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(54) **ARRANGEMENT IN CONNECTION WITH A PROPELLER WITH ANGULARLY ADJUSTABLE  
BLADES**

ANORDNUNG IN VERBINDUNG MIT EINEM PROPELLER MIT WINKELFÖRMIG EINSTELLBAREN  
BLÄTTERN

MECANISME DESTINE A UNE HELICE POURVUE DE PALES A ANGLE REGLABLE

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## Description

### TECHNICAL FIELD

**[0001]** The invention relates to an arrangement for an adjustable propeller for vessels comprising a propeller and a drive shaft extending through the hull, at least two propeller blades which are each mounted rotatably in a respective bearing seat, a propeller boss, a supply duct arranged in the said propeller boss for supplying lubricant to the said bearing seat, and a cavity for accommodating the lubricant.

**[0002]** The invention also relates to a method for lubricating a bearing seat in an arrangement for an adjustable propeller for vessels, lubricant being supplied to the bearing seat through a duct to a cavity in the propeller boss.

### BACKGROUND ART

**[0003]** Construction solutions with adjustable propellers for vessels have been developed in order for it to be possible better to adapt the speed of the engine to the speed at which the vessel is to proceed at the same time as good manoeuvrability is obtained.

**[0004]** In order to make a propeller adjustable, that is to say to make it possible for the propeller to be set at different angles, a number of moving parts are required. These moving parts have to be lubricated in order that corrosion, fatigue failure and unnaturally high wear do not occur on them. Lubricant, usually oil, is therefore arranged in the bearing seats in which the rotary joints which rotate the propeller blades are arranged.

**[0005]** Seals are arranged around the openings in the bearing housings in order to ensure that water does not leak into the bearing housings and that lubricant does not leak out. If a seal should fail or a leak should occur for some other reason and water finds its way into the lubricant, it will lubricate the moving parts less effectively, resulting in increased wear, corrosion and fatigue failure of non-stainless materials. Experience has shown that oil leaks out and water penetrates at the same time when the seals or the bearing seats have become worn.

**[0006]** In order to reduce the consequences of water leaking into the lubricant, the bearing housings have been provided with an inlet duct for lubricant, which is connected to a gravitation tank containing lubricant. In the event of leakage occurring, new lubricant will be added by means of the gravitation from the tank of lubricant. This counteracts the system being filled with water.

**[0007]** However, the construction with a gravitation tank does not solve the problem of seawater leaking in. A problem consequently remains in ensuring that lubricant does not leak out and that seawater does not leak in.

**[0008]** US 6,042,337 disclose a sealing system for a hydraulic machine which comprises a runner or a rotor with a hub body and blades which are rotatably journaled in oil lubricated bearings. The hub comprises a body chamber which is arranged with a limited amount of oil,

just enough so that upon rotation of the runner or rotor, the oil is pressed against the hub wall.

**[0009]** In order to ensure that the lubricant does not have too high a content of water, it happens that vessels have to be taken out of operation between the scheduled operational stops, and the propeller boss has to be renovated. However, this involves great cost. A problem therefore exists with the unscheduled withdrawal of vessels from operation for renovation of propeller bosses when the lubricant in the propeller boss contains too high a content of water.

### DISCLOSURE OF INVENTION

**[0010]** The abovementioned problems are solved by the invention by virtue of the fact that the cavity in the propeller boss is completely filled with lubricant which is under positive pressure, and that the propeller boss also comprises an outlet duct for return flow of the said lubricant from the said bearing seat in the propeller boss out through the propeller boss, the ducts being interconnected so that circulation of lubricant through the propeller boss is brought about.

**[0011]** According to a preferred embodiment, the outlet duct is arranged in the drive shaft. It is possible within the scope of the invention, however, to arrange the duct elsewhere. The inlet duct is preferably also arranged in the drive shaft. Both the inlet duct and the outlet duct can, for example, be arranged on the outside of the drive shaft.

**[0012]** According to an alternative embodiment of the invention, the circulation system comprises a measuring device for measuring the state of the lubricant. This state measurement can involve, for example, measuring the water content of the lubricant.

**[0013]** According to another embodiment of the invention, a device for regenerating the lubricant is connected to the circulation system.

**[0014]** The abovementioned problems are also solved by the invention by a method for lubricating a bearing housing in an arrangement for an adjustable propeller for ships, the cavity being completely filled with lubricant, arrangement being made such that the lubricant is under positive pressure and is conveyed away from the bearing housing through a duct, and in this way circulation of lubricant being brought about.

**[0015]** According to an alternative embodiment of the invention, a method according to the invention is characterized in that measurement of the state of the lubricant is performed between the lubricant having left the bearing housing and it being supplied to the bearing housing. The state measured can be, for example, the moisture content of the lubricant. In this way, the state of the lubricant can be measured continuously, and measures can be taken before there has been any effect on the parts to be lubricated.

**[0016]** According to a further embodiment of the invention, the lubricant is regenerated between it having left the bearing housing via the drive shaft and it being re-

turned to the bearing housing. Continued operation of the vessel is made possible by the circulation step and the regeneration step incorporated therein.

## DESCRIPTION OF FIGURES

### [0017]

Figure 1 shows a general diagram of a propeller and its drive.

Figure 2 shows a circulation arrangement according to the invention.

Figure 3 shows a detail of a circulation arrangement according to the invention.

Figure 4 shows an enlargement of Figure 3 in the area of the inlet duct in which the lubricant is introduced.

Figure 5 shows an enlargement of Figure 3 in the area of the outlet duct through which the lubricant is conveyed out.

## DETAILED DESCRIPTION OF THE INVENTION

**[0018]** Figure 1 shows a general illustration of a vessel propeller 22 arranged on a hull 23 and its drive 24. The propeller 22 comprises a propeller boss 17 and propeller blades 25. The driving of the propeller 22 is effected by means of an engine 26, via a gear 27, and a drive shaft 20. The drive shaft 20 is arranged essentially horizontally in the vessel.

**[0019]** Figure 2 shows a circulation arrangement for an adjustable propeller according to the invention. The propeller boss 17 is lubricated by a lubricant. The flow direction of the lubricant is shown by arrows in Figure 2. The flow direction of the hydraulic fluid is shown in the same way by arrows in Figures 2 and 3. In the embodiment shown, the hydraulic system and the lubrication system are interconnected. Lubricant and hydraulic fluid consequently consist of the same medium. It is possible within the scope of the invention, however, to design the lubricant and hydraulic fluid systems as separate systems. Not all the parts of the hydraulic system are illustrated in the figure, as the hydraulic system is not the subject of the invention. The arrangement comprises a first tank 1 for lubricant, and a conveying line 2 for conveying lubricant for a propeller boss 17 (shown in Figure 3). A pressure oil box 4 distributes lubricant to the boss 17. The lubricant usually used is oil, for example mineral oil, synthetic oil or vegetable oil, or another liquid suitable for the purpose.

**[0020]** The conveying line 2 leads to a pipe connection 3 on the pressure oil box 4 for the lubricant. The pipe connection is connected to an inlet duct 5. The inlet duct 5 then leads to a cavity 21 (shown in Figure 3) where the

moving parts of the boss are located. The whole boss, that is to say the whole cavity 21, is filled with lubricant. The volume of lubricant in the boss will vary slightly with the inward and outward movement in the cavity 21 performed by the piston rod 31 of the hydraulic system. From the cavity 21, the lubricant is returned through an outlet duct 6 which, at its outer end, is connected to a second conveying line 7 for return flow of lubricant. Both the inlet duct 5 and the outlet duct 6 are arranged in a gear shaft 18 and a drive shaft 20. The second conveying line 7 is connected to a second tank 8. The second tank is a reservoir for oil for the hydraulic system of the arrangement. The first tank 1 and the second tank 8 are interconnected to form a circulation system. The first tank 1 is located higher than the second tank 8. In this way, circulation driven by gravitation is brought about in the system. Lubricant flows out from the first tank 1 for lubrication in the boss 17.

**[0021]** The lubricant flows back to the second tank 8. A level monitor (not shown in figure) arranged in the first tank 1 senses when the level in the tank 1 is too low. A pump 9 is then started, which pumps lubricant from the second tank 8 to the first tank 1. The circulation according to the invention can be arranged in ways other than the two-tank system described. For example, it can be driven by a pump. The circulation system is driven under positive pressure, that is to say the pressure of the lubricant is higher than the surrounding water pressure. This is in order to reduce the risks of water leaking into the lubricant circulation system.

**[0022]** Assigned to the circulation system, in conjunction with the second tank 8, is a measuring device 10 for measuring the moisture content of the lubricant. The measuring device can be connected to a display in conjunction with the circulation system or a display on the bridge. The measuring device 10 is a moisture content meter of the HMP228 type from Vaisala. This measuring device measures how the capacitance of a polymer film changes when it takes up water. It is also possible for other measuring methods for moisture content measurement to be used in connection with the circulation system. It is also possible to connect other measuring devices to the system, which measure states of the lubricant other than the moisture content. It is also possible to connect regeneration devices to the circulation system in order to restore the lubricant, for example by virtue of the moisture content being reduced. A regeneration device 36 is suitably arranged in conjunction with the second tank 8.

**[0023]** Figure 2 also shows a forward pitch duct 11 and a backward pitch duct 12 for conveying hydraulic fluid to the hydraulic system which controls the pitch angle of the propeller blades. From the tank 8, the hydraulic fluid is conveyed to a forward pitch inlet 13 for inlet and outlet of hydraulic fluid and a backward pitch inlet 14, arranged close to the forward pitch inlet 13, for inlet and outlet of hydraulic fluid. The hydraulic system functions in such a way that hydraulic fluid is pumped into the forward pitch inlet and through the forward pitch duct 11 when the

speed of the vessel is to be increased or when operation is to be changed from backward operation to forward operation. Hydraulic fluid is pumped into the backward pitch inlet 14 and through the backward pitch duct 12 when the speed of the vessel is to be reduced or forward operation is to be changed to backward operation. Figure 2 also shows a gear shaft 18 and a flange 19 against the gear. The arrangement changes the speed of the engine of the vessel to the speed desired for operation of the propeller.

**[0024]** Figure 3 shows a detail of the circulation system in the boss 17. The cavity 21 is seen here. Also shown is a hydraulic servo 28 for the adjustability of the propeller. The hydraulic servo 28 comprises a piston 29, a chamber for forward pitch 15 and a chamber for backward pitch 16. The hydraulic system is described below with reference to Figures 2 and 3. A hydraulic unit 30 is connected to the forward pitch inlet 13 and the backward pitch inlet 14. The hydraulic unit 30 is constructed according to known art. The hydraulic unit 30 is controlled from the bridge or elsewhere in the vessel so as to pump the hydraulic fluid to and from the forward pitch inlet 13 and the backward pitch inlet 14. The hydraulic fluid is conveyed through the forward pitch duct 11 and the backward pitch duct 12 through the gear shaft 18 and the drive shaft 20 to the propeller boss 17. The forward pitch duct 11 opens centrally into the forward pitch chamber 15. The backward pitch duct 12 runs out through a hole in a piston rod 31 arranged in the drive shaft 20, so that the hydraulic fluid flows out into the backward pitch chamber 16. By pumping the hydraulic fluid out of or into the forward pitch chamber 15 and the backward pitch chamber 16 alternately, the piston 29 is made to move axially in one or other direction. The direction of movement of the piston is marked in Figure 3 by a double arrow.

**[0025]** The adjustability of the propeller is described below with reference to Figures 3 and 4. When the piston 29 moves in one or other direction in the boss 17, the piston rod 31 moves with the piston 29. Figure 4 shows another detail of the circulation system in the boss 17 according to the invention. Here, the inlet duct 5 for the lubricant, arranged in the piston rod 31 in the boss 17, is shown in detail. Arranged on the piston rod is a piston rod head 37. A groove 32 is arranged in the piston rod head. Four such grooves are arranged in the piston rod head 37, one for each propeller blade 25. A blade block 33 runs in each of these grooves. The blade block 33 is moved axially by means of the groove 32. Arranged in conjunction with the blade block 33 is a crank pin ring 38. A pin 34 is present as part of the crank pin ring 38. The blade block 33 is mounted movably on the pin 34, which is connected firmly to the screws 35 which are arranged on the outside of the boss 17 and is in this way also connected firmly to the propeller blade 25. When the blade block 33 moves axially, the pin 34 moves in a radius and brings about rotation of the propeller blade 25. The crank pin ring 38 and the propeller blade 25 are arranged rotatably in a bearing seat 39.

**[0026]** Figures 5 shows another detail of the circulation system in the boss 17 according to the invention. Here, the outlet duct 6 for lubricant, also arranged in the drive shaft 20, is seen

## Claims

1. An arrangement for an adjustable propeller for vessels comprising a propeller (22) and a drive shaft (20) extending through the hull, at least two propeller blades (25) which are each mounted rotatably in a respective bearing seat, a propeller boss (17), a supply duct (5) arranged in the said propeller boss (17) for supplying lubricant to the said seat, and a cavity (21) for accommodating the lubricant, **characterized in that** the entire cavity (21) is arranged to be filled with lubricant under positive pressure by means of a pressurizing source of lubricant (4), and in that the propeller boss (17) also comprises an outlet duct (6) for return flow of the said lubricant from the said bearing seat in the propeller boss (17) out through the propeller boss (17), the ducts (5), (6) being interconnected outside the boss (17) so that circulation of lubricant through the propeller boss (17) is brought about.
2. An arrangement according to Claim 1, **characterized in that** the outlet duct (6) is arranged in the drive shaft (20).
3. An arrangement according to Claim 1 or 2, **characterized in that** the inlet duct (5) is arranged in the drive shaft (20).
4. An arrangement according to any one of the preceding claims, **characterized in that** the circulation system comprises a measuring device (10) for measuring the state of the lubricant.
5. An arrangement according to Claim 4, **characterized in that** the state measured by the measuring device (10) is the moisture content of the lubricant.
6. An arrangement according to any one of the preceding claims, **characterized in that** the circulation system comprises a device for regenerating (36) the lubricant.
7. A method for lubricating a propeller boss (17) in an arrangement for an adjustable propeller for vessels, lubricant being supplied to a cavity (21) in the propeller boss (17) through a supply duct (5), **characterized by** filling the entire cavity (21) with lubricant under positive pressure by means of a pressurizing source of lubricant (4);

- conveying away said lubricant from the propeller boss (17) through a duct (6) and;
  - circulating said lubricant back to said propeller boss (17)
8. A method for lubricating a propeller boss (17) according to Claim 7, **characterized in that** measurement of the state of the lubricant is performed between the lubricant having left the propeller boss (17) and it being supplied to the propeller boss (17).
9. A method for lubricating a propeller boss according to Claim 8, **characterized in that** the state measured is the water content of the lubricant.
10. A method for lubricating a propeller boss (17) according to any one of Claims 7-9, **characterized in that** the lubricant is regenerated between the lubricant having left the propeller boss (17) and it being supplied to the propeller boss (17).

#### Patentansprüche

1. Anordnung für eine einstellbare Schiffsschraube, umfassend eine Schraube (22) und eine sich durch den Rumpf erstreckende Antriebswelle (20), zumindest zwei Schraubenblätter (25), die jeweils in einem entsprechenden Lagersitz drehbar befestigt sind, eine Schraubennabe (17), einen in der Schraubennabe (17) angeordneten Zuführkanal (5) zum Zuführen eines Schmiermittels zum Sitz, und einen Hohlraum (21) zum Aufnehmen des Schmiermittels, **dadurch gekennzeichnet, dass** der gesamte Hohlraum (21) mittels einer Schmiermittel-Bedruckungsquelle (4) unter einem positiven Druck befüllt werden kann, und **dadurch**, dass die Schraubennabe (17) ebenso einen Auslasskanal (6) für einen Rückführstrom des Schmiermittels vom Lagersitz in der Schraubennabe (17) heraus durch die Schraubennabe (17) umfasst, wobei die Kanäle (5, 6) außerhalb der Nabe (17) derart gekoppelt sind, dass eine Zirkulation des Schmiermittels durch die Schraubennabe (17) herbeigeführt wird.
2. Anordnung gemäß Anspruch 1, **dadurch gekennzeichnet, dass** der Auslasskanal (6) in der Antriebswelle (20) angeordnet ist.
3. Anordnung gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** der Einlasskanal (5) in der Antriebswelle (20) angeordnet ist.
4. Anordnung gemäß einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** das Zirkulationssystem eine Messvorrichtung (10) zum Messen des Zustands des Schmiermittels umfasst.

5. Anordnung gemäß Anspruch 4, **dadurch gekennzeichnet, dass** der durch die Messvorrichtung (10) gemessene Zustand der Feuchtigkeitsgehalt des Schmiermittels ist.

6. Anordnung gemäß einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** das Zirkulationssystem eine Vorrichtung zum Regenerieren (36) des Schmiermittels umfasst.

7. Verfahren zum Schmieren einer Schraubennabe (17) in einer Anordnung für eine einstellbare Schiffsschraube, wobei ein Schmiermittel durch einen Zuführkanal (5) zu einem Hohlraum (21) in der Schraubennabe (17) zugeführt wird, **gekennzeichnet durch:**

Befüllen des gesamten Hohlraumes (21) mit Schmiermittel mittels einer Schmiermittel-Bedruckungsquelle (4) unter einem positiven Druck, Wegführen des Schmiermittels von der Schraubennabe (17) durch einen Kanal (6), und Zirkulieren des Schmiermittels zurück zur Schraubennabe (17) .

8. Verfahren zum Schmieren einer Schraubennabe (17) gemäß Anspruch 7, **dadurch gekennzeichnet, dass** eine Messung des Zustands des Schmiermittels ausgeführt wird, nachdem das Schmiermittel die Schraubennabe (17) verlassen hat und bevor es zur Schraubennabe (17) zugeführt wird.
9. Verfahren zum Schmieren einer Schraubennabe (17) gemäß Anspruch 8, **dadurch gekennzeichnet, dass** der gemessene Zustand der Wassergehalt des Schmiermittels ist.
10. Verfahren zum Schmieren einer Schraubennabe (17) gemäß einem der Ansprüche 7-9, **dadurch gekennzeichnet, dass** das Schmiermittel regeneriert wird, nachdem das Schmiermittel die Schraubennabe (17) verlassen hat und bevor es zur Schraubennabe (17) zugeführt wird.

#### Revendications

1. Agencement pour une hélice réglable de vaisseaux comprenant une hélice (22) et un arbre d'entraînement (20) s'étendant à travers la coque, au moins deux pales d'hélice (25) qui sont montées chacune de manière rotative dans un siège de palier respectif, un moyeu d'hélice (17), un conduit d'alimentation (5), disposé dans ledit moyeu d'hélice (17) pour amener un lubrifiant audit siège, et une cavité (21) pour recevoir le lubrifiant, **caractérisé en ce que** la totalité de la cavité (21) est conçue de manière

- à être remplie de lubrifiant à une pression positive au moyen d'une source de mise en pression du lubrifiant (4), et en ce que le moyeu d'hélice (17) comprend également un conduit de sortie (6) pour le retour dudit lubrifiant depuis ledit siège de palier dans le moyeu d'hélice (17) par le moyeu d'hélice (17), les conduits (5), (6) étant interconnectés à l'extérieur du moyeu (17) afin qu'une circulation du lubrifiant à travers le moyeu d'hélice (17) soit possible. 5
2. Agencement selon la revendication 1, **caractérisé en ce que** le conduit de sortie (6) est disposé dans l'arbre d'entraînement (20). 10
3. Agencement selon la revendication 1 ou 2, **caractérisé en ce que** le conduit d'alimentation (5) est disposé dans l'arbre d'entraînement (20). 15
4. Agencement selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le système de circulation comprend un dispositif de mesure (10) pour mesurer l'état du lubrifiant. 20
5. Agencement selon la revendication 4, **caractérisé en ce que** l'état mesuré par le dispositif de mesure (10) est la teneur en humidité du lubrifiant. 25
6. Agencement selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le système de circulation comprend un dispositif de régénération (36) du lubrifiant. 30
7. Procédé de lubrification d'un moyeu d'hélice (17) dans un agencement pour une hélice réglable de vaisseaux, le lubrifiant étant amené à une cavité (21) dans le moyeu d'hélice (17) par un conduit d'alimentation (5), **caractérisé par** 35
- le remplissage de la totalité de la cavité (21) par un lubrifiant à une pression positive au moyen d'une source de mise en pression du lubrifiant (4) ; 40
  - la sortie dudit lubrifiant du moyeu d'hélice (17) par un conduit (6) ; et 45
  - le retour dudit lubrifiant vers ledit moyeu d'hélice (17).
8. Procédé de lubrification d'un moyeu d'hélice (17) selon la revendication 7, **caractérisé en ce qu'une** mesure de l'état du lubrifiant est exécutée entre le lubrifiant ayant quitté le moyeu d'hélice (17) et le lubrifiant amené au moyeu d'hélice (17). 50
9. Procédé de lubrification d'un moyeu d'hélice selon la revendication 8, **caractérisé en ce que** l'état mesuré est la teneur en eau du lubrifiant. 55
10. Procédé de lubrification d'un moyeu d'hélice (17) selon l'une quelconque des revendications 7 à 9, **caractérisé en ce que** le lubrifiant est régénéré entre le lubrifiant ayant quitté le moyeu d'hélice (17) et le lubrifiant amené au moyeu d'hélice (17).

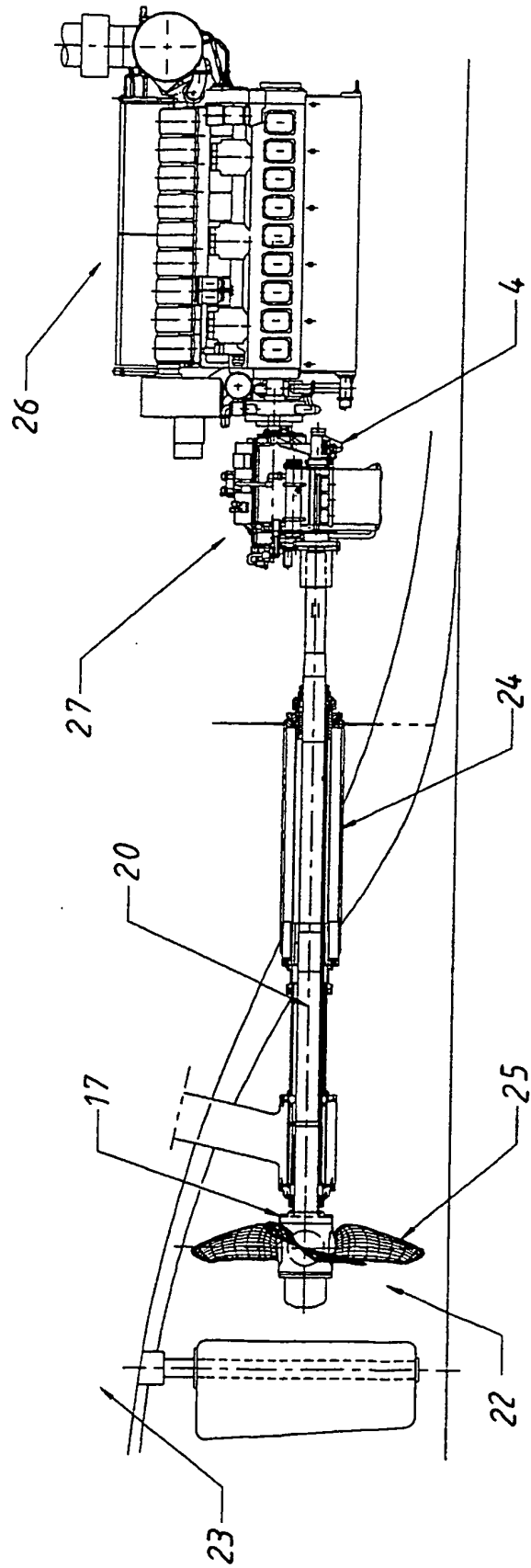


FIG.1

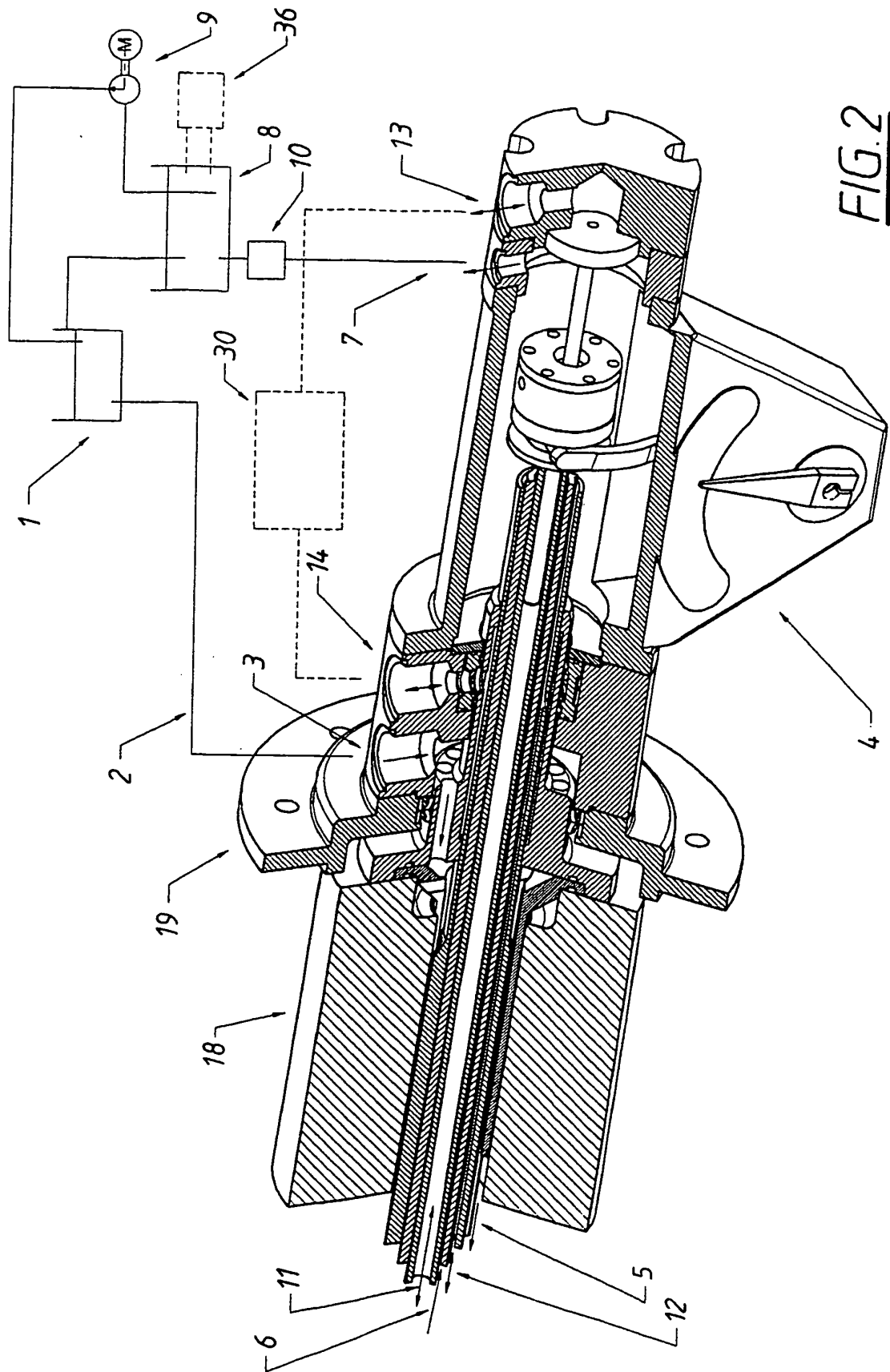


FIG. 2

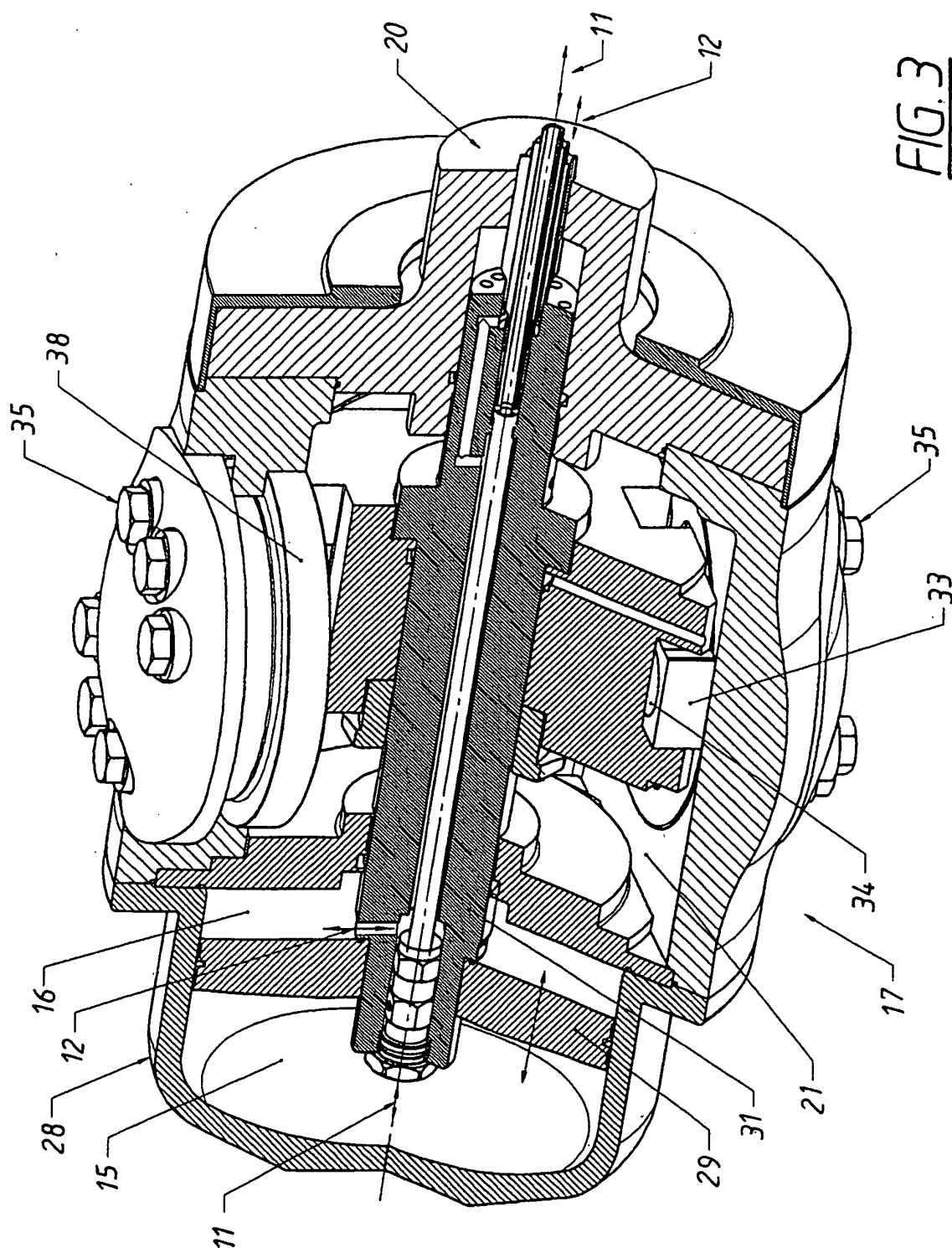
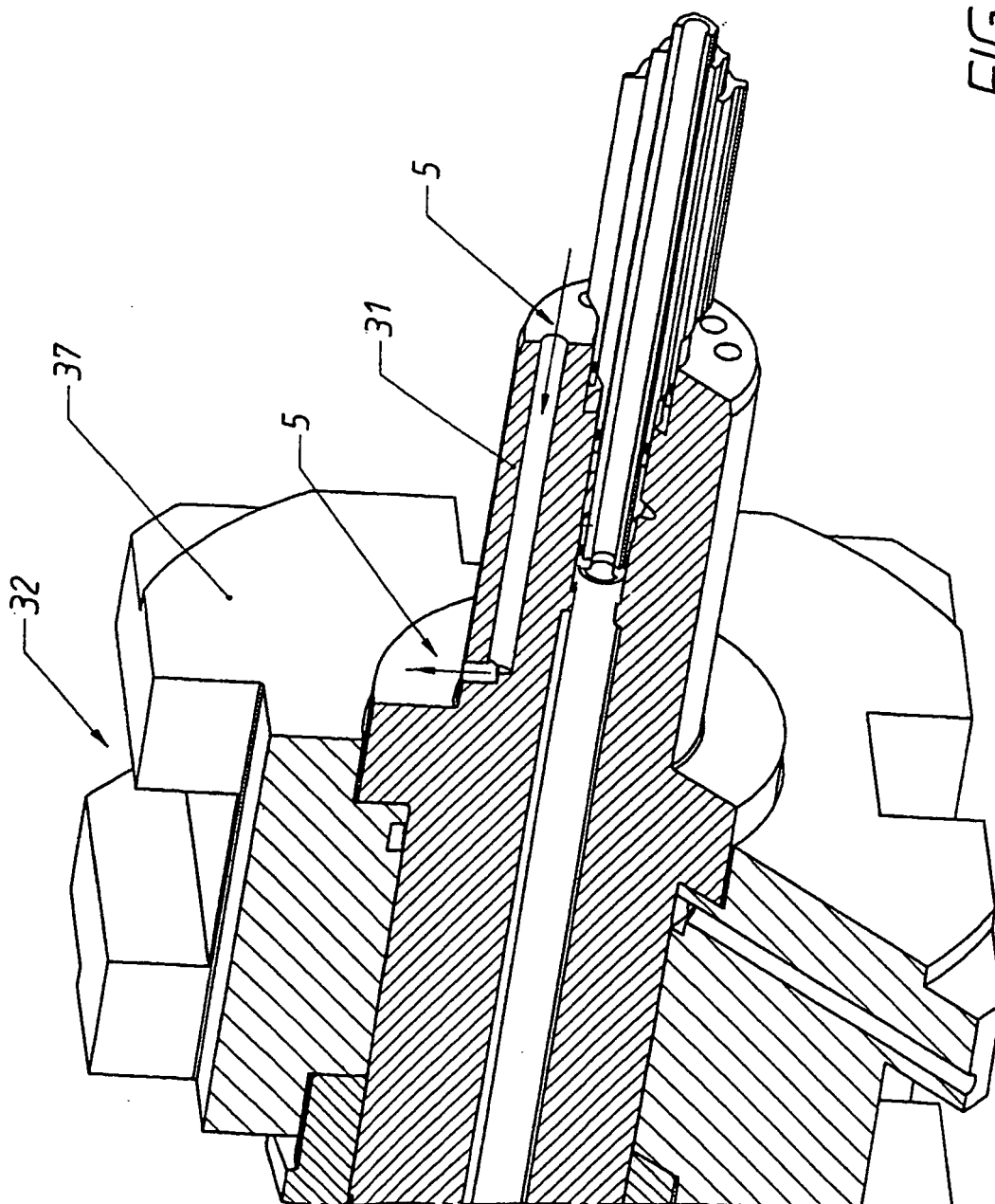
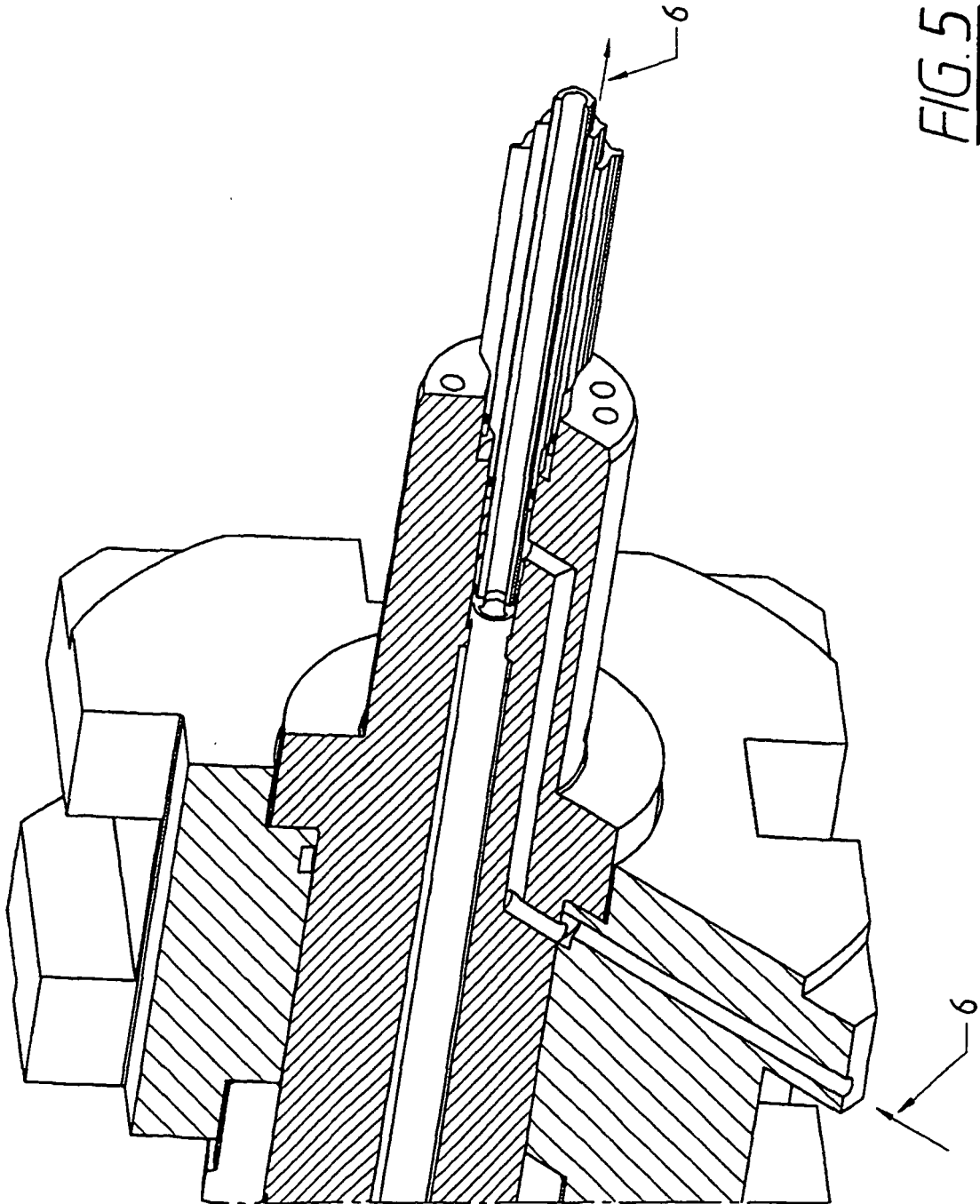


FIG. 3





**REFERENCES CITED IN THE DESCRIPTION**

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