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Brehme

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[54] **SHIP'S PROPELLER**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **416/198,** 416/200, 416/204, 416/212

[51] **Int. Cl.** **B44d 3/06,** B63h 1/20

[58] **Field of Search** 416/198, 200, 212, 204 416/120–124, 244, 201, 208

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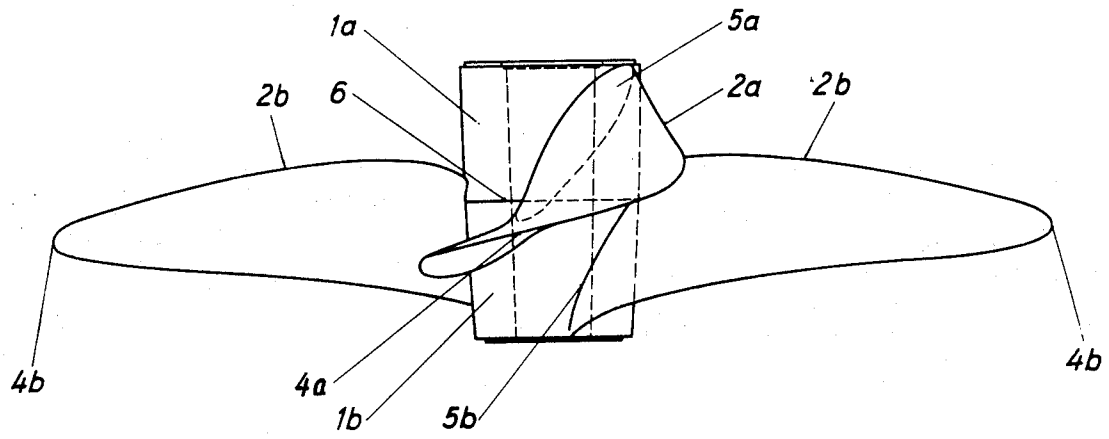
[57] **ABSTRACT**

A ship's propeller has two coaxial hub members and a plurality of blade members, one or more on each of the hub members. Each of the blade members is integral with and radially projects from one of the hub members and its root extends in part to the other hub member. The blade members each have a radially outward blade area and all areas of the blade members together form a propeller shape having blades located in a common propeller plane transverse of the axis of the hub members.

6 Claims, 6 Drawing Figures



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SHEET 1 OF 3

Fig. 1

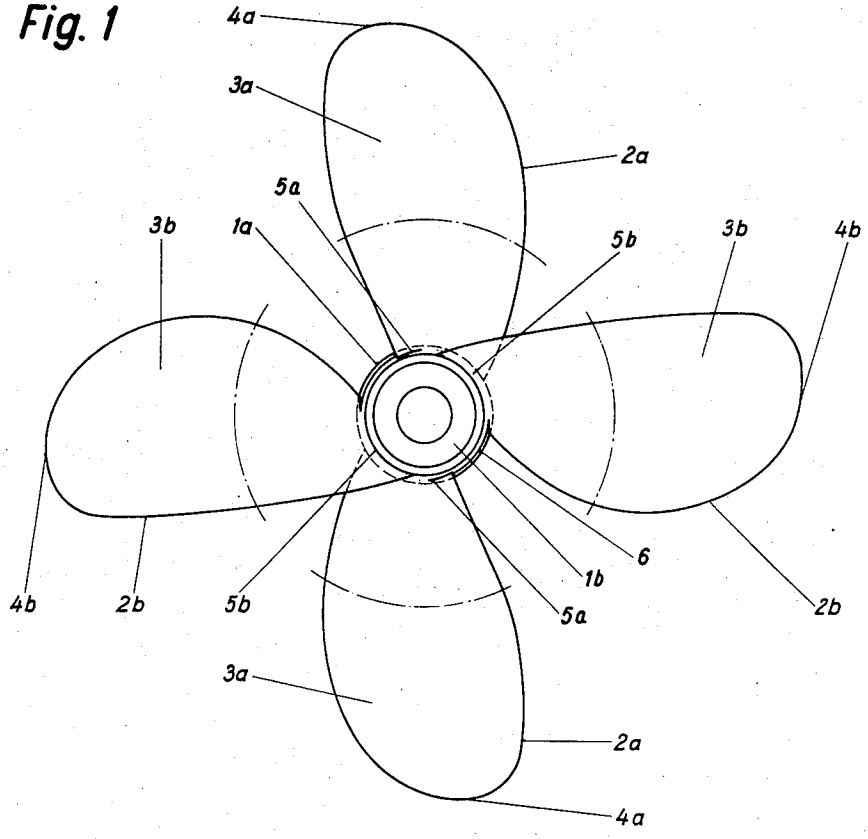

Fig. 2

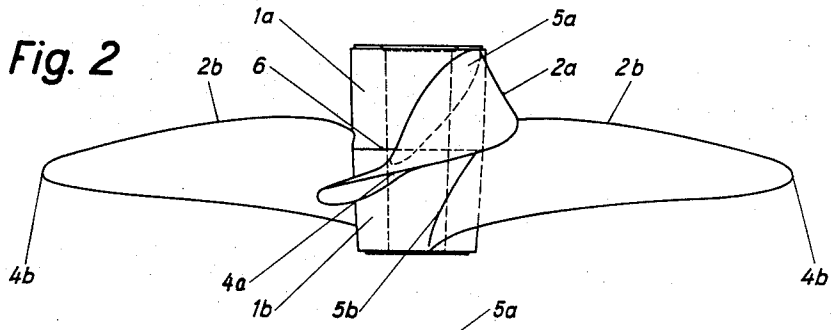

Fig. 3

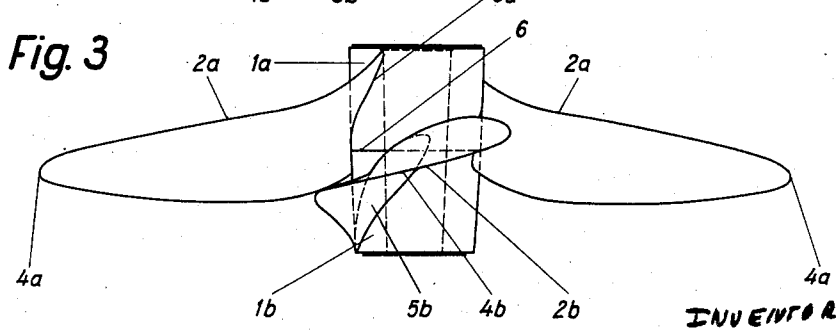

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Fig. 4

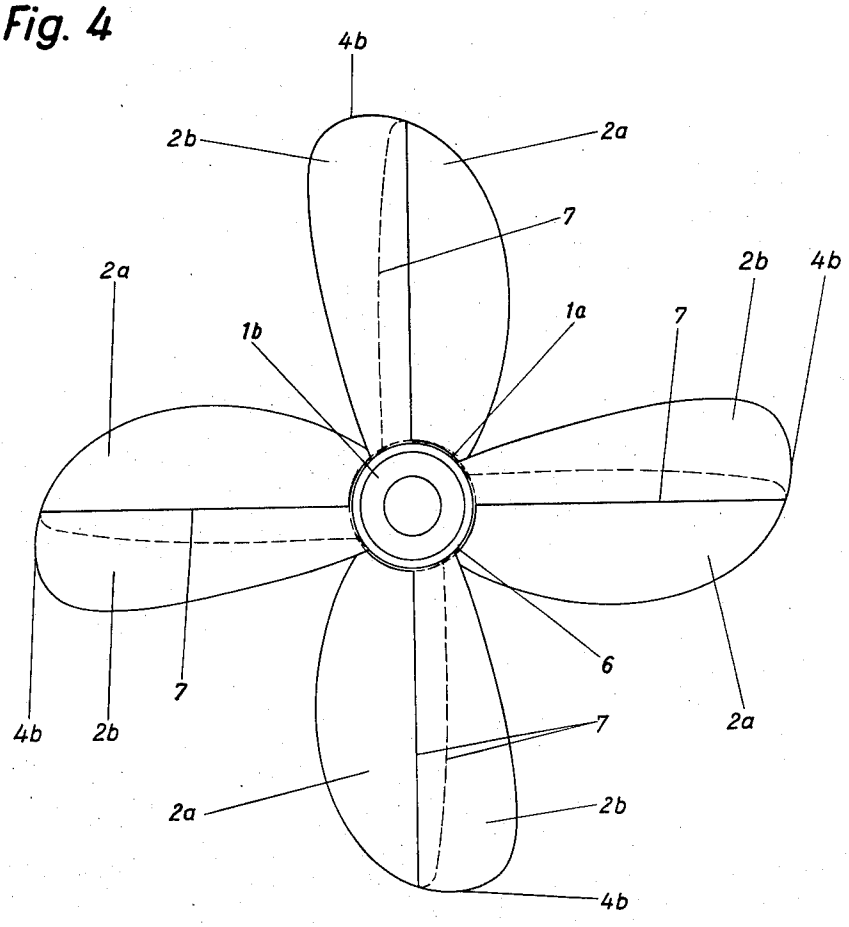

Fig. 5

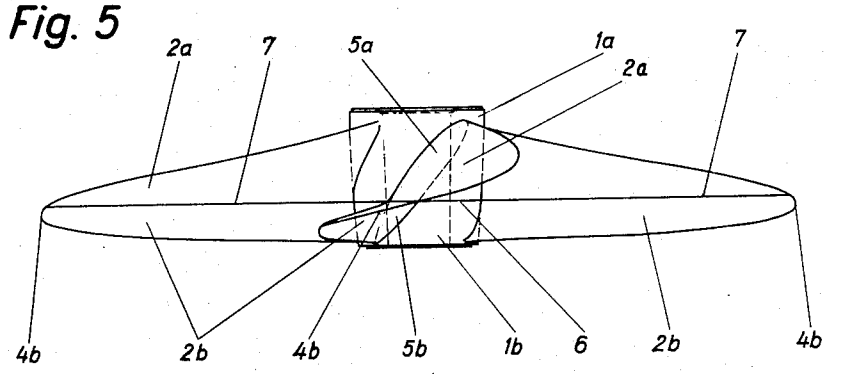

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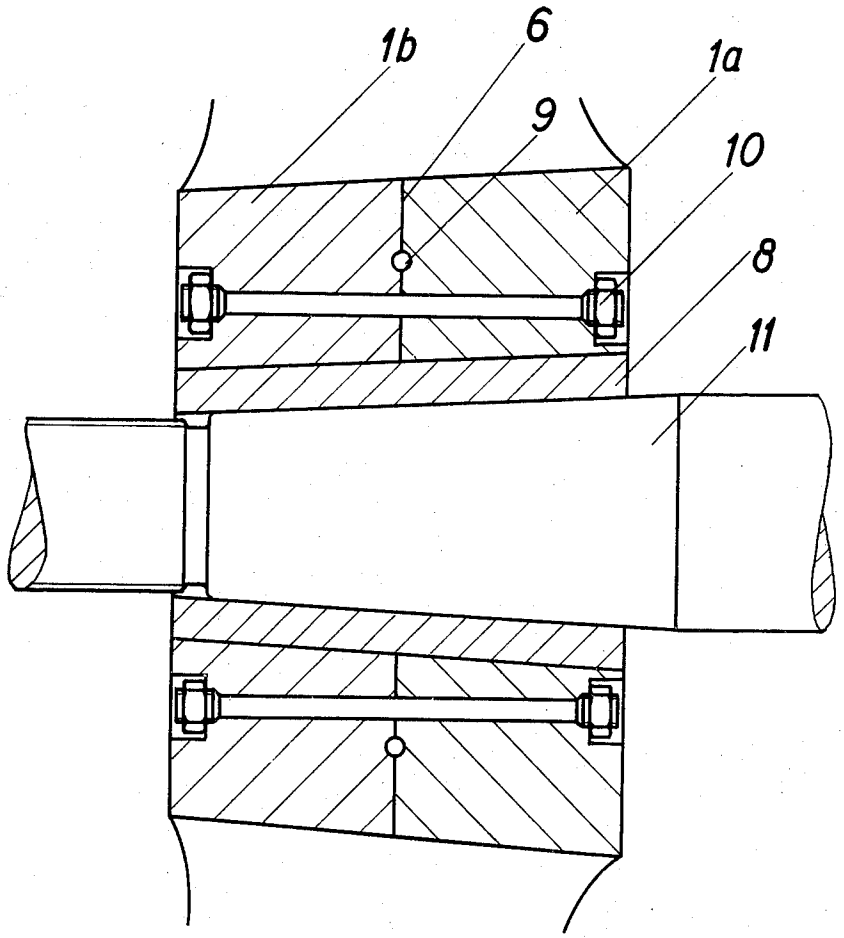
Fig. 6



SHIP'S PROPELLER

BACKGROUND OF THE INVENTION

The present invention relates generally to propellers, and more particularly to propellers which are especially but not exclusively suitable for use in ships' drives.

There is a still increasing tendency towards construction of larger and larger ships, especially freight ships and, still more especially, so-called super-tankers. Development of these constantly larger tankers and freight ships, including also container ships, requires that the dimensions of the ship's propellers be correspondingly increased in order to be capable of properly driving the respective vessel. Most of the modern vessels of this type are provided with only a single propeller, for various reasons including considerations of economy. It is currently already known to produce propellers having a diameter of 9.5 meters measured across the tips of the propeller blades and weights in the neighborhood of approximately 60 tons. In addition, many propellers must have blade areas or blade surfaces of approximately 100 percent of the propeller circle and, because of the configuration of the blades in certain regions the blades will have substantial overlapping. From this it was found that certain difficulties derived, both with respect to the high casting and piece weights involved, as well as in the working of the wide, frequently overlapping propeller surfaces. Other difficulties result from loading, transporting and mounting of propellers of these very large sizes and very heavy weights.

Of the known propeller types, there is a type in which the hub and the propeller blades are produced separately, the blades being provided with flanges and being later threadedly or otherwise connected to the hub. The disadvantage of this particular construction is that the dimensions required for the hub, especially if the number of blades carried by the hub is in excess of four, must be extremely large with the result that the effectiveness of the propeller in operation is substantially reduced. Another known propeller type is the so-called tandem propeller, in which two entirely separate propellers, each complete in itself, are mounted on one and the same shaft axially spaced from one another. In such a construction the propellers, that is the blades of each propeller, are located in axially spaced separate planes with the result that the trailing propeller or rearward propeller is influenced by the operation of the forward or leading propeller, the designation trailing and leading referring to the spacing of the propellers on the propeller shaft. When such a tandem propeller arrangement is mounted on a ship, it operates in a so-called ship stream field which varies with the distance of the propellers from the ship, both in its strength and in its direction. This causes difficulties in the initial configuration of the propellers, because the local differences in the flow of water to the two propellers frequently make a tandem propeller have a different characteristic with respect to a customary one-piece propeller. As a result of this, tandem propellers react differently to various loads and operating conditions. As a result of the positioning of the blades in two different planes a differential impulse strength of the force fluctuations which are transferred from the blades into the vessel, occurs in the slip stream, and this in turn frequently disadvantageously influences vibrations which are originated or transmitted to the vessel.

SUMMARY OF THE INVENTION

It is, accordingly, a general object of the present invention to provide an improved propeller, especially but not exclusively for ships' drives.

More particularly it is an object of the present invention to provide such an improved propeller which avoids the difficulties of the prior art, or at least significantly decreases them.

A concomitant object of the invention is to provide such an improved propeller which will have lower weight and can be more readily worked during manufacturing, especially with respect to the work which is to be carried out on the blade areas or surfaces.

A concomitant object of the invention is to provide such a propeller which can be more readily loaded, transported and mounted.

In pursuance of the above objects, and of others which will become apparent hereafter, one feature of the invention resides in a propeller, particularly a ship's propeller, which comprises at least two coaxial hub members and a plurality of blade members integral with and radially projecting from respective ones of these hub members. Each of the blade members has a radially outer blade area and the outer blade areas of the blade members provided on the hub members together form a propeller shape having blades located in a common propeller plane transverse to the axis of the hub members.

The hub members are, of course, mounted on one and the same shaft, and it is preferable that a leading and a trailing hub member be provided the number of blades of which differs at most by one. The blades are preferably so mounted that circumferentially successive blades alternately are located on the leading and trailing hub member. It is advantageous that the tips of the blade members are located in a common plane transversely of the axis of rotation of the hub members and that the outer regions of the blade members are substantially identical with respect to configuration and radial pitch distribution. Depending upon the dimensions involved, the roots of the respective blades—which roots are each connected with one of the hub members—may extend beyond the one hub member to the other hub member. Of course, more than two hub members may be provided, and the roots may then extend from the hub member with which they are rigidly connected, to one or more of these additional hub members.

A further embodiment of the invention provides for the hub members to correspond with respect to the number and distribution of their blade members, with the hub members being so connected that the respectively associated blade members (one blade member of each hub member always cooperates or is associated with one blade member of every other hub member in this embodiment) together constitute the configuration of a unitary blade, whose cylinder section is composed of the cylinder sections of the associated blade members which join along a common line. In this arrangement the unitary blade which is composed of the blade members of two or more hub members may be subdivided into blade sections in a radially outer blade area, with the blade sections being axially separated and these blade sections may be different from one another

as to contour, blade tip radius and direction or angle of inclination to the flow of liquid in which the propeller rotates. The associated blade members may be connected along their adjoining lines, for instance by being welded together.

The configuration and radial pitch distribution of the blades can be selected in accordance with prevailing requirements, and because the total propeller is composed of several partial propellers such forms and overlapping of the blade surfaces can be utilized which in conventional one-piece propellers cannot be effectively employed, because of the difficulties in making and working such propellers.

The common plane in which the propeller blade tips are located may be symmetrical or non-symmetrical with reference to the combined axial length of the several hub members. This is especially advantageous if the hub members all have hub bores which are produced at one and the same time in a single operating step. The hub members may also be connected—after they have been produced—rigidly but releasably, or they may simply be rigidly, but non-releasably connected. They may be releasably mounted on a common structural component such as the shaft or on a sleeve or the like which in turn is mounted on the shaft. The hub members may be releasably connected by means of screws or bolts which may be especially advantageously configurated as expansion bolts. In the space between axially adjacent hub members sealing means may be arranged.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic plan view of a ship's propeller according to the present invention, provided with four blades;

FIG. 2 is a side view of FIG. 1;

FIG. 3 is a further side view of FIG. 1, offset through 90° with reference to the view of FIG. 2;

FIG. 4 is a plan view of a further embodiment of a propeller according to the present invention; and

FIG. 5 is a side view of the propeller illustrated in FIG. 4 and FIG. 6 is a fragmentary diagrammatic view of still a further embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Before entering into a detailed discussion of the drawing it is emphasized that for facilitating explanations the invention will be described herein with reference to the construction of a ship's propeller. It is pointed out, however, that the invention is equally applicable to other propellers, including air screws and propellers or impellers which may for instance be utilized for mixing arrangements or the like.

Now referring to FIGS. 1—3 it will be seen that the ship's propeller illustrated therein is provided with a front or leading hub 1*a* and a rear or trailing hub 1*b*. These hubs or hub members are mounted on a common propeller shaft (no separate reference numeral) so that they are in axial abutment with one another. Each of the hub members 1*a* and 1*b* is provided at two diametrally opposite locations with blade members 2*a* and 2*b*, and the generatrices of the blade members 2*a* provided on the hub member 1*a* are declined rearwardly, whereas the generatrices of the blade members 2*b* on the hub member 1*b* are declined or deflected forwardly. As a result of this the radially outer blade areas or surface portions 3*a* of the blade members 2*a*, and those identified with reference numeral 3*b* and provided on the blade members 2*b*, are located in a common propeller plane extending transversely of the axis of the propeller shaft and as to configuration and radial pitch distribution they essentially conform with one another.

The drawing will show that the root profiles of the blade roots 5*a* of the blades 2*a*, and 5*b* of the blades 2*b*, are provided on the respectively associated hubs 1a and 1*b* to the extent necessary for obtaining the desired structural strength. The remaining profile length of the blade roots 5*a* and 5*b*, which is not necessary for structural strength but is desirable for hydrodynamic reasons, extends beyond the respective hub 1*a* to the area of the hub 1*b*, or vice versa.

The resultant ship's propeller is in effect composed of two partial propellers, but in so far as its effective blade areas 3*a* and 3*b* are concerned, its configuration and radial pitch distribution, it corresponds exactly to a conventional one-piece propeller from whose configuration it deviates only in the region of the propeller roots 5*a* and 5*b*. The axial displacement of the root profiles has only a very minor influence on the total operational characteristic of the propeller and is far outweighed by the advantages to be obtained in terms of lower shipping weight, simpler manufacturing and the like.

The propeller illustrated in FIGS. 4 and 5 also has the hub members 1*a* and 1*b*. However, in this embodiment each of the hub members carries four blade members 2*a* or 2*b* which are always offset with reference to one another through 90° about the respective hub member. The latter are so connected that one blade member 2*a* of the hub member 1*a* and one associated blade member 2*b* of the hub member 1*b* together define a single complete propeller blade whose cylinder sections are composed of the cylinder sections (abutting along the lines 7) of the two cooperating blade members 2*a* and 2*b*. Because in this embodiment the blades always extend under an angle with respect to the plane of the blade tips, the lines 7 passes each blade composed of blade members 2*a* and 2*b* along a surface the edges of which intersect with the blade surface which is concealed in FIG. 4, with the intersection being shown in broken lines. The respective lines 7 shown located in a plane in FIGS. 4 and 5, can also be located in a curved or conical surface, depending upon prevailing requirements. In the propeller illustrated in FIGS. 4 and 5 the blade tips of the individual blades which are each composed of one of the blade members 2*a* and 2*b*, are always provided on the blade members 2*b* of the hub member 1*a*. However, this depends exclusively on the positioning of the line 7 which is chosen in a particular case.

The embodiment in FIG. 6 shows two hub members 1a and 1*b* mounted on a canner sleeve 8, which latter in turn is mounted on a propeller shaft 11. Expansion bolts 10 releasably connect the hub members, and a

sealing member 9 is inserted between and in sealing relationship with the hub members 1*a* and 1*b*.

It will be appreciated that the partial propellers can be connected, after they are individually manufactured, and then placed in unison upon the propeller shaft, or they can be individually placed on the propeller shaft and then be connected with one another. The mounting of the propellers on the shaft can be carried out by means of a Woodruff key located in corresponding recesses of the hub bores and the shaft, but is preferably carried out without the need for such keys, particularly by shrinking the hub members onto the propeller shaft in known manner, for instance with the help of an oil pressure process. To prevent the entrance of corrosive salt water between the abutting axial end faces of the hub members 1*a* and 1*b*, especially to prevent the penetration of such salt water to the shaft, it is preferable to locate in the juncture 6 between these abutting end faces a non-illustrated sealing member. Generally speaking, incidentally, the end faces of the hub members which abut, may be either planar or profiled as desired.

It is pointed out that although for purposes of simplicity of illustration and explanation only two hub members and associated blade members are illustrated in the drawing, it is similarly possible to produce a propeller of three or more partial propellers each having a hub member and associated blade members. It is also possible to have the junctures 6 and the junctures along the lines 7 closed by welded seams, rather than utilizing screw or bolt connections. The propeller according to the present invention is well suited even where the overall dimensions of the propeller are smaller, rather than for the very large propellers mentioned in the introductory portion of the specification, especially in circumstances in which at a given diameter for the propeller a maximum propeller blade area and overlapping of the propeller blades is necessary or desirable.

It will be appreciated that the propeller according to the present invention cannot only be manufactured much more simply than what is known heretofore, but can also be transported and mounted in a simpler and quicker manner than herebefore. In addition, propellers according to the present invention save time and expense in case of collisions, for instance if only a part of the propeller is damaged and can then be replaced without having to discard and replace the entire propeller. It is also important that by increasing the propeller surfaces, and by providing a double-decker arrangement of the outer blade regions with the propeller according to the present invention, cavitation symptoms can be reduced which heretofore have provided a major source of difficulties in the use of propellers.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a propeller, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

1. Ship's propeller for axial propulsion, comprising a leading and a trailing hub member mounted in axial alignment with each other on a propeller shaft and having a juncture at which they abut, each hub member havin a hub bore through which said propeller shaft extends; a common sleeve mounting said hub members on said shaft; a sealing member between and in engagement with said hub members; connecting means connecting said hub member rigidly but releasably with one another; and at least one outwardly projecting blade member integral with the respective hub member, each of said blade members being helically twisted about its longitudinal axis and having a root portion, a radially outer blade area and a free curved outer tip, each blade member on said leading hub member having a rearwardly declined generatrix and each blade member on said trailing hub member having a forwardly declined generatrix so that said outer blade areas of all blade members have substantially the same configuration and radial pitch distribution and said outer blade areas axially overlap said juncture with said free outer tips being located in a common propeller plane extending transversely of the axis of said propeller shaft, whereby the propeller configuration in the region of said outer blade areas corresponds to that of a conventional one-piece ship's propeller.

2. A ship's propeller as defined in claim **1,** wherein said connecting means comprises expansion bolts engaging said hub members.

3. A ship's propeller as defined in claim **1,** wherein said hubs have juxtaposed end faces each provided with an annular groove which surrounds said shaft and faces the respective other groove; and wherein said sealing member is partly located in each of said grooves.

4. Ship's propeller for axial propulsion, comprising a leading and a trailing hub member having tapering bores and mounted in axial alignment with each other on a tapering propeller shaft, said hub members having juxtaposed end faces which abut and which are each formed with an annular recess surrounding said shaft, said recesses facing one another and together forming an annular channel; sealing means located in said channel in sealing engagement with both of said hub members; connecting means releasably connecting said hub members to one another; and at least one outwardly projecting blade member integral with the respective hub member, each of said blade members being helically twisted about its longitudinal axis and having a root portion, a radially outer blade area and a free curved outer tip, each blade member on said leading hub member having a rearwardly declined generatrix and each blade member on said trailng hub member having a forwardly declined generatrix so that said outer blade areas of all blade members have substantially the same configuration and radial pitch distribution and said outer blade areas axially overlap said juncture with said free outer tips being located in a common propeller plane extending transversely of the axis of said propeller shaft, whereby the propeller configuration in the region of said outer blade areas corre-

sponds to that of a conventional one-piece ship's propeller.

5. A ship's propeller as defined in claim **4**; and further comprising a common sleeve mounting both of said hub members on saiid shaft.

6. A ship's propeller as defined in claim **4**; wherein said connecting means comprises expansion bolts which engage said hub members.

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