March 2, 1971 S. BARTHA 3,567,336

PROPELLERS

Filed April 21, 1969 2 Sheets-Sheet 1

FIG. 1

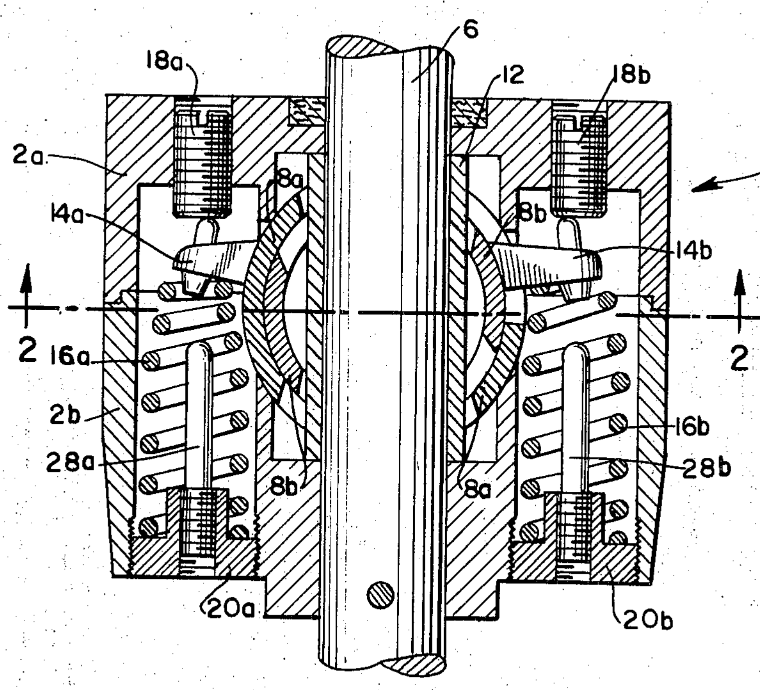

FIG. 2

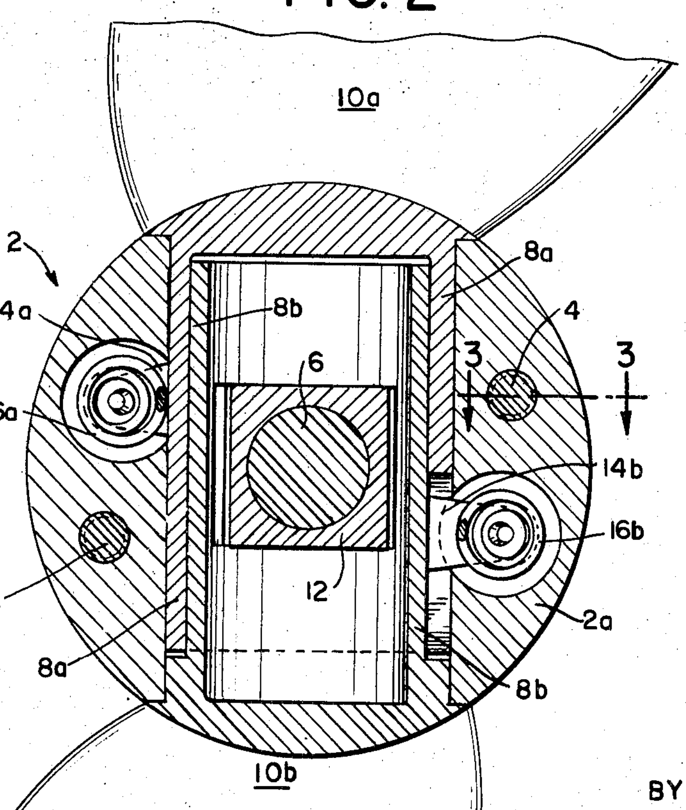

FIG. 3

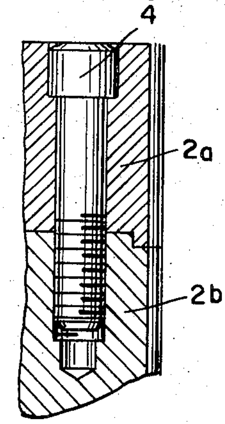

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FIG. 4

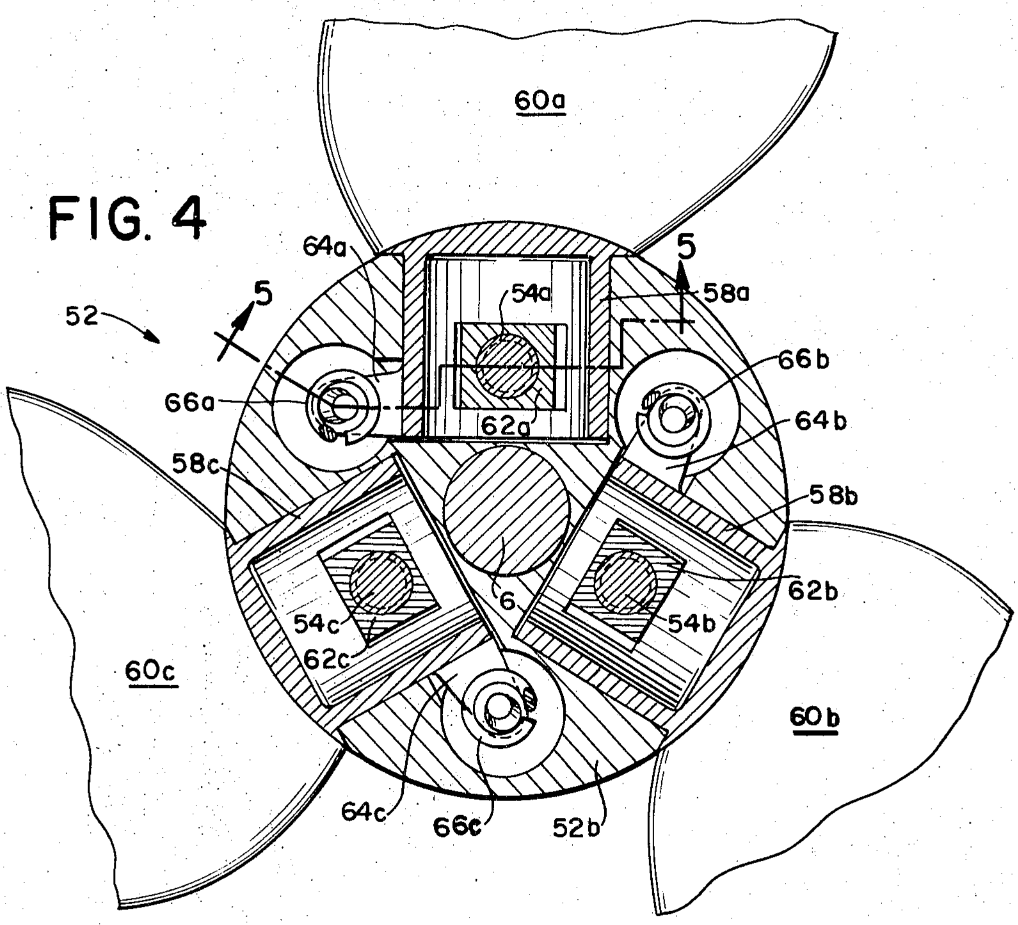
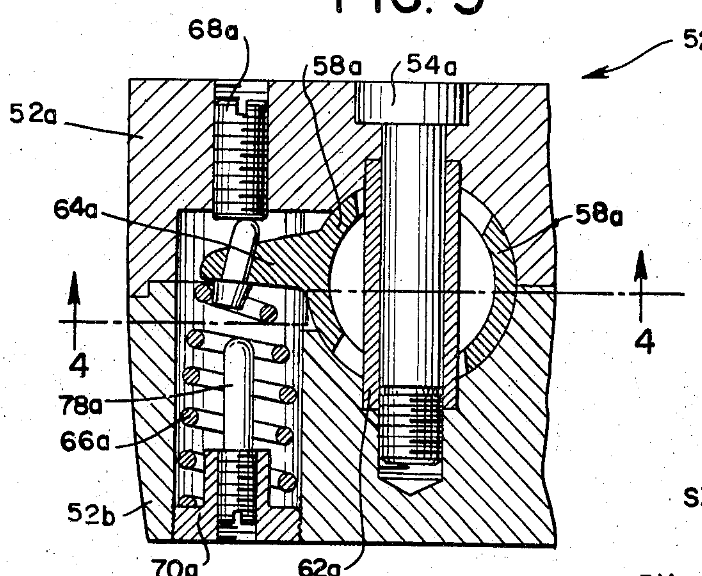


FIG. 5



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3,567,336
PROPELLERS

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U.S. Cl. 416—136 13 Claims

ABSTRACT OF THE DISCLOSURE

Propeller of the variable-pitch type wherein most efficient operation is ensured at all speeds of the engine drive shaft as a result of individual and direct pitch control provided for the blades associated with the drive shaft, within a predetermined maximum and minimum range. Biasing means are provided, preferably in contiguous hollow areas of two separable portions forming part of the propeller hub, for urging hub members associated with the blades into a normal rest position, and stop means for limiting the movement of the sub members at least in one extreme position wherein the blades are forced by the increasing pressure of the surrounding medium into an off-normal operated position.

The invention relates to propellers of the variable-pitch type, in which the pitch angles of the blades automatically vary between a maximum and a minimum pitch position, the inventive arrangement seeking a position of maximum operating efficiency which is consistent with the variable forces acting thereon.

It is known that airplane and ship propellers reach maximum revolution when the vehicle has reached the speed which properly corresponds to its load. The latter being variable both in airplanes and in ships, higher loads will result in higher resistance values. Since the necessary speed, and consequently r.p.m., cannot be attained, the engine in question cannot be exploited to its fullest extent. In other words, the engine is incapable of delivering its full output. At small loads higher revolutions are attained, with concomitant higher speeds, which, on the other hand, may endanger the engine.

Accordingly, various load values would require individual propellers so as to attain optimum performance, which is of course impractical and sometimes impossible. With airplanes, this deficiency has been overcome by regulating the adjusting angle of the propeller wings by mechanical or hydraulic means. Attempts have been made with ships to solve the problem but so far no serious results could be achieved, particularly on account of the considerable power effects and the proposed relatively costly equipment, not always reliable in its operation.

Outboard motors generally in use are of the two-cycle type and will usually not operate at maximum efficiency at both high cruising speeds and slow strolling speeds, as required. When the motor is throttled down to low speeds, particularly for extended periods of time, the oil mixed with the gasoline for lubrication purposes is liable to foul the spark plugs. Attempts have been made to slow the forward motion of such boats or ships while permitting the motor to run at sufficiently high r.p.m.'s to prevent the fouling.

Various types of mechanical devices have been proposed, usually adjustable by hand or by the use of springs, for controlling the propeller pitch of smaller marine craft, while hydraulics or electricity have been proposed for large marine craft. In the former, adjusting means have been provided whereby the blades may be manually adjusted for varying their pitch angles in order to obtain a low-pitch position for normal cruising speeds. Such manual adjustment is both inconvenient and inefficient. Propellers have also been designed in which the pitch angles will automatically vary under certain operating conditions. It should be noted that variable-pitch propellers become also known in which pitch changes are accomplished sole by momentarily interrupting the driving power. This of course is not conducive to the smooth and foolproof operation of the marine craft in question.

With the widely practised water sports, motor boats are being used which are sensitive to changes in load. Particularly for water skiing, the use of motor boats, having a relatively low economy factor to begin with, is only practical if stronger engines were used (outboard or inboard motors). The problem can be solved by providing a propeller which automatically adjusts itself to all load values, and furthermore is adjustable according to the operating conditions of the particular boat or ship. Such propellers have to be economical in operation and adapted to be attached to practically any propeller shaft, without any noteworthy installation effort. Substitution for propellers presently used should also be possible so as to achieve commercial demand in the particular variable-pitch type propeller.

It is therefore one of the major objects of the present invention to provide a propeller of the kind just described in which the pitch of the blades is automatically adjusted by the forces acting thereupon to a position of maximum operating efficiency. The propeller should automatically seek the most efficient blade pitch within a predetermined maximum and minimum range, consistent with the forces acting thereupon.

The novel propeller according to the invention has two or more blades which individually adjust themselves within a range encompassing the encountered lowest and highest load values. The mechanism is provided with biasing means in the form of conventional springs or similar devices, allowing individual, separate and direct tensional adjustment.

According to one of the important features of the invention, a variable-pitch propeller is provided which comprises sleeve-like hub members for the blades that radially extend from the engine drive shaft, the hub members having noses which are acted upon by respective biasing means. Stop means are provided, preferably in an adjustable arrangement, for limiting the movement of the noses in one or both extreme positions.

Preferably means are provided for individually adjusting the force with which the biasing means act on the noses, counteracting the force of the medium surrounding the blades, by way of the respective hub members.

Centrifugal forces are taken up, according to an important feature of the invention, by one or more bearing members operatively associated with said hub members.

The journaling means in the hub of the inventive propeller may include two separable complementary portions extending in the direction of the shaft axis, the biasing means being lodged in contiguous hollow areas of both portions, the stop means being adjustably secured to at least one of said separable portions. Conventional interconnecting means such as screws or bolts, may be provided for the separable portions. The latter may also be formed with at least partly mating peripheral locking or engaging portions.

In one preferred, exemplary embodiment, the propeller has two blades and two hub members, the latter being telescoped in one another, the bearing member being interposed between the inner hub member and the drive shaft.

In another exemplary embodiment, three or four blades may be provided, with a corresponding number of associated hub members, the latter being disposed symmetrically around the drive shaft, while in this case the bearing member has portions individually disposed within each hub member, the interconnecting means passing through the bearing member portions.

Other objects and many of the attendant advantages of the invention will be readily appreciated as the same becomes better understood by reference to the following detailed description. when considered with the accompanying drawings, wherein

FIG. 1 is an axial section of a first exemplary embodiment of the inventive variable-pitch propeller, with two radial blades;

FIG. 2 is a transversal sectional view of the propeller of FIG. 1, taken along line **2—2** thereof;

FIG. 3 is a detail view, along line **3—3** of FIG. 2, showing interconnecting means in the form of a screw securing two complementary hub portions together in the area of peripheral locking portions;

FIG. 4 is a transversal sectional view, similar to that of FIG. 2, but of a second exemplary embodiment, with three blades, corresponding to the section **4—4** of FIG. 4; and

FIG. 5 is an axial section, similar to FIG. 1, of the propeller of FIG. 4, taken along line **5—5** of the latter.

The first embodiment, shown in FIGS. 1 through 3, will be described first in full detail. The inventive propeller has a hub **2** (by general designation) preferably consisting of two separate portions, namely **2***a* and **2***b* for reasons of easy manufacture and assembly, although of course a different housing or hub could be provided within the same inventive concept. The two portions **2***a*, **2***b* are held together, as a matter of example, by two or more screws **4** disposed parallel to the propeller shaft **6** which is of course driven by an engine (not shown) in a conventional manner.

In this embodiment, two inner hub portions **8***a*, **8***b* are rigidly connected with the respective blades **10***a*, **10***b* (broken away since their shape does not affect the present invention). The hub portions or members **8***a*, **8***b* are held together by a preferably rectangular bearing member **12** which is adapted to take up the centrifugal forces acting on the two blades. The hub members **8***a*, **8***b* have respective noses **14***a*, **14***b* formed thereon, as shown, directly acted upon by respective biasing springs **16***a*, **16***b*.

Adjusting screws **18***a*, **18***b* and **28***a*, **28***b* are provided in the portions **2***a*, **2***b*, for setting respective terminal or extreme positions for the smallest and largest travel of the noses **14***a*, **14***b*. Screws **20***a*, **20***b* are provided to regulate the tension of the springs **16***a*, **16***b*, as well as the adjusting angle of the respective blades **10***a*, **10***b*.

In their rest positions, the blades and the elements associated therewith are in their positions corresponding to the largest travel, as illustrated in FIGS. 1 and 2. The momentum acting on the blades, as they rotate in a medium such as water, is due to the fact that the line of action of the power resulting from the reaction of the medium is behind the rotational axis of the blades. This momentum tends to twist or rotate the blades against the force of the respective biasing springs. If the momentum is larger than that resulting from the spring force, the blades will assume a position corresponding to the smaller travel of the associated nose. This will of course allow the engine to run at a higher speed, thereby producing a higher output.

By this arrangement it is possible for the vehicle (e.g. boat) to attain maximum speed within a shorter time than would be the case with hitherto used conventional arrangements, the blades always assuming optimum positions which correspond to the prevailing load values.

Most efficient propeller operation is thus achieved by the inventive arrangement, at all speeds of the drive shaft, as a result of the individual and direct pitch control provided for the blades, within a predetermined maximum and minimum range. The blades will at all times function in positions of maximum allowable pitch, consistent with the prevailing medium pressure acting thereon.

It will be noted that the hub member or portions **8***a*, **8***b* are pivotally mounted in the propeller hub in a direction perpendicular to the axis of the shaft **6** so as to allow freedom of individual pivotal movement for the blades **10***a*, **10***b* about their respective longitudinal pitch axes. The peripheral mating portions of the hub portions **2***a*, **2***b*, shown in FIG. 3 on a somewhat enlarged scale, could of course be provided in a different manner as long as proper axial alignment is secured when the interconnecting screws **4** are tightened.

FIGS. 1 and 2 show that the hub members **8***a*, **8***b* are telescoped in one another, the nose **14***b* of the inner member **8***b* protruding through an appropriate cut-out provided in the outer member **8***a* (see right-hand side of FIG. 1). The bearing member **12** is shown interposed between the inner hub member **8***b* and the shaft **6** (see FIG. 2).

The noses **14***a*, **14***b* have lower bearing surfaces, as can be seen in FIG. 1, for the associated springs **16***a*, **16***b*, the latter being preferably disposed as shown in the sectional view of FIG. 2, in a diametral line which includes the shaft axis, in a plane perpendicular to the latter. Preferably, the screws **4** are spaced a distance away from the springs **16***a*, **16***b*, but in the same parallel arrangement with the shaft **6**, in another diametral line which also includes the shaft axis. This arrangement lends rigidity and stability to the inventive propeller structure, free from vibrations.

It will be understood by those skilled in the art that adjustment of regulating screws **20***a*, **20***b* may involve subsequent re-adjustment of the associated adjusting or stop elements **28***a*, **28***b* if the same extreme positions should be maintained for the noses **14***a*, **14***b* abutting against the latter when the blades are acted upon by the forces of the surrounding medium, as explained before.

The second exemplary emobdiment is shown in FIGS. 4 and 5, similar in their illustration to the previously described respective FIGS. 2 and 1. A hub **52**, similar in general structure to the hub **2** of the first embodiment, has portions **52***a*, **52***b*, held together by screws **54***a*, **54***b*, **54***c* or similar elements (similar in their effect to screws **4**). Drive shaft **6** (shown in FIG. 4 only) is the same as before but it is directly journaled in the hub portions **52***a*, **52***b*.

As a matter of example, three blades are shown, designated **60***a*, **60***b*, **60***c* although, it should be noted, four would be arranged in a substantially identical manner. These blades are rigidly connected to hub portions **58***a*, **58***b*, **58***c* shown in FIG. 4 in their spatial arrangement with respect to the shaft **6** (and only **58***a* in FIG. 5, in accordance with the particular section shown). Centrifugal forces are being taken up by respective sleeve-like bearing portions **62***a*, **62***b*, **62***c* through which the screws **54***a*, **54***b*, **54***c* are made to pass. This arrangement provides separate journaling for the three (or four) blades of this embodiment, against the central journaling in the first embodiment (by way of the bearing member **12**).

The remaining structural parts **64***a*, **64***b*, **64***c*; **66***a*, **66***b*, **66***c*; **68***a*; **70***a*; and **78***a* are substantial counterparts of the previously described elements **14***a*; **16***a*; **18***a*; **20***a*; and **28***a*. The operation of the second exemplary embodiment is similar to that described before.

FIGS. 4 and 5 show that the hub members **58***a*, **58***b*, **58***c* are disposed symmetrically around the shaft **6**, each surrounding its bearing member portion (e.g. **62***a*) and the interconnecting screw (e.g. **54***a*) therein. In a preferred arrangement, the noses **64***a*, **64***b*, **64***c* and the associated biasing springs **66***a*, **66***b*, **66***c* are symmetrically disposed to the same sides of the screws **54***a*, **54***b*, **54***c* (see FIG. 4), e.g. in counter-clockwise arrangement, as shown, in locations further away from the central shaft **6**. This again provides uniform load and stress distribution in the hub portions **52***a*, **52***b*, avoiding the danger of vibrations or untoward forces acting on the propeller structure.

For a better correlation of the similar or identical parts of the two embodiments, it may be added that the complementary hub portions **2**a, **2**b are similar to parts **52**a, **52**b, and constitute journaling means together with the bearing member **12** and the portions **62**a, **62**b, **62**c. Stop means are constituted by screw-type adjustable elements **18**a, **18**b, **28**a, **28**b, as well as **68**a and **78**a (only one being shown from the total of three used in the second embodiment). Finally, the adjusting means is constituted by screws **20**a, **20**b, having their counterparts in the (sole) screw **70**a of the second propeller embodiment. The elements omitted from FIGS. 4 and 5 will of course be self-explanatory to those skilled in the art, from what was described for FIGS. 1 through 3.

Changes and modifications will of course be possible without affecting the purpose and/or operation of the inventive variable-pitch propeller structures.

What I claim is:

1. A propeller of the variable-pitch type, adapted to be mounted on an engine drive shaft having at least two radially extending blades operatively associated therewith, the propeller comprising, in combination: an axially extending, rotary, central hub secured to said shaft for rotation therewith; journaling means in said hub; sleeve-like hub members for said blades, pivotally mounted in said journaling means in a direction perpendicular to the axis of said shaft, so as to allow freedom of individual pivotal movement for said blades about their respective longitudinal pitch axes; protruding noses rigid with said hub members; biasing means acting on said noses to urge them as well as the associated hub members and blades into a normal rest position wherein said blades have maximum pitch angles and offer relatively high resistance to the surrounding medium during rotation of the propeller, said biasing means having axes of operation substantially parallel to said axis of the shaft, which axes are symmetrically and equidistantly arranged about said axis of the shaft; stop means for limiting the movement of said noses at least in one extreme position wherein said blades are forced by the increasing pressure of the medium into an off-normal operated position, against said biasing means, said blades then having minimum pitch angles and offering relatively small resistance to the medium, whereby most efficient operation of the propeller is ensured at all speeds of said shaft as a result of the individual and direct pitch control provided for said blades within a predetermined maximum and minimum range, wherein said journaling means includes two separable complementary portions extending in the direction of said axis of the shaft, said biasing means being lodged in contiguous hollow areas of said portions of the journaling means, said stop means being adjustably secured to at least one of said portions of the journaling means for limiting maximum pivotal movement of said hub members toward the operated position of said blades, and at least two means for releasably interconnecting said portions of the journaling means.

2. The propeller as defined in claim **1**, wherein said biasing means is interposed between said noses and portions of said journaling means, said stop means being adjustably secured to one of said portions of the journaling means.

3. The propeller as defined in claim **1**, wherein said stop means includes two oppositely disposed screw members for limiting the movement of said noses in the respective rest and operated positions of the blades.

4. The propeller as defined in claim **1**, further comprising means for individually adjusting the force with which said biasing means act on said noses, counteracting the force of the medium which acts on the respective blades, by way of the respective hub members.

5. The propeller as defined in claim **1**, wherein said journaling means includes at least one bearing member operatively associated with said hub members for taking up centrifugal forces acting on said blades during rotation of the propeller.

6. The propeller as defined in claim **1**, wherein said portions of the journaling means have at least partly mating peripheral locking portions.

7. The propeller as defined in claim **1**, wherein the propeller has two blades with two associated hub members, the latter being telescoped in one another, with the nose of one hub member protruding through a cut-out in the other hub member, and wherein said axes of operation of the biasing means pass through a diametral line through which passes said axis of the shaft.

8. The propeller as defined in claim **7**, wherein said bearing member is interposed between the inner one of said hub members and said shaft.

9. The propeller as defined in claim **7**, wherein said noses have bearing surfaces for the associated biasing means, which are in said diametral line through which passes said axis of the shaft, and in a plane perpendicular to the latter.

10. The propeller as defined in claim **9**, wherein said interconnecting means are spaced a distance away from said biasing means in another diametral line which also passes said axis of the shaft, and in a symmetrical arrangement with respect to said first-named diametral line through which pass said axes of operation of the biasing means.

11. The propeller as defined in claim **1**, wherein the propeller has at least three blades with a corresponding number of associated hub members, the latter being also symmetrically and equidistantly arranged about said axis of the shaft.

12. The propeller as defined in claim **11**, wherein said bearing member has portions individually disposed within each hub member, said interconnecting means passing through said bearing member portions.

13. The propeller as defined in claim **11**, wherein the respective noses of said hub members and the associated biasing means are symmetrically disposed to the same sides of the respective interconnecting means in locations further away from said shaft.

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