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Strong

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[54] **ANTI-CAVITATION MEANS FOR MARINE PROPULSION DEVICE**

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[52] **U.S. Cl.** ..... **115/17,** 416/93 M

[51] **Int. Cl.**..... **B63h 21/26**

[58] **Field of Search** . 115/17, 18, 34, 35; 416/93 M, 416/90 A, 231, 181

[56] **References Cited**

UNITED STATES PATENTS

2,213,609 9/1940 Ronning ..... 416/93 M

3,587,510 6/1971 Shimanckas..... 416/93 M

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[57] **ABSTRACT**

Cavitation eminating from the leading edge near the hub of a propeller of a marine propulsion device is prevented by introducing exhaust gas air adjacent the junction of the leading edge of each blade of the propeller and the propeller hub from the interior of the hub through which the exhaust gas or air flows.

7 Claims, 3 Drawing Figures

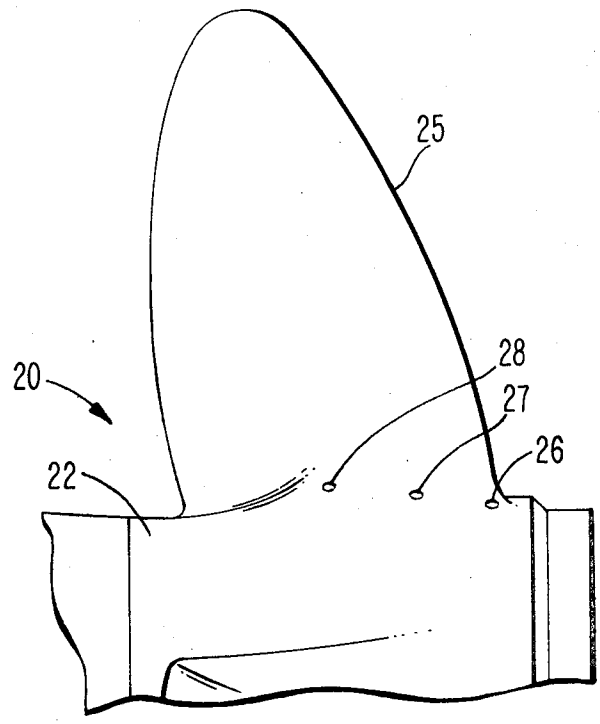


FIG. 1

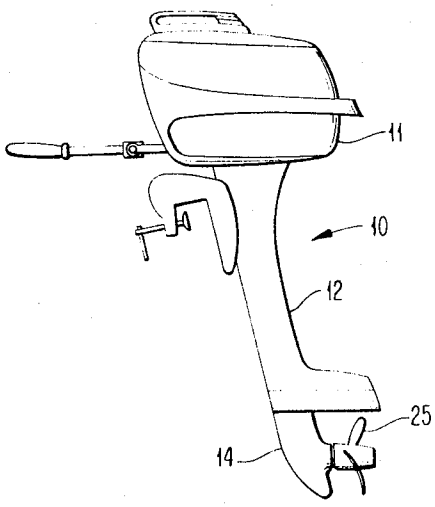


FIG. 2

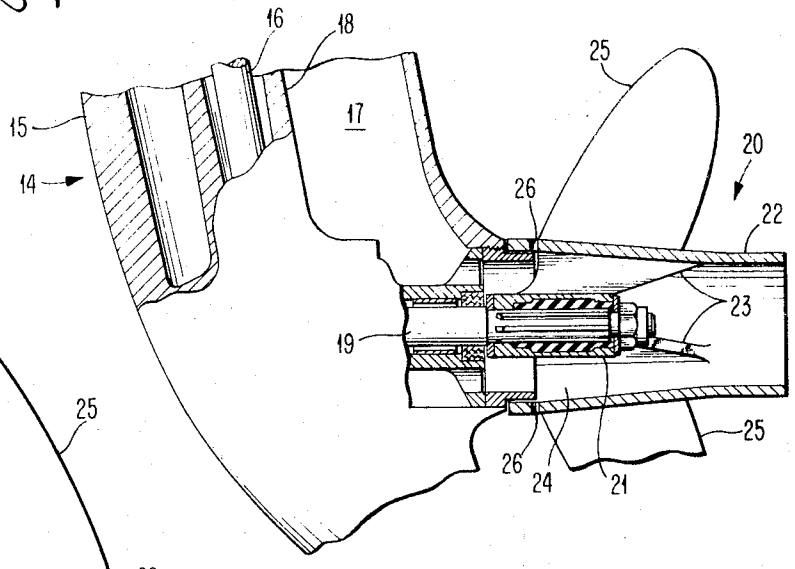
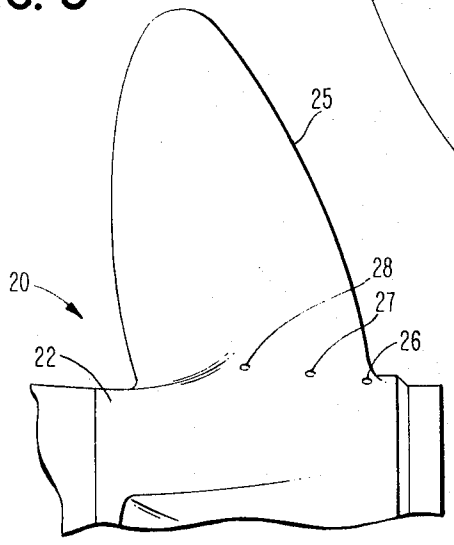


FIG. 3



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ANTI-CAVITATION MEANS FOR MARINE PROPULSION DEVICE

Cavitation is a vapor cavity that can form when an object moves rapidly through a fluid such as water. In boating, the vapor cavity may take the shape of many small bubbles or one large steady void. It is created by the local pressure dropping to the water's vapor pressure at which point simple boiling occurs. The bubbles themselves are not necessarily detrimental but their condensing or collapse which occurs when the local pressure rises releases sufficient energy that pitting or erosion of adjacent surfaces is likely. This erosion can cause sufficient weakening at propeller blades that breakage can occur in a short time.

With lightly loaded propellers for planing pleasure boats made in mass production where precise control of the configuration of the leading edge is difficult or too expensive, cavitation may occur particularly near the hub on the pressure side of the blades. The increasingly popular trend toward cupping propellers, or increasing the pitch at the trailing edge has a worsening effect on the generation of cavitation on the pressure side of the blade. This is due to the effective reduction of the leading edge pitch which reduces the angle of attack of the blade on the water and thus increases the difficulty of the water remaining in contact with the blade as it must accellerate around the leading edge of the blade.

Propeller cavitation can occur under different operating conditions of a boat. Thus, propeller cavitation can occur when an outboard drive unit is "trimmed out" too far whereby the relative pitch or angle of attack of the propeller is greatly reduced on one side. Another operating condition which often results in propeller cavitation is when the drive unit is positioned too high on the boat transom. If the propeller becomes bent or damaged, propeller cavitation can result.

Cavitation most often occurs in higher speed propellers and can be minimized by proper design and careful polishing of the propeller. However, mass produced at high volume propellers cannot be economically made if extensive and careful polishing is required.

The present invention satisfactorily overcomes the foregoing problems by providing means in the propeller to help prevent propeller cavitation from occurring. The present invention satisfactorily overcomes the major position of propeller cavitation without having adverse effects on the performance.

The present invention prevents a low pressure from developing at the junction of a propeller blade and the propeller hub. As a result, the conditions for creating the cavitation bubbles do not exist so that there can be no collapse of the cavitation bubbles on the surface of the blade. Accordingly, the present invention prevents erosion of the propeller and subsequent breakage of the propeller blade due to cavitation.

An object of this invention is to provide an anti-cavitation device for a propeller.

Another object of this invention is to provide a marine propulsion device in which propeller cavitation is substantially prevented.

A further object of this invention is to provide a longer life propeller for a marine propulsion device.

Other objects of this invention will be readily perceived from the following description, claims, and drawing.

This invention relates to an improvement in a marine propulsion device having an outboard drive unit, which carries a rotatable propeller. The propeller has an inner hub, an outer hub spaced from the inner hub to define an axial passage therebetween to pass exhaust gas or air therethrough into the water being the propeller hub, and at least two blades extending radially outwardly from the outer hub. The improvement comprises means to provide communication from the passage to an area adjacent the leading edge of each of the blades to release gas from the space along the root of each of the blades such that the vacuum therealong is relieved.

The attached drawing illustrates a preferred embodiment of the invention, in which:

FIG. 1 is a side elevational view of an outboard motor having the anti-cavitation device of the present invention;

FIG. 2 is a sectional view, partly in elevation, of a portion of the outboard motor showing the anti-cavitation device of the present invention; and

FIG. 3 is a side elevational view of a portion of the propeller with the anti-cavitation device.

The outboard motor **10** has a drive shaft housing **12,** which supports the cowl **11** at its upper end. An underwater unit **14** or gearcase is carried at the lower end of the drive shaft housing **12.**

As shown in FIG. **2,** the underwater unit **14** includes a housing **15** into which extends a drive shaft **16,** which is driven by the engine of the outboard motor **10.** The housing **15** has a chamber **17** formed therein between the inner wall of the housing **15** and the outer wall of an annular member **18** within which the drive shaft **16** is rotatably supported. The exhaust gases from the engine in the cowl **11** are supplied to the chamber **17.**

The drive shaft **16** is connected by gearing to a rotatably mounted propeller shaft **19** in the normal well-known manner such as shown and described in U.S. Pat. No. 2,948,252 to Alexander. The propeller shaft **19** has a propeller **20** connected thereto for rotation therewith. The propeller **20** includes an inner hub **21** which is connected to the propeller shaft **19** for casuing rotation of the propeller **20** whenever the drive shaft **16** is driven by the engine.

The propeller **20** includes an outer hub **22,** which is spaced from the inner hub **21** by a plurality of supports **23.** The supports **23** are angularly spaced from each other so as to permit an annular passage **24** to be formed between the inner hub **21** and the outer hub **22.** The chamber **17** in the housing **15** communicates with the annular passage **24** of the propeller **20** so that the exhaust gases escape from the chamber **17** through the rear of the propeller **20** and into the water through the annular passage **24.**

The propeller **20** has a plurality of blades **25** formed integral therewith and extending radially outwardly from the outer hub **22.** While the propeller **20** has been shown as having two blades **25,** it should be understood that the propeller **20** may have more than two blades **25** if desired.

The outer hub **22** of the propeller **20** has a plurality of second passages **26** extending through the outer hub **22** to provide communication between the annular passage **24** and the exterior of the outer hub **22.** Each of the second passages **26** is formed adjacent the junction of the leading edge of one of the propeller blades **25** and the outer hub **22** as shown in FIGS. **2** and **3.**

As shown in FIG. 3, two additional second passages 27 and 28 are formed adjacent the junction of each of the blades 25 and the outer hub 22 to provide additional communication between the passage 24 and the exterior of the outer hub 22 adjacent the junction of each of the blades 25 and the outer hub 23. Each of the passages 26, 27, and 28 has its axis perpendicular to the axis of rotation of the propeller 20.

The passages 26 are employed to substantially prevent cavitation for any size propeller 20. However, the additional passages 27 would be employed along with the passages 26 for larger size propellers 20. The passages 28 are employed along with the passages 26 and 27 for even larger propellers 20. Thus, the passages 26, the passages 26 and 27, or the passages 26, 27, and 28 may be employed depending on the size of the propeller 20.

The passages 26 to 28 provide a source of gas for delivery to the area of each of the blades 25 in which a sufficient low pressure would exist to cause cavitation bubbles to develop. Because of relief of the vacuum due by the gas flowing through the passages 26 to 28, no cavitation bubbles are produced so that there are no cavitation bubbles collapsing on the face of the propeller blades 25.

Tests have been conducted to determine the effectiveness of the present invention against cavitation. These test disclose that the supply of the exhaust gas through one or more of the passages 26 to 28, depending on the size of the propeller blades 25, was completely effective against cavitation near the root of the blades 25 and partially effective further cut on the blades 25 with no adverse effects on performance.

Each of the passages 26 to 28 for each of the blades 25 preferably has a diameter of 3/16 inch with the axes of the passages preferably being longitudinally spaced 1 ½ inches from each other in a direction along the axis of rotation of the propeller 20. The axis of the passage 26 is located preferably ⅛ inch from the junction of the leading edge of the blade 25 with the outer hub 22. While the foregoing spacing is the preferred spacing for the most effective results, it should be understood that such is not a requisite for the device to function satisfactorily.

While the present invention has described the annular passage 24 as receiving the exhaust gases from the engine in the cowl 11, it should be understood that it is not necessary for the exhaust gas to be the source of gas for the anti-cavitation device of the present invention to function properly. It is only necessary that there be some source of gas. For example, if the chamber 17 were connected to the atmosphere rather than the exhaust of the engine, as it is with many larger stern drives, the gas supplied through the passage 24 could be fresh air since the suction created behind the propeller hub would draw fresh air through the chamber 17 and the annular passage 24.

Also, while the present invention is shown used on an outboard motor, it is to be understood that it is just as useful on the outboard drive unit of a stern drive or sometimes referred to as an inboard-outboard.

An advantage of this invention is that it prevents damage to a propeller blade due to cavitation. Another advantage of this invention is that it increases the life of the propeller.

For purposes of exemplification, a particular embodiment of the invention has been shown and described according to the best present understanding thereof. However, it will be apprent that changes and modifications in the arrangement and construction of the parts thereof may be resorted to without departing from the spirit and scope of the invention.

What is claimed is:

1. In a marine propulsion device having an outboard drive unit with an internal chamber in communication with a source of gas, a rotatable propeller carried by said drive unit and having an inner hub, an outer bub spaced therefrom to define a primary annular passage therethrough in communication with said chamber to pass substantially all of said gas from said chamber out the rear of the propeller, and at least two blades extending radially outwardly from said outer hub forward of said propeller rear; the improvement comprising secondary passage means to provide communication from said passage to an area adjacent the face of each of said blades to release a minor amount of said gas from said passage along the root of each of said blades such that any vacuum therealong is relieved, said secondary passage means including at least one aperture in said outer bhub associated with each propeller blade, said aperture being positioned adjacent to the face of its associated blade.

2. The improvement according to claim 1 in which said second passages extend substantially perpendicular to the axis of rotation of said propeller.

3. The improvement according to claim 2 in which the source of gas is the exhaust of the propulsion device.

4. The improvement according to claim 2 in which each of said second passages is disposed adjacent the junction of the leading edge of one of said blades and said outer hub.

5. The improvement according to claim 1 in which said secondary passage means includes a plurality of passages for each of said blades extending through said outer hub from said primary annular passage to the exterior of said outer hub and said passages for each of said blades being longitudinally spaced from each other in the direction of the rotational axis of said propeller.

6. The improvement according to claim 5 in which each of said second passages extends substantially perpendicular to the axis of rotation of said propeller.

7. The improvement according to claim 1 in which the source of gas is the exhaust of the propulsion device.

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