(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 731 418 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.12.2006 Bulletin 2006/50

(51) Int Cl.:
B63H 23/08 *(2006.01)*

(21) Application number: **06011317.2**

(22) Date of filing: **01.06.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **10.06.2005 IT MI20051088**

(71) Applicant: **FB DESIGN S.r.l.**
23841 Annone Brianza (Prov. of Lecco) (IT)

(72) Inventor: **Buzzi, Fabio**
23848 Oggiono (LC) (IT)

(74) Representative: **Valentini, Giuliano**
Marietti Gislon e Trupiano S.r.l.
Via Larga 16
20122 Milano (IT)

(54) Propulsion unit for motor boats

(57) A propulsion unit for motor boats is disclosed, wherein a drive member (10,110) is assembled within the hull bottom, in proximity of the transom (20) and drives at least one propeller (30) having a large-diameter hub (31) and being placed outside the hull in proximity of the transom (20).

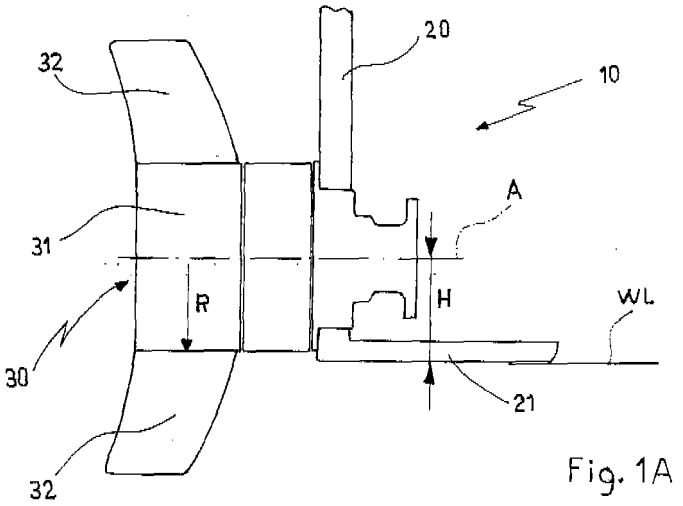

Fig. 1A

EP 1 731 418 A1

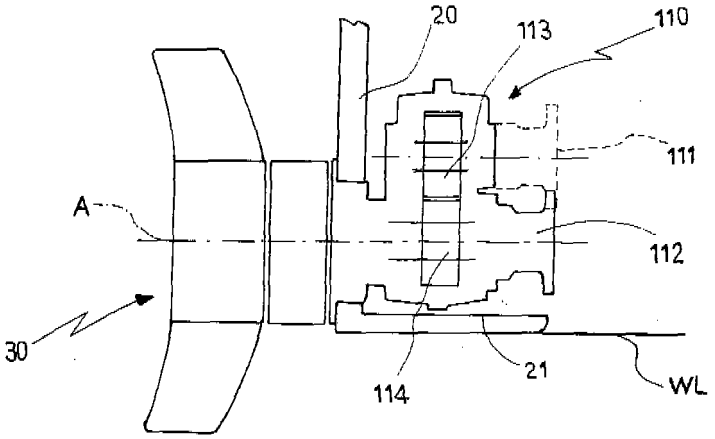

Fig. 1B

Description

[0001] The present invention generally relates to motor boats, and particularly, a propulsion unit for these boats.

[0002] In all transmissions for nautical use, except those of stern outdrive type, the propeller axis is inclined by a certain angle α relative to the water line WL of the boat. This condition is schematically represented in Fig. 8, which illustrates a propulsion system with a submerged propeller according to the prior art.

[0003] It can be seen that the thrust generated by the propeller is directed as the axis thereof, and thus - since the axis is inclined, a part of the thrust destined to propulsion is lost because a component is present, which is normal to the forward direction of the boat.

[0004] The case of surface propeller transmissions, particularly when applied to fast planing hulls, is however the most significant as the design operating condition provides that the small sized propeller hub is kept out of water in order to decrease the frictional resistance, and thus only the lower blades of the propeller are submerged. Some examples of prior art fast hulls with surface propeller transmissions are represented in Fig. 9A and 9B. In this case, the inclination angle a can be less sharp as compared with the submerged propeller transmission, but this is still considerable relative to the thrust fraction normal to the forward direction of the boat.

[0005] The ideal condition, i.e. a propeller having a horizontal (or almost horizontal) axis is difficult to obtain because it is in contrast with the actual feasibility of installing the engine and reversing gearbox onboard the hull. For example, there may be interference problems between a reversing gearbox or an engine oil pan and the hull bottom.

[0006] To partially solve these installation problems, in order to obtain a particularly small angle a, the engine and reversing gearbox must be advanced using cardan joints (also segmented) or homokinetic joints. This solution, however, entails a bad use of the space onboard the hull (larger engine room), and especially the advance of the barycenter of the boat with consequent slowing down.

[0007] In addition to these drawbacks, a common basic problem with all marine transmissions, including those of the stern outdrive type is the corrosion of the submerged parts. Using the top-quality materials made available from the technological development and properly grounding all the metallic components may not be sufficient to obtain full protection from corrosion. It is thus desirable that the number of submerged components is reduced as much as possible.

[0008] In view of the above, the object of the present invention is to provide a propulsion unit for motor boats which allows considerably reducing, or even setting to zero, the inclination of the propeller axis relative to the waterline of the boat.

[0009] Another object of the present invention is to provide a propulsion unit for motor boats allowing the parts exposed to the corrosive action of water to be limited.

[0010] A further object of the present invention is to provide a propulsion unit that can be easily installed on any type of motor boat, independently of the configuration of the transmission (either V-Drive or in-line), either with submerged propeller or surface propeller.

[0011] These objects are achieved by the present invention due to a propulsion unit for boats according to claim 1. Further peculiar features of the present invention are set forth in the dependent claims.

[0012] A propulsion unit according to the present invention, which is provided with a drive member allowing to lower the drive shaft to be as close as possible to the hull bottom, allows obtaining an inclination of the propeller axis which is either very close to 0°, or however forms a very small angle, normally less than 4°, relative to the water line of the boat.

[0013] The drive member is preferably mounted inside the hull close to the transom, whereas at least one propeller mounted close to the transom of the hull is provided on the outside, the hub of which has a radius substantially equal to the distance between the axis of the output shaft and the outer wall of the hull bottom.

[0014] The propulsion unit according to the present invention is further suitable for different embodiments, such as that in which the reversing gearbox is integrated within the drive member.

[0015] Furthermore, a propulsion unit according to the invention may advantageously comprise means for changing, in a controlled manner, the inclination of the output shaft axis relative to the waterline of the boat.

[0016] The invention further relates to a boat being provided with a propulsion unit of the type cited above. For example, the boat can be either provided with a G-Drive transmission, with the reversing gearbox being directly mounted on the drive member, or a V-Drive transmission (with the engine and reversing gearbox being placed above the propeller axis) or Ring-Drive transmission (similar to V-Drive but with closed loop, with the engine being supported by the transmission).

[0017] According to the present invention, horizontal axes (or small inclination angles) can be obtained for the propeller, and the problems of installing power units onboard a hull (mainly with deep V planing bottoms) can also be reduced.

[0018] The submerged metallic parts are further reduced by adopting a propeller having a hub of a greater size than a conventional one, and a drive member mounted in proximity of the transom, because the long drive shaft projecting down into the water as well as the support thereof can be avoided.

[0019] Further characteristics and advantages of the present invention will appear more clearly from the description below, which is to be considered as being illustrative and non-limiting, with reference to the annexed schematic drawings, in which:

- Figs. 1A and 1B are longitudinal sectional views of

possible embodiments of a propulsion unit according to the present invention, which is installed in proximity of the transom of a boat;

- Fig. 2 is a schematic elevation view of the stern portion of a boat being provided with a pair of propulsion units according to the present invention;
- Fig. 3 is a longitudinal section view of another possible embodiment of a propulsion unit according to the present invention;
- Fig. 3A is a cross-section view illustrating the arrangement of the gears in the propulsion unit represented in Fig. 3;
- Fig. 4 is an enlarged view of a detail from Fig. 3;
- Fig. 5 is a longitudinal section view of possible arrangement of the propulsion unit according to the present invention;
- Fig. 6 is a longitudinal section view of a further possible embodiment of a propulsion unit according to the present invention;
- Figs. 7A-7C illustrate possible applications of a propulsion unit according to the present invention to a V-Drive and Ring-Drive transmission, respectively; and
- Figs. 8, 9A and 9B illustrate several embodiments of the propulsion units according to the prior art.

[0020] In Fig. 1 is illustrated a drive member 10 without gears and mounted close to the transom 20 of a boat. To the drive member 10 there is output-connected a propeller 30 having a hub 31 of a greater size than those generally used in known propellers. Particularly, the hub 31 has a radius R substantially equal to the distance H between the axis A, which is common to the propeller 30 and the output shaft from drive member 10, and the hull bottom.

[0021] In Fig. 1B is schematically represented a possible embodiment of a drive member 110 of the type having gears. One or two power takeoffs can be provided on the side facing the reversing gearbox, the one upper 111 and the other lower 112, which are connected to each other by a pair of respective gears 113 and 114.

[0022] The lower power takeoff 112 is co-axial with the output axis A, and together with the upper power takeoff, advantageously allows connecting the member 110 with any existing reversing gearbox, without requiring dedicated reversing gearboxes or however means for adapting the connection. This does not exclude, however, the possibility that (homokinetic or cardan) joints are used to connect the reversing gearbox to the member 110 when this is required in order to take advantage of the zero or reduced inclination of axis A.

[0023] Accordingly, one of the peculiar features of the drive member 10 is that it has a very low axis A exiting from the stern, and consequently, the angle formed between this axis and the waterline WL is about 0°, or however not greater than 4°.

[0024] As represented by way of example in the view from Fig. 2, the hub 31 of each propeller 30 thus comes to be always out of the dynamic waterline WL, preferably working as a surface propeller, where only the lower blades 32, with planing hull, come in contact with water.

[0025] A propeller 30 having a hub with a greater diameter than a traditional one allows using the propeller axis having an inclination which is either zero or not greater than about 4° in an optimum manner. This further allows reducing the projection of the propulsion unit relative to the transom 20, and simultaneously reducing the number of metallic parts being in direct contact with water and reducing the drag.

[0026] In other words, the diameter of the hub 31 of a propeller being mounted very close to the transom 20 is such to lap by its lower part, in height, the hull bottom 21, such as to have, practically, a propeller 30 in which only the lower blades 32 project to the water relative to the hull bottom 21.

[0027] The propulsion unit described above can be as well applied to single-engine or double-engine equipment. In the latter case, or however with an even number of motors, the equipment is particularly advantageous, as the contrarotating propellers altogether cancel the torque generated by each engine or propeller. The single-propeller solution, also in the version of Fig. 1B with two power takeoffs 111 and 112 stands out for its compactness.

[0028] In Figs. 3 and 3A, an embodiment of the invention is represented as being applied to a type of transmission with two co-axial and contrarotating propellers 30 and 35. This solution is more advantageous than the single-propeller version discussed above, because the torques generated by the propellers - equal and opposite - are "automatically" cancelled and this is ideal for single-engine applications and optimum for equipment with any number of motors (two, three, four, etc.), also offering a greater acceleration and retrieving the energy dissipated in the rotary motion imparted to the water by the first propeller.

[0029] The gear drive member 210 of the double-propeller version is different from those already described above, since it has a hollow shaft 215 that houses a co-axial shaft 213 therein. The two co-axial shafts 213 and 215 transmit a contrarotating movement to respective propellers 30 and 35.

[0030] Counter-rotation is ensured by a set of gears 21 1 a, 211b and 211c as schematically represented in Fig. 3A. It can be noted that the operation of the contrarotating propulsion unit is ensured independently of the power takeoff selected for use, i.e. the upper power takeoff 218 connected to the gear 221 a, or the lower power takeoff 216 connected to the gear 211c.

[0031] The provision of a gear drive member with a drive shaft for each propeller also allows, when desired, selecting a different gear ratio for each propeller, by changing the size and number of teeth of the gears. Unlike other double-propeller systems, such as "duo-prop" stern outdrives, the contrarotating propellers of a propulsion unit according to the present invention can make a

different number of revolutions.

[0032] In the view from Fig. 3, a duct 51 can be seen which is provided for the engine exhaust gas. The engine exhaust gas can be caused to pass through the hub of the propellers 30 and 35. To the purpose, the bottom of the hub is preferably provided with holes.

[0033] A duct 52 to vent the propellers 30 and 35, i.e. to suck the air from above the water surface in the vicinity of the propellers may be also provided.

[0034] The two contrarotating co-axial shafts 213 and 215 can be differently supported. A possible solution, which is particularly interesting, is that wherein both shafts are supported by means of rubber bushes 212 and 214 that are dynamically lubricated with sea water. To obtain this result, the propulsion unit provides a dynamic intake 250 that forces the water to enter the open lubrication "circuit". A face seal is provided upstream, i.e. towards the transom 20, for each shaft. This solution is more advantageous relative to the traditional use of cages and oil bath bearings because it eliminates these components.

[0035] It is possible, however, to adopt a hybrid solution, i.e. the one of the two shafts being supported by water-lubricated bush and the other shaft being supported by oil bath bearings and cages.

[0036] The solution providing the shaft as being supported by means of a rubber bush, and forced lubrication with a dynamic water intake can be however adopted also for the single-propeller embodiments already described with reference to Figs. 1 A and 1B. Alternatively, the single-propeller drive shaft can be however supported with oil-bath bearings.

[0037] A gear drive member according to the present invention, from which the shaft (or the two co-axial shafts) to which the propeller is fixed can be directly mounted close to the transom 20 due to a round hole made on the transom.

[0038] Fig. 4 illustrates an enlarged detail from Fig. 3 in which elastic sealing elements 220 are seen, such as rubber O-rings having a big section, and through holes 230 for fixing the propulsion unit to the hull by means of nuts and screws. The provision of rubber sealing rings 220 allows using their capacity to deformation in order to obtain the possibility of slightly changing the inclination of the propulsion unit by means of rotation about an axis 280.

[0039] Fig. 5 illustrates another embodiment of a propulsion unit according to the present invention. The gear drive member 310 as represented therein particularly comprises an envelope having a substantially spherical fitting portion 330 for the drive shaft(s) to pass therethrough. The spherical portion 330 is housed in a correspondingly sized and shaped seat, which is provided for example by a pair of concave flanges 340 that are fixed to the transom 20. A bellow-like elastic element 320 ensures the seal at the outlet hole of the propulsion unit from the transom. Similar to the embodiment discussed above, the inclination of the propulsion unit can be changed by some degrees relative to the waterline WL of the boat by causing it to rotate about an axis 380. This embodiment can be particularly advantageous because the whole system can be disassembled after installation, either when needed or in order to carry out the periodical maintenance and/or overhaul operations.

[0040] A further advantageous feature of the embodiment shown in Fig. 5 is that it allows the inclination of the propulsion unit to be significantly changed. Practically, suitable actuators can be provided, which can be operated in a controlled manner, and are capable of imparting a rotation about an axis 380.

[0041] An actuator that can be used for this application can be, for example, of a hydraulic, electrical or electro-hydraulic type, being arranged within the hull and thus not exposed to corrosion or inadvertent damage.

[0042] The actuator (not shown) can be fixed at one end thereof to a fixed part of the boat, such as integral with the transom, whereas the opposite end can be fixed to the gearbox.

[0043] In the embodiments described above, the gear drive member is a separate element relative to the reversing gearbox that is normally associated with each engine. In Fig. 6 there is represented a further embodiment in which the gear drive member 410 and the reversing gearbox 490 are integrated in a single element 400.

[0044] The propulsion unit described herein is particularly suitable to be applied to fast hulls, both planing and displacement ones, either mono-hull or catamaran, with any number of engines.

[0045] Several exemplary applications of the propulsion unit according to the present invention to boats provided with different transmissions are illustrated in Fig. 7A-7C.

[0046] In Fig. 7A there is illustrated a V-Drive propulsion system with engine 50 and reversing gearbox 40 placed above the propeller(s) axis. The engine 50 and the reversing gearbox 40 are connected to the lower power takeoff of a gear drive member 210 through a shaft 60 being provided with suitable cardan or homokinetic joints 61 at the ends thereof.

[0047] In Fig. 7B, a Ring-Drive transmission (similar to the V-Drive but with closed loop) is illustrated in which the engine 50 and the reversing gearbox 40 are supported by the same drive member 210, with the reversing gearbox 40 being connected to the upper power takeoff of the drive member 210. In Fig. 7C, a Ring-Drive transmission is again illustrated, in which, however, the engine 50 is connected to an element 400 which integrates both the reversing gearbox and the gear drive member.

Claims

1. A propulsion unit for boats, comprising at least one engine and at least one reversing gearbox that are housed within the hull of a boat, and at least one

propeller which is driven by said engine and placed outside the hull of said boat, **characterized by** comprising at least one drive member that is assembled within the bottom of said hull in proximity of the transom and having at least one output shaft with at least one propeller adjusted thereon, and said at least one propeller being assembled in proximity of the transom of said hull, the hub of said at least one propeller having a radius substantially equal to the distance between the axis of said at least one output shaft and the outer wall of the bottom of said hull.

2. The propulsion unit according to claim 1, wherein the axis of said at least one output shaft is substantially parallel to the waterline of the boat.

3. The propulsion unit according to claim 1, wherein the inclination of the axis of said at least one output shaft relative to the waterline of the boat ranges between 0° and 4°.

4. The propulsion unit according to claim 1, wherein said drive member is assembled close to the transom of said hull,

5. The propulsion unit according to claim 1, wherein said drive member comprises at least one power takeoff that is substantially parallel to the axis of said output shaft.

6. The propulsion unit according to claim 1, wherein said drive member comprises at least one power takeoff that is substantially co-axial with the axis of said output shaft.

7. The propulsion unit according to claim 1, wherein said drive member is a gear drive member and comprises at least two co-axial output shafts of which at least one is hollow and houses the other therein, and wherein one or more gears are provided in order to rotate said co-axial output shafts in mutually opposite direction.

8. The propulsion unit according to claim 7, wherein at least one propeller is provided which is mounted at the end of each of said co-axial output shafts, and wherein the hub of said propellers has a radius substantially equal to the distance between the axis of said co-axial output shafts and the outer wall of the bottom of said hull.

9. The propulsion unit according to claim 7 or 8, wherein a first of said propellers is mounted in proximity of the transom and is adjusted to the end of the outer co-axial output shaft and a second one of said propellers is assembled in proximity of said first propeller and adjusted to the end of the inner co-axial output shaft.

10. The propulsion unit according to claim 7, wherein said gear drive member comprises different gear ratios between said two output shafts.

11. The propulsion unit according to claim 7, wherein said co-axial output shafts are supported with friction-reducing means.

12. The propulsion unit according to claim 11, wherein said friction-reducing means include one or more bearings.

13. The propulsion unit according to claim 11, wherein said friction-reducing means include one or more bushes with dynamic water-lubrication.

14. The propulsion unit according to claim 1, wherein said drive member comprises an outer envelope that is provided with a mounting section suitable to be fitted in a through hole of the transom.

15. The propulsion unit according to claim 14, wherein the substantially cylindrical mounting section of the envelope of said drive member comprises one or more seats to hold one or more sealing elastic members in position between said mounting section and said hole of the transom.

16. The propulsion unit according to claim 1, wherein said drive member comprises an outer envelope that is provided with a substantially spherical mounting section suitable to be housed in a correspondingly shaped and sized seat.

17. The propulsion unit according to claim 16, wherein said spherical seat housing said spherical mounting section includes one or more flanges being fixed to the transom of the boat.

18. The propulsion unit according to claim 1, wherein said reversing gearbox is integrated in said gear drive member.

19. The propulsion unit according to claim 1, wherein means are provided in order to change, in a controlled manner, the inclination of the axis of said at least one output shaft relative to the waterline of the boat by an amount ranging between 0° and 4°.

20. The propulsion unit according to claim 19, wherein said drive member comprises a control piston in order to change the inclination of the propeller axis relative to the waterline.

21. A motor boat, **characterized by** comprising a propulsion unit according to any of claims 1 to 20.

22. The motor boat according to claim 21, wherein said

propulsion unit is applied to a transmission with reversing gearbox directly fixed to the propulsion unit.

23. The motor boat according to claim 21, wherein said propulsion unit is applied to a V-Drive transmission with engine and reversing gearbox being arranged above the propeller axis.

24. The motor boat according to claim 21, wherein said propulsion unit is applied to a Ring-Drive transmission with engine being supported by said propulsion unit.

25. The motor boat according to claim 21, wherein the hull is a mono-hull or catamaran, either planing or displacement hull.

26. The motor boat according to claim 21, wherein means are provided to suck the air in the vicinity of said propellers above the water line to avoid the phenomenon of cavitation.

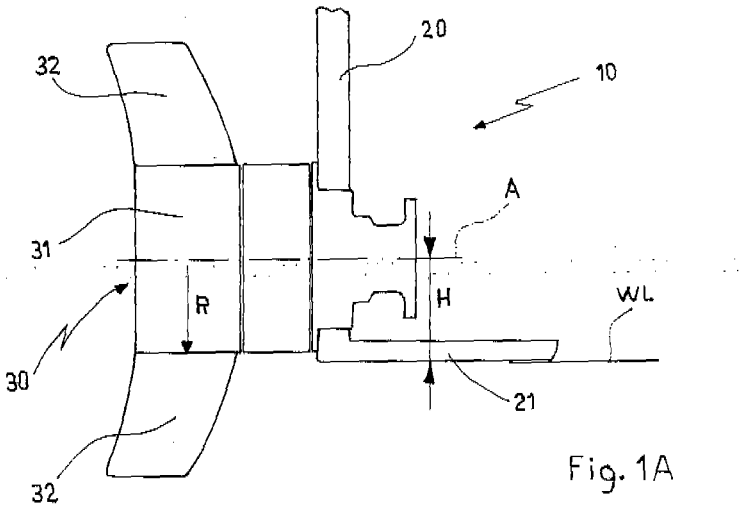

Fig. 1A

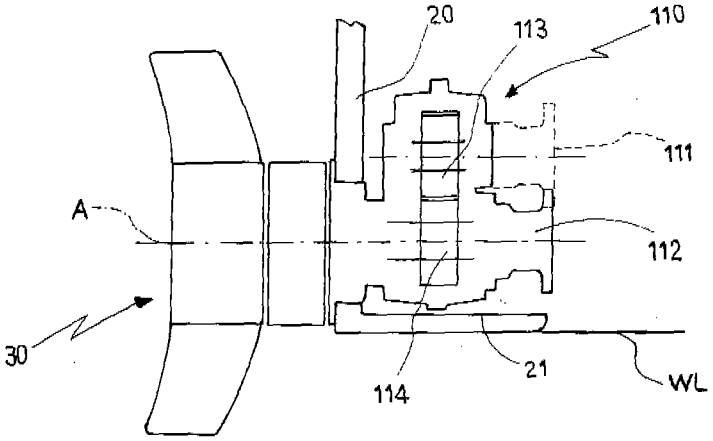

Fig. 1B

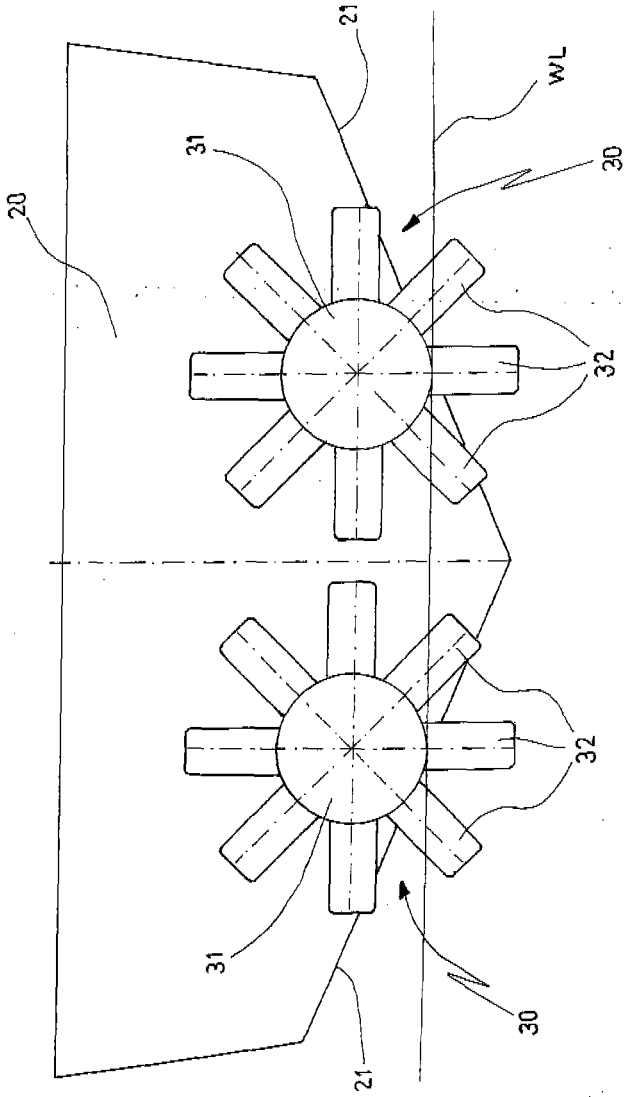

Fig.2

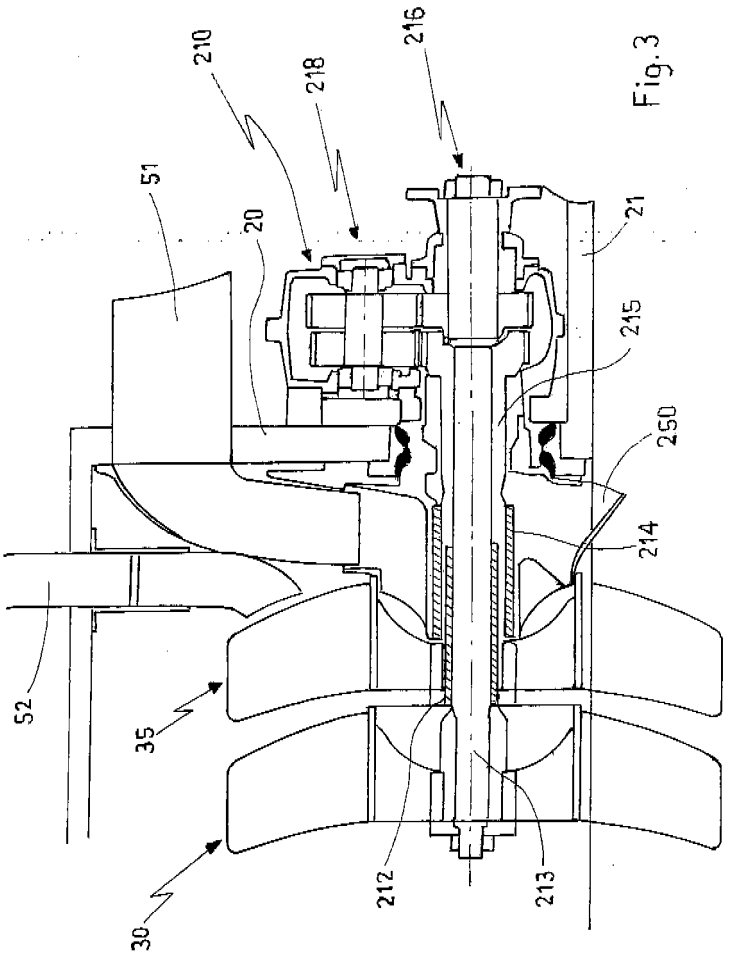

Fig. 3

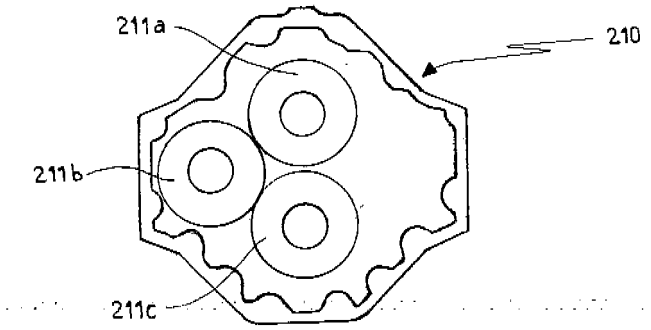

Fig. 3A

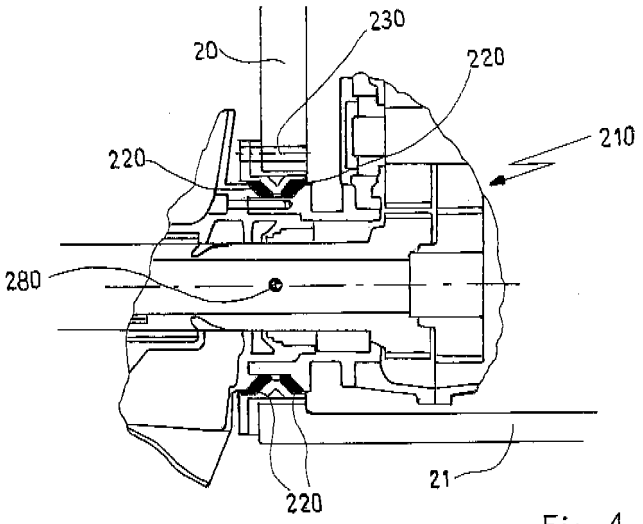

Fig. 4

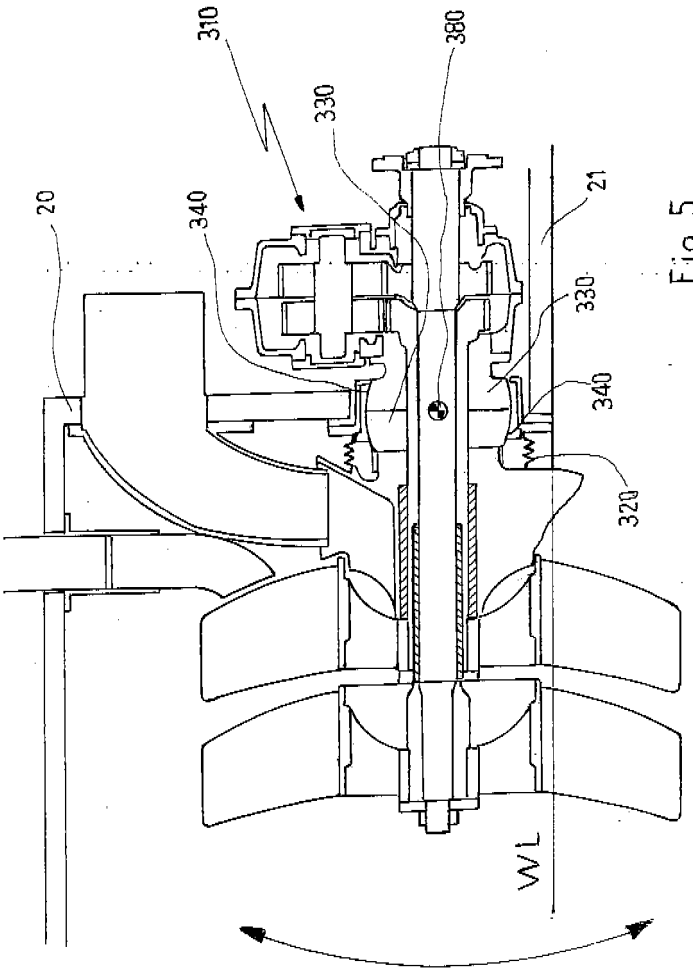

Fig. 5

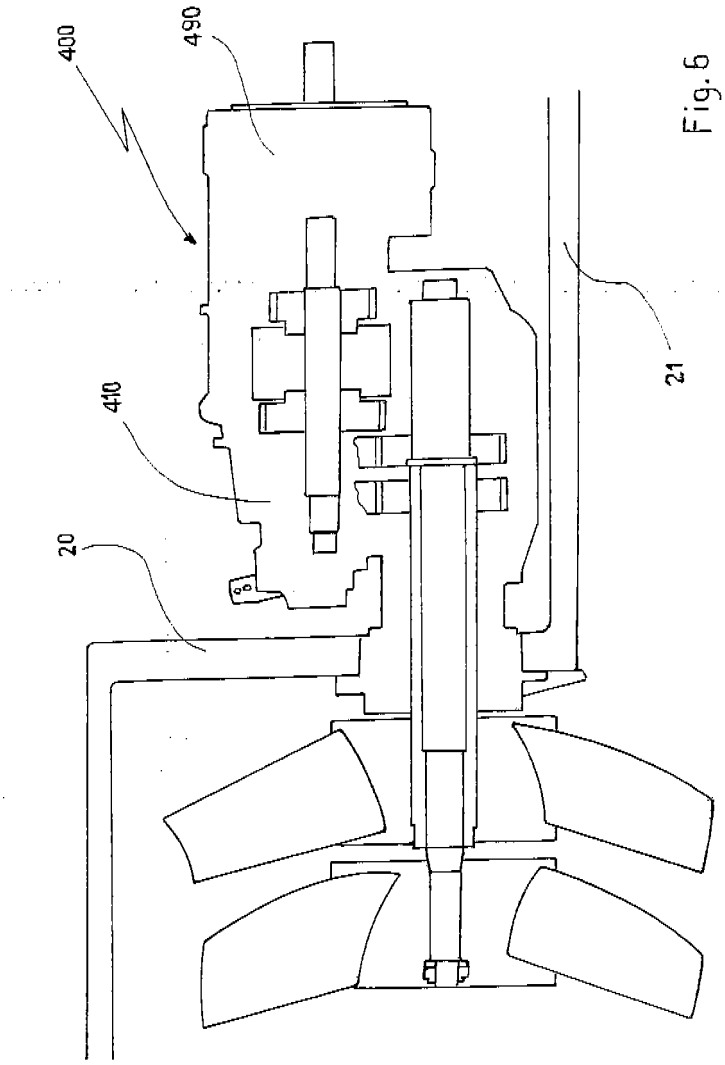

Fig. 6

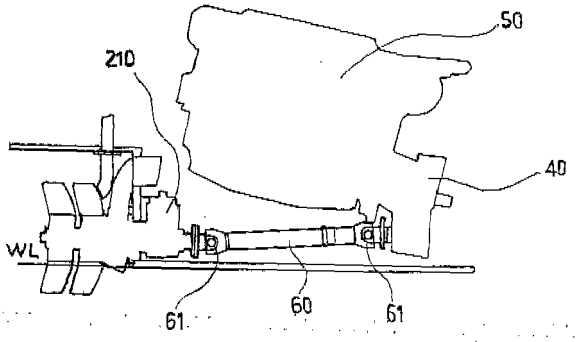

Fig. 7A

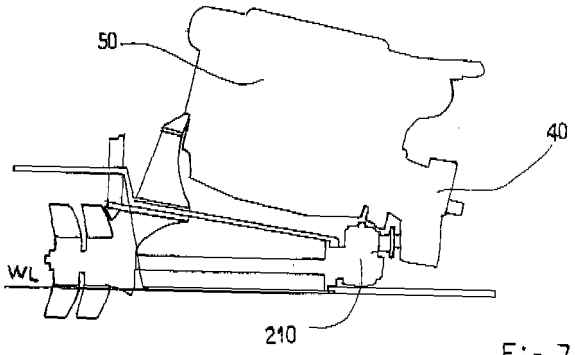

Fig. 7B

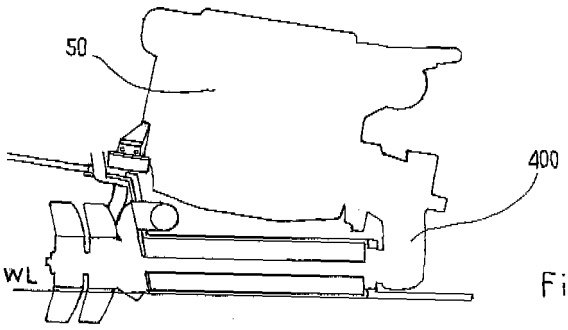

Fig. 7C

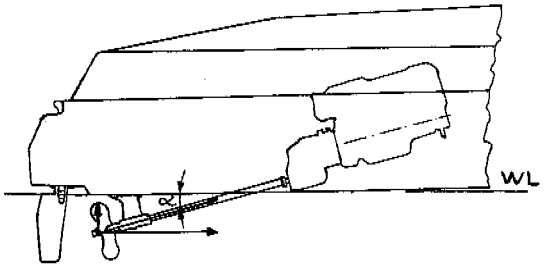

Fig. 8
(PRIOR ART)

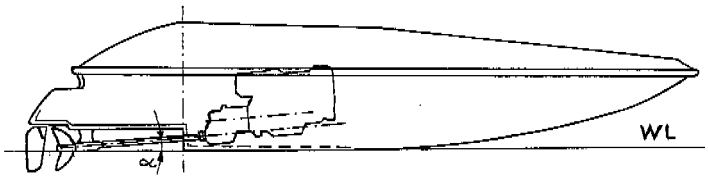

Fig. 9A
(PRIOR ART)

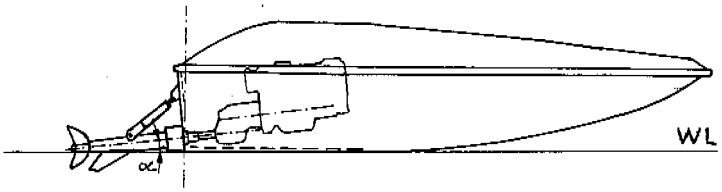

Fig. 9B
(PRIOR ART)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 01 1317

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 6 361 387 B1 (CLARKSON DANIEL E) 26 March 2002 (2002-03-26) * figure 4 *	1	INV. B63H23/08
A	US 4 459 873 A (BLACK ET AL) 17 July 1984 (1984-07-17) * figure 1 *	1	
A	US 2 224 309 A (MACK PERRY E) 10 December 1940 (1940-12-10) * figure 1 *	1	
A	DE 18 13 439 B1 (CARL HURTH MASCHINEN UND ZAHNRADFABRIK) 9 April 1970 (1970-04-09) * figures *	1	

TECHNICAL FIELDS SEARCHED (IPC)

B63H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 September 2006	Nicol, Yann

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

2

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 06 01 1317

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

15-09-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6361387 B1	26-03-2002	NONE	
US 4459873 A	17-07-1984	DE 3305705 A1	01-09-1983
		GB 2115089 A	01-09-1983
		JP 58161694 A	26-09-1983
US 2224309 A	10-12-1940	NONE	
DE 1813439 B1	09-04-1970	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82