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Gotmalm

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[54] PROPELLING MEANS FOR MOTOR BOATS AND AUXILIARY SAILING YACHTS

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[52] **U.S. Cl.** ..... **115/34 A**

[51] **Int. Cl.** **B63h 23/26**

[58] **Field of Search** ..... 115/34, 34 A

[56] **References Cited**

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[57] **ABSTRACT**

The present invention relates to propelling means for motor boats and especially auxiliary sailing yachts. More specifically, the invention relates to improved propelling means comprising a combustion engine driving a hydraulic oil pump, the pressurized oil from the said hydraulic pump being fed over a valve mechanism to a hydraulic motor, the shaft of which is bearing a conventional boat propeller. The thrust of the propeller is taken up by bearings arranged inherently in the hydraulic motor unit; thrust and torque are transferred to the boat hull via the hydraulic motor housing or a positively leak-proof propeller shaft casing which is fixedly attached thereto.

12 Claims, 10 Drawing Figures

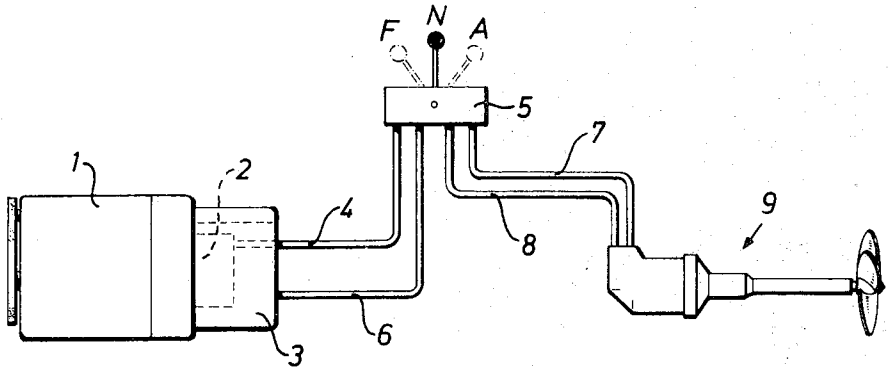


Fig. 1

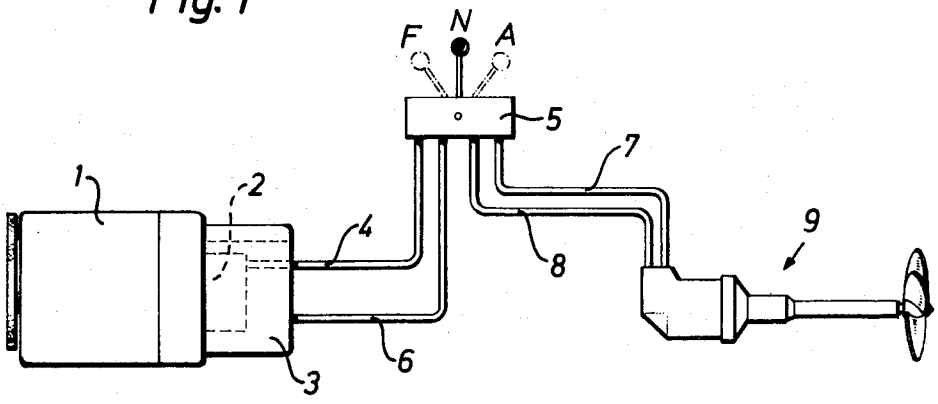


Fig. 2

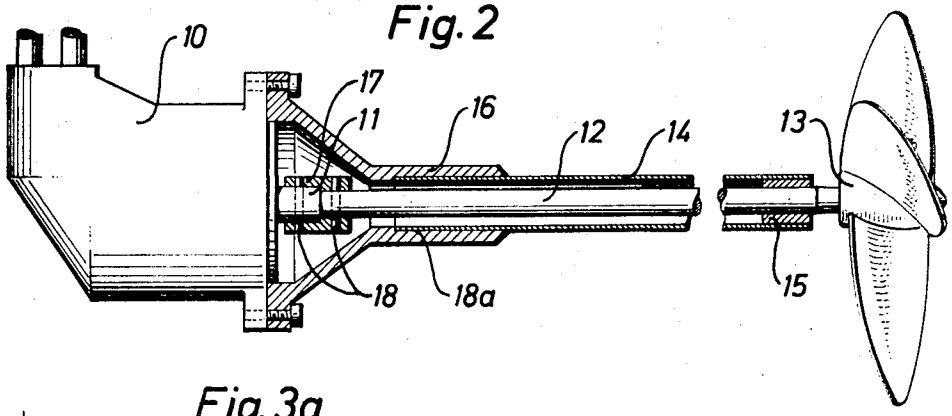


Fig. 3a

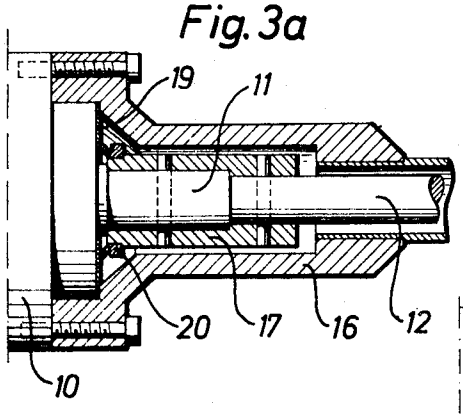


Fig. 3b

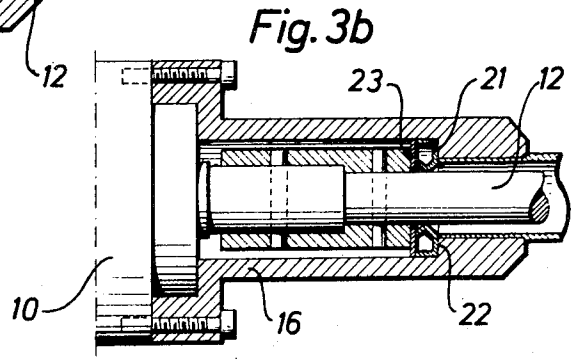


Fig. 4a

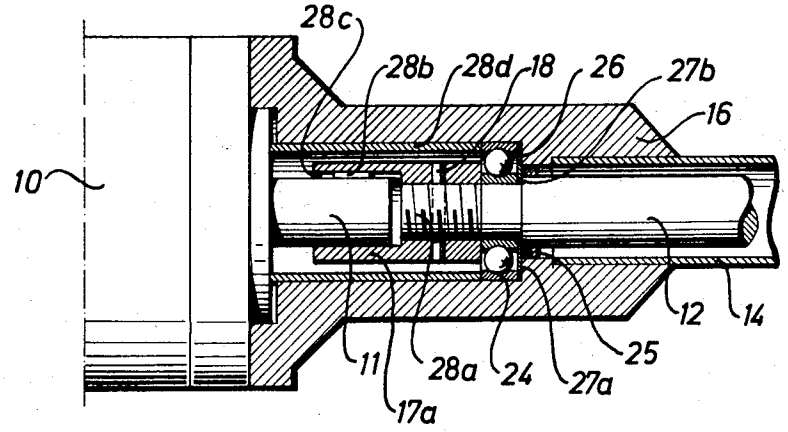


Fig. 4b

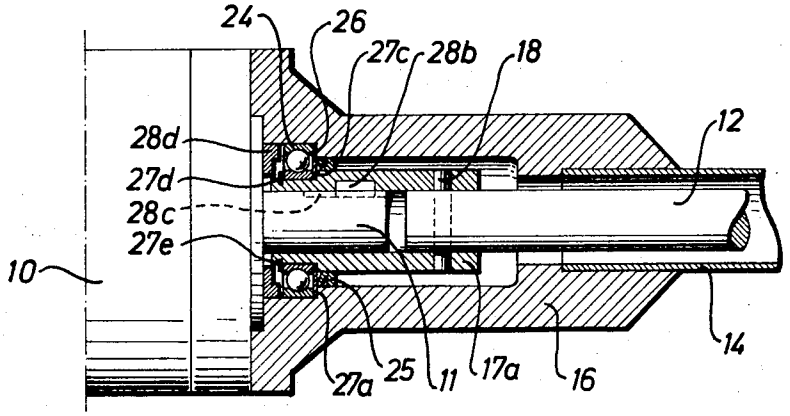


Fig. 5

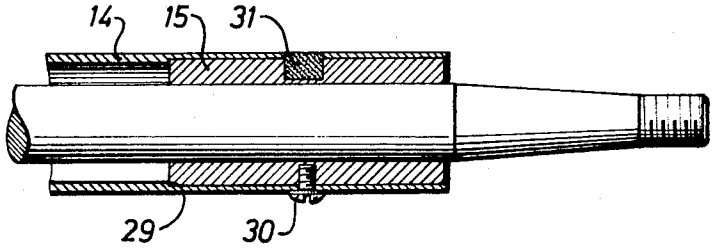


Fig. 6

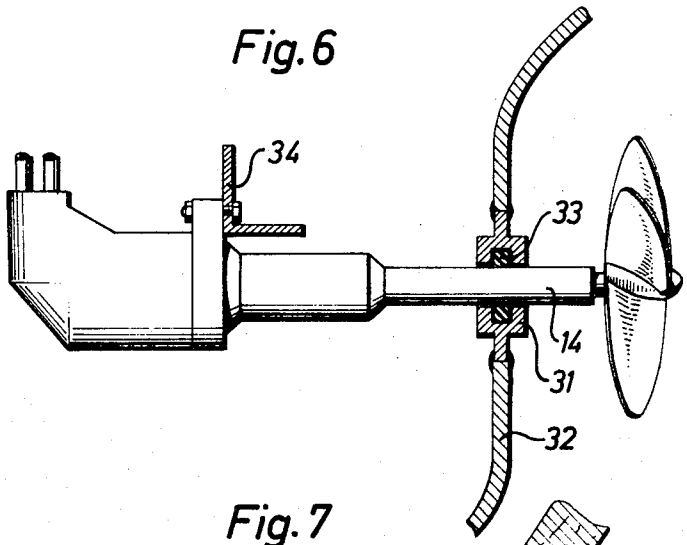


Fig. 7

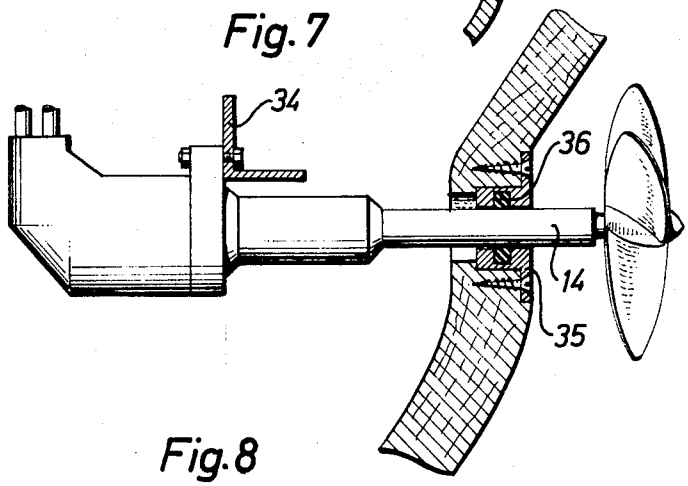
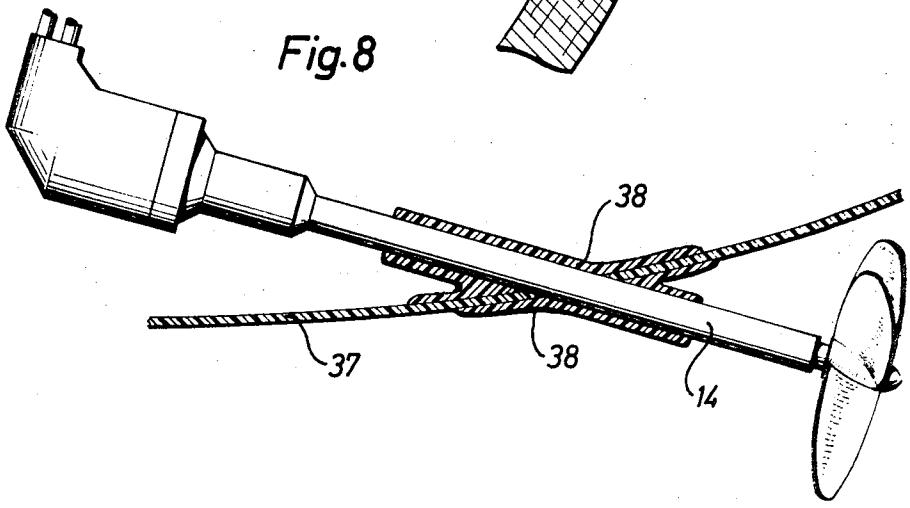


Fig. 8



PROPELLING MEANS FOR MOTOR BOATS AND AUXILIARY SAILING YACHTS

The present invention relates to propelling means for motor boats and especially auxiliary sailing yachts. The invention particularly relates to improved means for propelling a boat with the use of a conventional combustion engine which directly is driving a hydraulic pump pumping a hydraulic liquid such as oil at a high pressure from a tank over a valve mechanism to a hydraulic motor to which a propeller shaft bearing a conventional propelling screw is attached, the said valve mechanism being used for reversing the propeller rotation by reversing the oil flow through the hydraulic motor and for obtaining a neutral position, in which the propeller is stationary in spite of the fact that the engine is running and driving the hydraulic pump, by providing a positive short circuit for the oil flow.

The advantage of this type of propulsion is that the engine driving the hydraulic pump can be placed at liberty within the hull of the boat which is especially advantageous in small craft. The hydraulic components, viz. the pump, the valve mechanism and the hydraulic motor are connected with each other conventionally such as with reinforced flexible rubber tubes of the high pressure type. The hydraulic pressure in such systems may be as high as 300 kp/cm^2 or more but is usually within the range 100– 200 kp/cm^2 at full engine speed.

A further advantage of this type of propulsion is that the hydraulic system provides a means for reducing the propeller revolutions per minute when a light powerful engine running at high speed is used. This is achieved by using a hydraulic motor with a displacement of oil per revolution which is greater than that of the hydraulic pump, such as 2-4 times greater which gives a corresponding reduction of the propeller revolutions per minute as compared to that of the engine. A big slow-running propeller is desired especially in auxiliary sailing yachts since it gives a better drive to a heavy hull in a seaway.

A still further advantage of the said type of propulsion is that it is weight saving since the conventional reverse gear and reduction gear is replaced with the above-mentioned valve mechanism in combination with the hydraulic motor and pump.

One object of the invention is to provide an improved propelling unit for use in the above-described hydraulic system. The propelling unit according to the invention comprises a conventional hydraulic motor of any suitable commercially available type with a protruding driving shaft, a propeller shaft with a casing, the propeller shaft being fixedly attached to the protruding hydraulic motor shaft as shown below, the casing being fixedly attached to the hydraulic motor body via an intermediary member likewise as shown below. The hydraulic motor may be of the gear type, the rotor type or wing type. The preferred hydraulic motor is of the axial piston type which inherently contains axial as well as radial bearings for the driving shaft. Hydraulic motors which do not contain axial bearings for the shaft must be combined with such bearings when used for the purpose of the invention.

Further objects of the invention are to provide means for fixedly attaching the propeller shaft to the protruding shaft of the hydraulic motor; means for fixedly attaching the propeller shaft casing to the hydraulic motor body; means for fixing the bearing for the propeller shaft within the casing at the propeller end of the same; means for preventing sea water to enter the hydraulic motor and cause corrosion; means for providing a propelling unit comprising a hydraulic motor without an inherent axial bearing with an external axial bearing taking up the propeller thrust and drag.

A further object of the invention is to provide improved means for attaching the propelling unit of the invention to the boat hull.

A still further object is to provide a propelling unit which can be attached to the hull of a boat so that the propeller is at a comparatively great distance from the hull without any use of external shaft supports being required, such as V-brackets or similar.

In the present context it should be pointed out that hydraulic engines of the common types mentioned above may be used both as motors and as pumps. When a hydraulic engine is referred to as being a "pump" or a "motor" this only indicates the function of the engine in question in the propelling system described above.

The invention is further elucidated with reference to the accompanying drawings in which

FIG. **1** diagramatically shows the basic principle of the propelling system described above;

FIG. **2** shows the propelling unit of the invention, partly in section;

FIGS. **3***a* and **3***b* are close-ups of the hydraulic motor in the propelling unit of FIG. **2**, partly in section, also showing the optional external V-ring or simmerring resp. used for ensuring that no sea water entering the propeller shaft casing will corrode the steel in the vicinity of the internal O-ring or other shaft sealing;

FIGS. **4***a* and **4***b* show, partly in section, the arrangement of an axial bearing located in the intermediary member for use with hydraulic motors without an internal bearing taking up the axial thrust and drag of the propeller;

FIG. **5** shows, in section, the after part of the propeller shaft with its casing and bearing and means for securing the bearing in position;

FIGS. **6** and **7** show means for attaching the propelling unit of the invention in metal and wooden hulls resp.;

FIG. **8** shows attachment of the propelling unit to a glass fiber reinforced plastic hull.

More specifically, FIG. **1** shows diagramatically the propelling system to which the present invention refers in which a combustion engine **1** is directly driving a hydraulic pump **2** located in an oil tank **3** submersed in the oil therein. The pressure side of the pump is connected to a pipe **4** leading to a valve **5** and a pipe **6** connects the valve with the oil tank **3**, pipe **6** being the return oil pipe. From the valve **5** two pipes **7** and **8** lead to the hydraulic motor **9** of the propelling unit of the invention, one being the feeding pipe for high pressure oil, the other being the return oil pipe. In practice the system also comprises a return pipe (not shown) for leak oil from the hydraulic motor to the oil tank **3**, an oil cooler (not shown) and an oil filter (not shown).

By means of the valve the oil can optionally, by proper setting of a handle on the valve, be circulated from pressure pipe **4** directly back into pipe **6** leading to the oil tank, i.e. the idling position, or from pipe **4** to

pipe 7 for bringing the motor 9 to rotate in one direction such as for going forwards, or from pipe 4 to pipe 8 in which case the motor turns in the opposite direction, i.e. for going astern. As mentioned above the connecting pipes preferably consist of flexible reinforced rubber hosing which means that the engine 1 can be mounted flexibly to the hull so as to reduce vibration to a minimum.

FIG. 2 shows, partly in section, one embodiment of the propelling unit of the invention. A hydraulic motor 10 having a protruding shaft 11 is fixedly connected to the propeller shaft 12 bearing the propeller 13 conventionally attached thereto. A propeller shaft casing 14 with a shaft bearing 15 at its after end is fixedly attached to an intermediary member 16 and coaxially with the propeller shaft. Member 16 is fixedly attached to the housing of the hydraulic motor 10 such as with bolts and nuts around the periphery of the motor housing.

As stated above the hydraulic motor shaft is fixedly attached to the propeller shaft 12. In the form shown in FIG. 2 this is achieved by providing a sleeve 17 with borings fitting the two shaft ends, preferably so that the two shaft ends meet and the thrust is directly transferred or via the sleeve 17. The torsion is taken up by two pins 18 which may be of the conical type. It is obvious that the two shaft ends may be fixedly attached to each other by other means, such as by shrinkage fit, welding, soldering, glueing; by providing threads on the shaft ends and locking a threaded sleeve thereon with locking nuts; by providing keyways on the shafts and using keys to fix a sleeve thereon, the drag being taken up by stopping screws or pins in the sleeve; by providing a clamping sleeve; or by vulcanizing a rubber joint in case of flexible fixation is desired. When a pin is used for taking up the torsion it may also serve as a breaking pin when the system is overloaded.

The propeller shaft casing 14 and the intermediary member 16 are likewise fixedly attached to each other. The member 16 is preferably provided with a boring 18*a* in the after end, fitting the propeller shaft casing 14. The casing may be fixed by welding, if welding is possible, by soldering, gluing, threading, optionally in combination with stopping screws; or by providing a clamping sleeve on the after end of the member 16. It will also be possible to attach the casing to the member 16 with the use of flanges and bolts and nuts. Other methods will be obvious.

It is preferred that the boring 18*a* is not continued through the whole length of the after part of the member 16 so that the casing will rest against an annular edge which will take up the drag force of the propeller when the propelling unit is attached to the hull via the propeller casing as described below. When the hydraulic motor is attached per se to the hull no axial forces will act on the connection between the casing 14 and the member 16. Alternatively, the part of the propeller shaft casing which enters the member 16 may be lathed to a smaller diameter to the formation of an annular edge on the casing which gives the same effect.

As mentioned above, the hydraulic motor is usually provided with an O-ring packing or similar to ensure that no oil leaks out around its shaft. Such a packing or sealing is usually sufficient to ensure that no sea water enters the said shaft area, especially due to the fact that the hydraulic oil pressure is high as compared to the sea water pressure at this location. It may, however, often be desirable to prevent corrosion of the steel shaft of the hydraulic motor since such corrosion may damage the sealing in the motor when the shaft is rotating. According to the present invention such corrosion may be prevented by fitting an external rubber packing or sealing such as one of the V-type or of the simmerring type as shown in FIGS. 3*a* and 3*b*.

In FIG. 3*a* a smooth non-corrodable plate 19 such as of plastic or bakelite or similar is attached to the hydraulic motor housing, preferably by gluing, to the formation of a smooth, non-corroding surface against which a sealing 20 of the V-type rests. This sealing may be axially fixed on the sleeve 17 by providing a shoulder thereon as shown in FIG. 3 or by adjusting the position of the sleeve 17 on the motor shaft end 11 and to fit the sealing directly on the shaft 11.

Alternatively, the said sealing may be arranged as shown in FIG. 3*b*, in which a sealing 21 of the simmerring type is located on the propeller shaft and resting against a shoulder 22 on the member 16. A washer 23 keeps the sealing in position as is conventional. Other alternatives for arranging a sealing to prevent sea water from entering the hydraulic motor area are obvious to the expert and form a part of the present invention.

As mentioned above the preferred hydraulic motor is an axial piston motor which by necessity comprises axial bearing taking up the propeller thrust and drag forces. Other types of hydraulic motors such as gear motors etc. can, however, be used for the purpose of the invention provided that a propelling unit comprising such a motor is provided with an axial bearing which suitably is located in the intermediary member 16. FIGS. 4a and 4b show two modifications of such axial bearings.

In FIG. 4*a* the intermediary member 16 is adapted for a thrust and drag bearing 24 which takes up axial forces from the propeller shaft 12 and conveys them to the hydraulic motor casing 10 via the member 16. The bearing 24 is located on the propeller shaft 12 fixed between a lathed shoulder 27*b* thereon and the sleeve 17*a*. The sleeve 17a is as in FIG. 2 fixed on the propeller shaft end with the aid of a pin 18 or, optionally, with threads 28*a* and a locking screw (not shown). The sleeve 17*a* is connected to the hydraulic motor shaft 11 via a key 28*b* and a key-way 28*c* or via splines, i.e. in such a way that no axial forces are transferred from the propeller shaft to the motor shaft. The bearing 24 also rests against a shoulder 27*a* in the member 16. A tubular support 28*d* is located between the bearing 24 and the motor casing 10, transferring the propeller shaft thrust via the bearing 24 to the motor casing 10. When backing the propeller shaft drag will be transferred via the sleeve 17*a* and the bearings 24 to the intermediary member 16 and the hydraulic motor casing 10.

A washer 26 optionally fitted between the bearing 24 and the member 16, extending so as to cover most of the distance between the member 16 and the propeller shaft, will, in combination with a sealing 25 of the V-ring type or similar, fixedly located around the propeller shaft and resting against the washer 26, prevent seawater from coming in contact with the bear-

ing 24 or other corrodable parts. The washer 26 is preferably embedded in a sticky sealant such as a resilient silicone plastic for securing complete watertightness and is suitably made of plastic, bakelite or a similar non-corrodable material providing a smooth surface for the sealing 25.

FIG. 4*b* shows the preferred way of arranging the axial bearing. The propeller shaft 12 os at its inner end attached to the sleeve 17*a* as described above, such as with a pin 18; the sleeve 17*a* is connected to the hydraulic motor shaft 11 via a key 28*b* and a key-way 28*c* or via splines, i.e. in such a way that no axial forces are transferred from the propeller shaft to the motor shaft. The sleeve 17a has at its motor end a shoulder 27*c* against which the axial bearing 24 rests. An SGA-ring 27*d* fixed in an annular groove 27*e* keeps the bearing in position and transfers the propeller drag from the propeller shaft via the bearing 24 to a shoulder 27*a* on the member 16. An annular support ring 28*d* is located between the bearing 24 and the hydraulic motor casing 10 and transfers the propeller thrust to the said casing.

Seawater can be prevented from entering the vital corrodable parts by providing a washer 26 between the bearing 24 and the member 16, extending so as to cover most of the distance between the member 16 and the sleeve 17*a* and preferably embedded in a sticky sealant such as a resilient silicone plastic, in combination with a sealing 25 of the V-type or similar, fixedly located around the sleeve 17*a* and in contact with the free surface of the washer 26. The washer 26 is suitably made of plastic, bakelite or a similar non-corrosive material providing a smooth surface for the sealing 25.

FIG. 5 shows the preferred arrangement of the propeller shaft bearing 15 located within the propeller shaft casing 14, suitably resting against a lathed annular shoulder 29. The bearing 15 is kept in position with the aid of a locking screw 30 or, alternatively, with the aid of a plug or stopper 31 consisting of a rapidly heat curable plastic such as of the epoxy type which is pressed into a hole bored from the outside through the casing 14 into the bearing, if desired all through, in which case leveling will be necessary on the inside.

The bearing 15 preferably consists of polytetrafluoroethylene or a similar material such as rubber which is lubricated by the sea water. A rubber bearing may be vulcanized in position or inserted fixed to a metal sleeve.

The propeller shaft end is adapted for the propeller in a conventional manner, such as with the aid of a conical shape, a key-way and a thread.

FIGS. 6, 7 and 8 relate to the attachment of the propelling unit to different types of boat hulls. More specifically, FIG. 6 shows a preferred embodiment for use in metal hull; FIG. 7 shows a preferred embodiment for use in wooden hulls; and FIG. 8 shows a preferred embodiment for use in glass fiber reinforced plastic hulls.

In FIG. 6 the propelling unit of the invention is attached to a metal hull through a sealing and guiding member 31 having a preferably circular outer form, welded to the hull 32 in a suitable part thereof. The member 31 has a circular center hole of a slightly greater diameter than the propeller shaft casing. For preventing the sea water to enter the hull a sealing 33 such as an O-ring is provided in an annular ridge in the center hole of the member 31. The propelling unit is attached to the hull by means of at least one metal beam 34 bolted to the hydraulic motor. The said beam may be welded or bolted or otherwise attached to the hull or to any suitable part thereof. The beam 34 will take axial as well as torsional forces. The propelling unit may be retracted into the hull after disconnecting the propeller.

FIG. 7 shows the attachment of the propelling unit to be wooden hull. In this case a hole is bored as is conventional for fitting propeller shafts but a flanged member 35 is used for guiding the propeller shaft through the hull. The member 35 has, like the member 31 in FIG. 6 a boring of a diameter slightly greater than the outer diameter of the propeller shaft casing, such as 0.1–1.0 mm, in which boring an annular ridge is provided in which an O-ring 36 or a similar sealing is located. The propelling unit is attached to the hull by means of at least one metal beam 34 bolted to the hydraulic motor. The said beam may be bolted to the hull or any suitable part thereof.

FIG. 8 shows a suitable way of attaching the propelling unit to a plastic hull. A hole is made in the hull 37, the propelling unit eombodiment inserted through the said hole and fixed in position with the use of glass fiber cloth or mat and resin to form a firm reinforced bonding 38 between the hull and the propeller shaft casing 14. The said bonding will take all axial and torsional forces from the propelling unit and transfer them to the hull. In this case the propelling unit cannot be detached from the hull. The hydraulic motor can be detracted together with the propeller shaft after removal of the propeller and the bolts securing the hydraulic motor to the intermediary member 16.

A special advantage of the propelling unit of the present invention is that it enables installation of the propeller at a relatively great distance from the hull without the use of supporting frames or studs for the outer end of the shaft. This is due to the important fact that the propeller shaft casing may be extended all the way to the propeller, which is not possible with conventional propeller shaft arrangements. The said feature is of a special interest in most modern auxiliary sailing yachts in which the propeller often is located sideways of the rudder. A further advantage is that the propelling unit does not cause the usual difficulties as regards alignment of motor shaft, propeller shaft and brackets.

What I claim is:

1. A boat comprising a hull; and a propelling unit comprising a hydraulic motor including an axial bearing and a shaft; a sleeve; a propeller shaft axially fixed to the shaft of the said motor with said sleeve; an intermediary member; a casing for the said propeller shaft, fixed via said intermediary member to the casing of the said hydraulic motor; and a bearing for the said propeller shaft within said casing; said motor being fixed to said hull via the casing of said shaft.

2. A boat according to claim 1 wherein said propelling unit further comprises a seal of the V-ring type located on the surface of the sleeve, the V-part of the said seal resting against a disc consisting of a non-corrodible, smooth material attached to the surface around the shaft of the said hydraulic motor.

3. A boat according to claim 1 wherein said propelling unit further comprises a seal of the V-ring

type located on the shaft of the motor, the V-part of the said seal resting against a disc consisting of a non-corrodible, smooth material attached to the surface around the shaft of the said hydraulic motor.

4. A boat according to claim 1 wherein said propelling unit further comprises a seal of the simmerring type located on the propeller shaft and resting against a shoulder on the intermediary member.

5. A boat according to claim 1 wherein said sleeve is attached to the ends of the propeller shaft and the motor shaft with pins in holes extending through the said sleeves and the said shafts.

6. A boat according to claim 1 wherein said propeller shaft bearing consists of polytetrafluoroethylene.

7. A boat according to claim 1 wherein said propeller shaft bearing consists of rubber vulcanized in a metal sleeve.

8. A boat according to claim 1 wherein said propeller shaft bearing is fixed in position by a plug consisting of a heat curable plastic which is pressed into a hole extending through the casing into the said bearing.

9. A boat comprising a hull; and a propelling unit for said hull comprising a hydraulic motor including a bearing and a shaft; a propeller shaft slidable in axial direction and connected with the shaft of the said motor by a sleeve which is axially fixed to the end of the said propeller shaft with a pin, the said sleeve being connected with the shaft by a key and a keyway; a casing for the said propeller shaft, fixed via an intermediary member to the casing of the said hydraulic motor; a bearing for the said propeller shaft within its casing; an axial bearing resting against a shoulder on the said propeller shaft and against a shoulder on the member; a tubular support being located between the axial bearing and the front of the hydraulic motor; said motor being fixed to said hull via the casing of said shaft.

10. A boat according to claim 9 wherein said propelling unit further comprises a washer between the bearing and the shoulder; a seal such as of the V-ring type located on the propeller shaft and resting against the said washer.

11. A boat comprising a hull; and a propelling unit for said hull comprising a hydraulic motor including a shaft; a propeller shaft slidable in axial direction connected with the shaft of the said motor by a sleeve which is axially fixed to the end of the said propeller shaft with a pin, the said sleeve being connected with the shaft by a key and a keyway; a casing for the said propeller shaft, fixed via an intermediary member to the casing of the said hydraulic motor; a bearing for the said propeller shaft within its casing; an axial bearing fixed against a shoulder on the sleeve with a locking ring inserted in an annular groove and against a shoulder on the member; a support ring being located between the axial bearing and the front of the hydraulic motor; said motor being fixed to said hull via the casing of said shaft.

12. A boat according to claim 11 wherein said propelling unit further comprises a washer between the bearing and the shoulder; a seal such as of the V-ring type located on the sleeve and resting against the said washer.

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