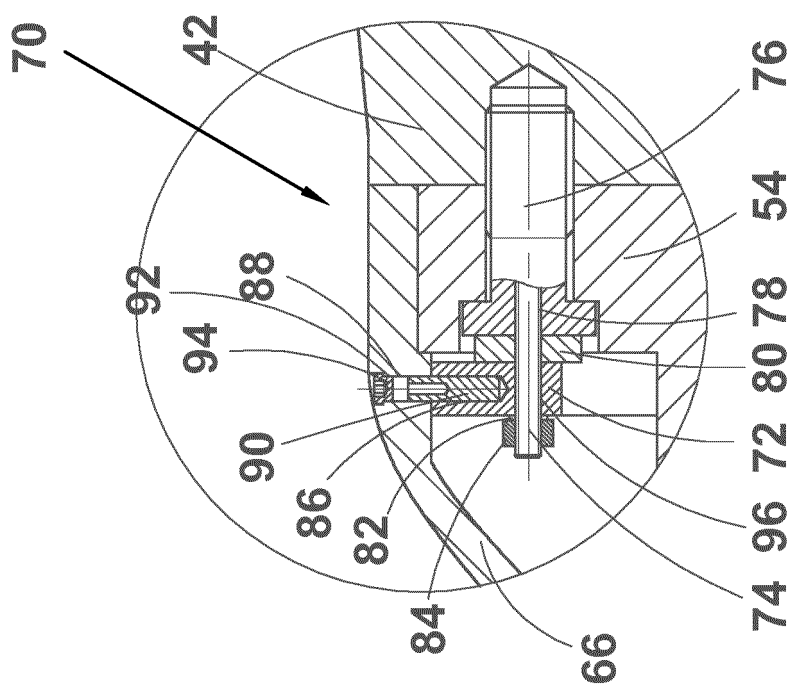


Fig. 2a

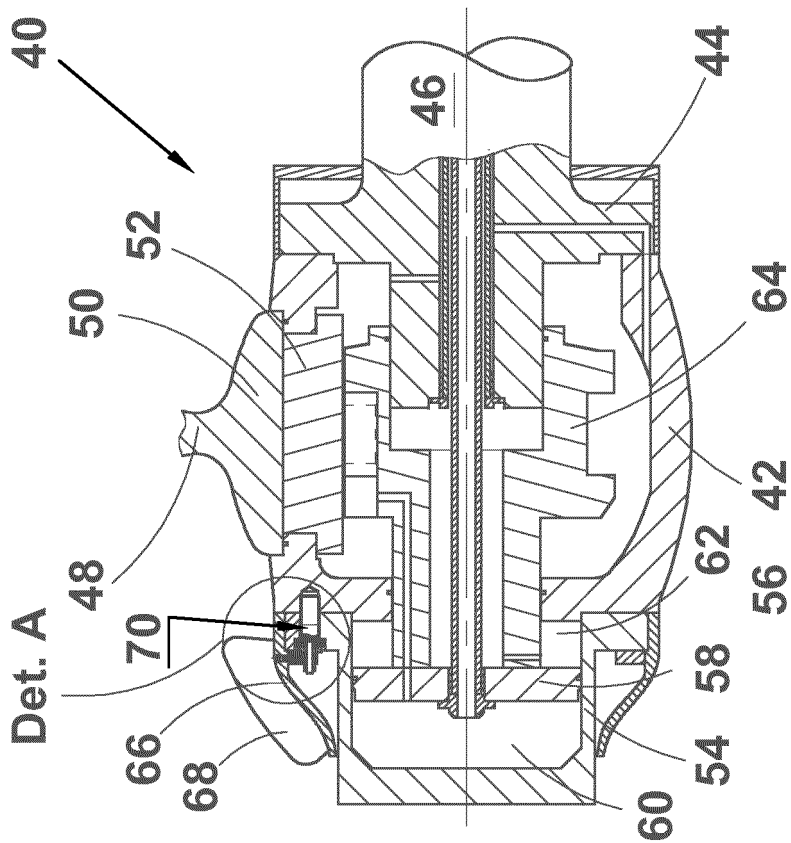


Fig. 2b (Det. A)

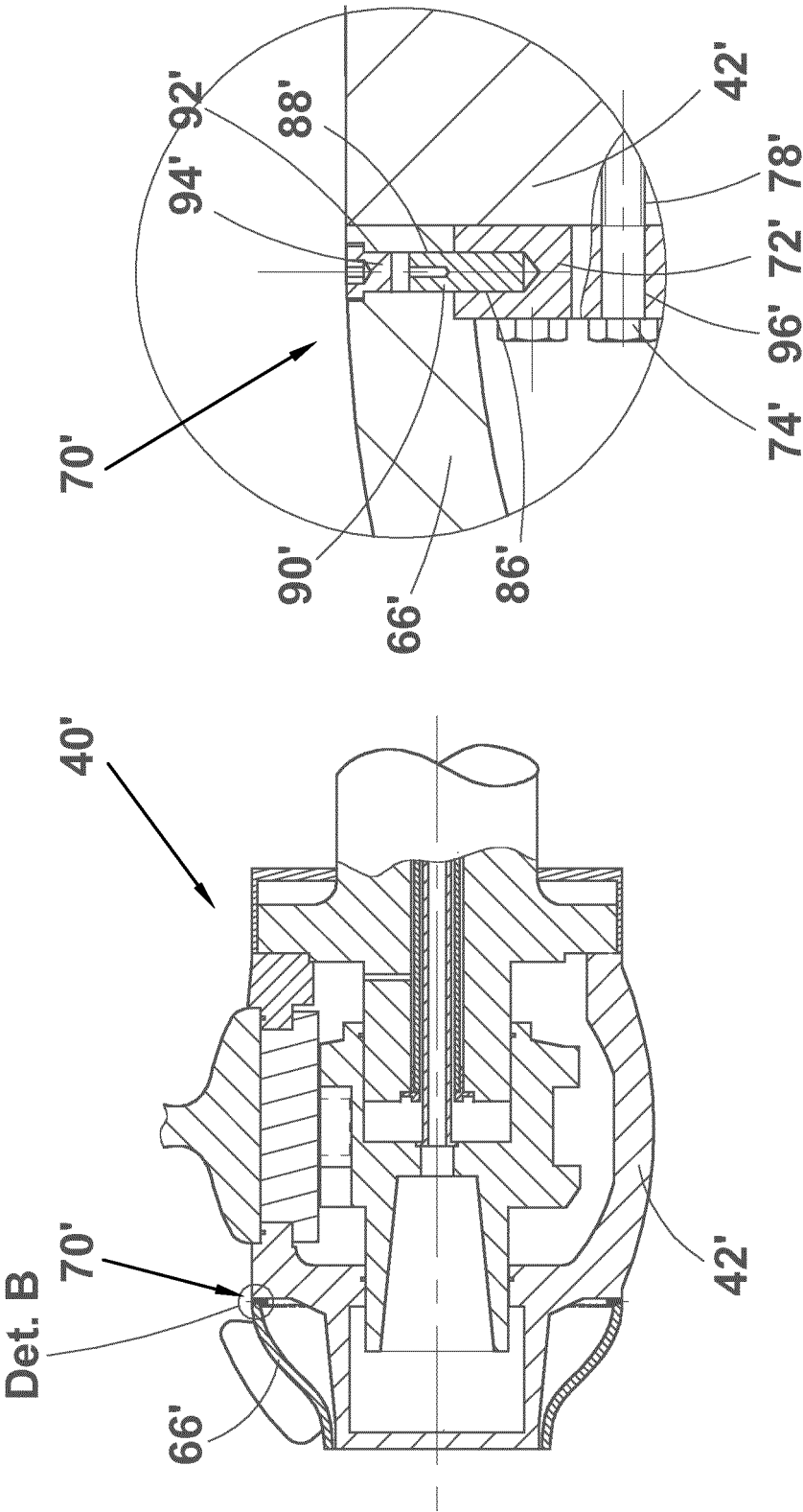


Fig. 3b (Det. B)

Fig. 3a

REFERENCES CITED IN THE DESCRIPTION

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