Feb. 21, 1950 F. E. THOMPSON, JR 2,498,348

MARINE PROPELLER

Filed May 29, 1947 3 Sheets-Sheet 1

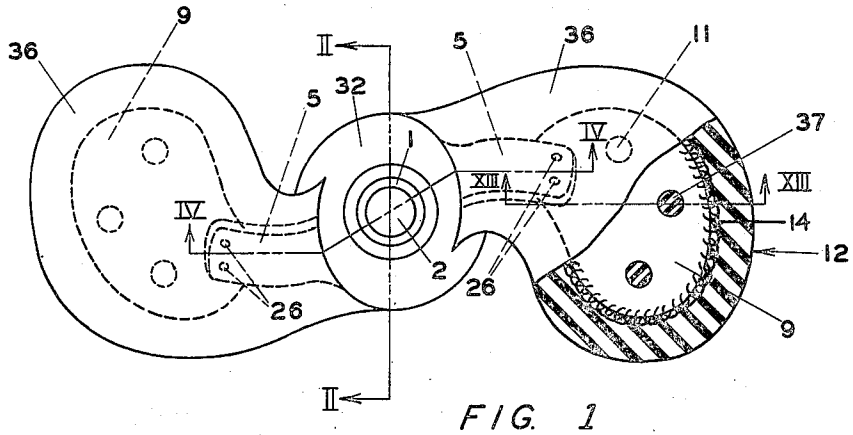


FIG. 1

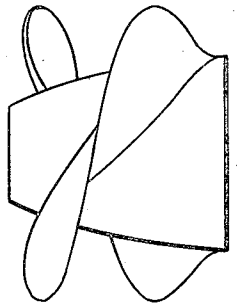


FIG. 3

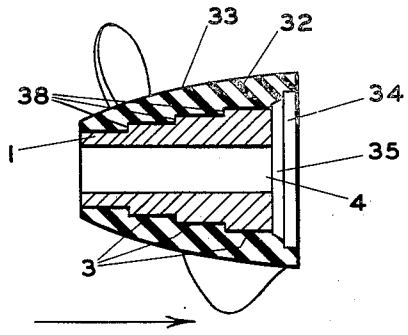


FIG. 2

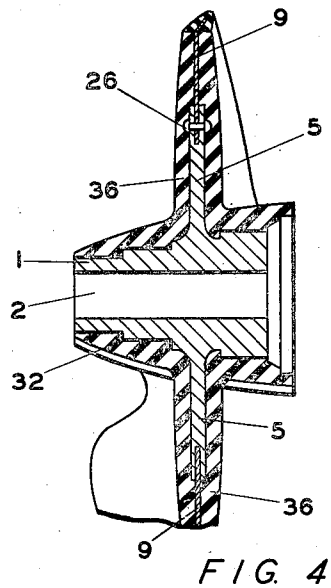


FIG. 4

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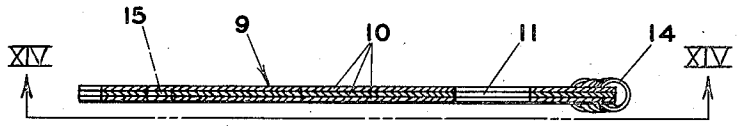


FIG. 13

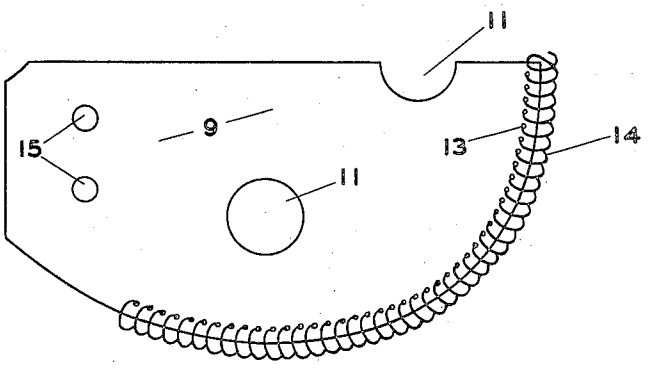


FIG. 14

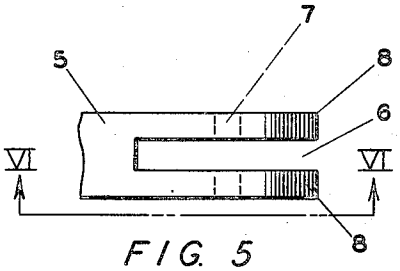


FIG. 5

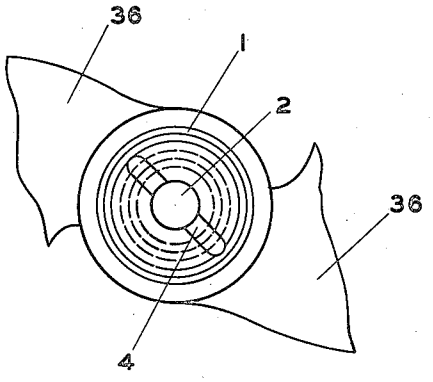


FIG. 12

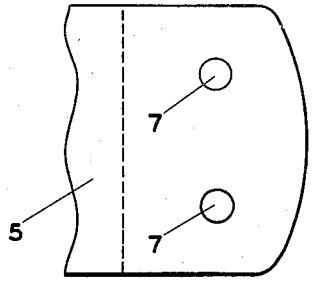


FIG. 6

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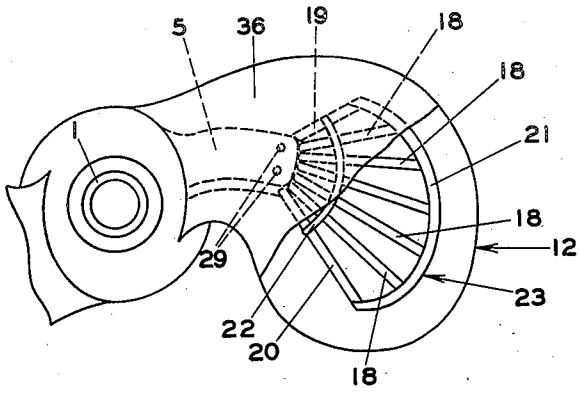


FIG. 7

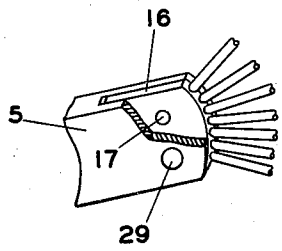


FIG. 8

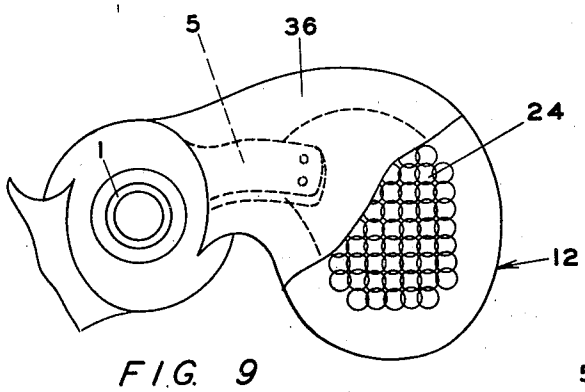


FIG. 9

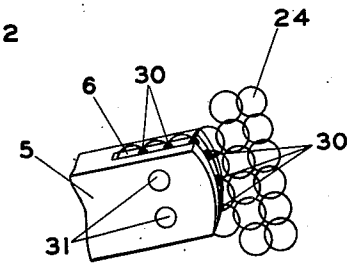


FIG. 10

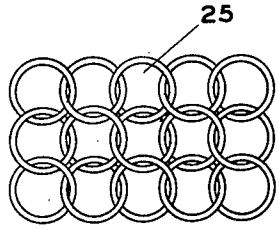


FIG. 11

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UNITED STATES PATENT OFFICE

2,498,348

MARINE PROPELLER

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Application May 29, 1947, Serial No. 751,286

3 Claims. (Cl. 170—160.5)

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This invention relates to marine propellers and particularly to one with blades and hub of reinforced rubber.

It has long been an object of those engaged in the designing of marine propellers to develop one which will not foul in weeds. Heretofore, attempts to solve this problem have generally involved the use of guards to deflect the weeds before they reach the propeller. This has not proved satisfactory for several reasons, of which at least a major one is that in order not to prevent the efficient functioning of the propeller, guards of this type must leave large openings for the free passage of water. When this is done, many weeds still get through to the propeller despite the guard. Further, these guards are expensive and by reason of their exposed position quite subject to damage. When used on an outboard motor they often add considerable weight, which is a serious factor, especially when the units have to be portaged to and from the place of use.

Another problem which has long troubled propeller designers is the damage resulting to propellers from striking submerged objects, such as logs. This likewise has in the past largely been met by the provision of some form of metallic guard.

By extensive experimentation I have found rubber to possess the unexpected and unique quality of being able, in the form of a propeller, to pass through weeds without such propeller's becoming fouled by them. Experiments show that weeds will slip off a rubber propeller under conditions which would render the conventional metallic propeller useless. In addition to possessing this unique anti-fouling characteristic, rubber has the well known property of flexibility which renders it an ideal solution to the injury problem. By reason of this characteristic it will deflect upon striking a foreign object without sustaining injury.

Accordingly, a major object of my invention has been to provide a marine propeller which will pass freely through weeds without fouling.

A further object of the invention has been to provide a marine propeller which will not be readily injured upon striking submerged objects, such as rocks or logs.

A further object has been to develop a specific propeller construction by which the newly discovered non-fouling characteristic of rubber could be utilized.

A further object has been to provide a means of reinforcing a rubber propeller such that a balance is provided between rigidity and flexibility

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at a point which will permit the unit to produce substantially the same thrust as a metallic propeller yet be capable of substantial deflection under conditions of excessive load.

A further object has been to provide a reinforcement construction for a rubber propeller which will both permit deflection of the blades and which will strengthen the rubber against tearing.

A further object has been to provide a means of securely gripping the rubber to the reinforcement and thereby preventing separation between the two.

Another object has been to provide a metallic hub core capable of giving ample support to the rubber hub casing in the direction of thrust.

Another object has been to provide a hub core and reinforcement of such a type that it will be cheap and quick to manufacture.

Other objects and purposes of my invention will be apparent to those acquainted with equipment of this sort and the problems which it is intended to solve, upon reference to the accompanying drawings and the following specification.

In the drawings:

Figure 1 is a rear elevational view of my propeller.

Figure 2 is a sectional view of the hub of my propeller taken along the plane II—II of Figure 1.

Figure 3 is a right hand side elevational view of my propeller.

Figure 4 is a partial sectional view of the hub and propeller blades taken along the plane IV—IV of Figure 3.

Figure 5 is an enlarged fragmentary view showing only the end of the reinforcing support.

Figure 6 is an enlarged fragmentary rear elevational view of the reinforcing support taken along the plane VI—VI of Figure 5.

Figure 7 is a fragmentary rear elevational view showing a variation of my reinforcing.

Figure 8 is a detail of the attachment of the reinforcing shown in Figure 7 to the reinforcing support.

Figure 9 is a fragmentary rear elevational view showing an additional variation of my reinforcing.

Figure 10 is a detail of the attachment of the reinforcing shown in Figure 9 to the reinforcing support.

Figure 11 is a detail of the reinforcing structure shown in Figure 9.

Figure 12 is a fragmentary view of the propeller shown in Figure 3 showing the entirety of the hub in front elevation.

Figure 13 is a fragmentary view taken along the plane XIII—XIII of Figure 1 showing the flexible reinforcement only, and a portion of the helical member.

Figure 14 is a fragmentary front elevational view taken along the plane XIV—XIV of Figure 13.

In providing means meeting the objects and purposes outlined above, I have provided a structure which includes a hub comprising a rubber shell mounted over a multi-step metallic core. This core has opposed laterally projecting rigid inserts, to the ends of which are attached flexible inserts. A heavy rubber shell integral with the hub shell is molded over these reinforcements to form a complete smooth coating for the entire structure. For convenience in description, the terms "forward," "rearward," "left" and "right" will be freely used in the following specification and will always be taken to mean in relation to the propeller as mounted on the aft of a boat and viewed facing the rear. Further, for the sake of simplicity, the description, except as otherwise expressly appearing, will be given in terms of only one blade, it being understood that the blades of the propeller are all identical to each other. A two-bladed propeller is here utilized for illustrative purposes, although the invention could as well be expressed in other multi-bladed propellers or in a counter-weighted single bladed propeller.

Description

Referring now to the drawings in more detail, the numeral 1 indicates a metallic hub core (Fig. 2) with a central opening 2 suitable to accommodate a conventional propeller drive shaft designed for use with a propeller of the dimensions involved. The thickness of the core increases in a forward direction in a series of annular steps 3. The purpose of these steps will be explained hereinafter.

On the forward end of the core there is a shear-pin key-way 4 extending radially outward in opposite directions from the central opening 2 a distance equal to or more than half of the radius of the core (Fig. 12). This key-way and shear-pin associated therewith are conventional both as to location and as to size and form no part of my invention and, therefore, further detail or description is unnecessary.

A short distance forward of the longitudinal center of the hub core, and preferably integral therewith, there are provided the rigid reinforcement inserts 5. These are set at such an angle to the diametric centerline of the hub core as will enable them to follow and lie in the central plane of the propeller blades, the latter to be more fully described hereinafter. The rigid inserts 5 should also have a circumferential sweepback sufficient to correspond to a similar variation, where it exists, in the centerline of the blades. The rigid inserts are preferably substantially rectangular in cross-section and are provided with a slot-type end opening 6 parallel to the central place of the end portion of the said insert. Two openings 7 (Figs. 5 and 6) are provided through each of the walls 8 of the slot-type openings suitable to accommodate rivets or similar fastening means (Figs. 5 and 6). The opening 6 is of sufficient depth to provide substantial edge margin for the fastening means installed in the openings 7 in a reinforcement, to be hereinafter described, inserted into the slot between the walls 8.

When the propeller diameter is 4 inches or less the rigid reinforcements 5 may be omitted; however, excepting possibly only under conditions of exceptionally small thrust, a more satisfactory product is provided in even these small sizes when the rigid reinforcements are used. In sizes above 4 inches in diameter they are, in substantially all cases, essential to satisfactory performance.

A flexible blade reinforcement insert 9 extends outwardly from the insert 5 (Figs. 1, 13 and 14). As shown in these figures, the body of the insert 9 comprises several layers 10 of heavy cloth bonded together by any suitable bonding agent, such as resin, glue or rubber.

This flexible insert 9 corresponds substantially in shape to that portion of the blade extending beyond the rigid insert 5 but is materially smaller in all dimensions. Sufficient distance must remain between the perimeter of the flexible insert and the edge of the blade 12 to permit the rubber covering to be reduced to a thin edge cross-section while maintaining a smooth and efficient hydrodynamic curve. The thickness of this flexible insert must likewise be sufficiently limited that a rubber covering of sufficient thickness to provide necessary strength may be provided without exceeding blade thickness limitations of good hydrodynamic blade design.

Openings 11 are provided through the cloth, especially in propellers of over 10 inch diameters. These serve as a means of anchoring the molded rubber shell as will be explained more fully hereinafter. A wide latitude of hole sizes may be used but those of approximately ¼ inch diameter reproduce highly satisfactory results for the usual six to ten inch blades.

The periphery of the flexible insert is pierced with a series of small diameter openings 13. A resilient, preferably metallic, helical coil 14 is passed through these openings, each hole accommodating one loop. As a variation, an individual metallic ring in each hole may be substituted for the helix. This will perform the same anchoring function as the helix but the resilient qualities of the helix will be sacrificed.

When the overall diameter of the propeller is less than 10 inches, the coil 14 and associated attaching holes 13, together with the openings 11, may be eliminated and the propeller unit will maintain a workable, though perhaps less satisfactory, balance between rigidity and flexibility.

Two or more installation openings 15, suitable for rivets or similar fastening means, are provided through the flexible insert 9 proximate to the edge nearest the central axis of the propeller. These openings are coordinated with the openings 7 through the end of the rigid insert 5.

The cloth flexible insert 9 together with the coil 14 may be replaced with a fan-type arrangement 23 of single or multiple strand wires (Fig. 7). A mounting base 16 is provided (Fig. 8) which may consist of metal or a strong, rigid plastic and having two or more installation openings 17, suitable for rivets or similar fastening means, through the mounting base and coordinated with the openings 7 in the rigid insert 5. A multiplicity of individual metallic wire spokes 18 are inserted in the base. Each of these wires are of different lengths and are given suitable degrees of deflection to coordinate with the central plane of the blade. The two end wires 19 and 20 are given the greatest degree of deflection. The free ends of these wires, are joined by a capping wire 21 of similar size and shape

and formed substantially to parallel the perimeter 12 of the blade. The spoke wires and the capping wire are attached by soldering, welding or wrapping. One or more bracing wires 22, depending upon the diameter of the propeller, may be used at suitable spacing or spacings between the mounting base 16 and the capping wire 21. The bracing wire 22 may be attached to the spoke wires in a manner similar to the joining wire 21. The overall size of the fan-type flexible insert 23 is substantially similar to the size of the cloth insert 9 for propellers of corresponding diameters.

A further variation in the type of flexible insert may be made by the use of a wire cloth 24 consisting of interlocking individual metallic wire rings 25 (Figs. 9, 10 and 11). This is cut to form flexible reinforcement body substantially similar in size and shape to the cloth insert 9.

Assembly

To assemble a propeller of the type illustrated in Figures 1, 2, 13 and 14, the flexible inserts 9 are attached to the rigid inserts 5 of the core. This is accomplished by inserting the flexible insert 9 into the slot-type opening 6 (Figure 5) until the openings 7 and 15 are in register. Rivets 26, or other suitable fastenings means, are then passed through the holes and locked into position in any usual manner (Fig. 1). By means the rigid and the flexible reinforcements are securely locked together as a single unit.

The flexible, fan-type insert 23 is secured to the rigid inserts 5 by its mounting base 16 in the same manner as the flexible cloth insert 9 (Figs. 7 and 8). The rivets 29 perform the same function and may be installed in the same manner as the rivets 26.

The flexible wire cloth insert 24 is mounted to the rigid insert 5 by passing a portion of the insert into the slot-type openings 6 (Figs. 9, 10 and 11). The links 25 within the opening are then soldered to the walls 8 as indicated at 30. Rivets 31 may then be installed as an additional fastening means if desired.

When the inserts have been assembled and fastened together a rubber body or housing 32 is then molded over the entire unit to form a complete shell about the inserts. Any good grade of natural or synthetic rubber of a Shore hardness between 40 and 100, preferably for most uses between 60 and 80, may be used for this shell, excepting only that it should have a fair degree of flexibility and tensile strength. A rubber of low tensile strength and low flexibility, such as reclaimed rubber, will not be particularly satisfactory. The exterior surface 33 of the hub portion of this shell 32 is substantially in the form of a truncated hyperbola (Fig. 2). The rubber is molded tightly into the steps 3 for reasons which will appear more fully hereinafter. The rubber shell 32 is molded at the forward end to provide two circular depressions 34 and 35 (Fig. 2) to clear the structure to which the propeller is attached (not shown as it forms no part of this invention).

The rubber shell 36 of the propeller blades is molded integral with the rubber shell 32 of the hub. The exterior shape of this shell is that conventional for marine propellers, except that sufficient thickness must be provided to contain the inserts, and conforms to the accepted principles of hydrodynamic design. Since this form is conventional and forms no part of my invention, further description of it will not be given.

As the rubber shell 36 of the blades is molded about the flexible insert 9, a portion of the rubber will pass through the openings 11 to form posts 37 of rubber through the flexible inserts (Fig. 1). The rubber will also fill in the interstices between the wires of the coil 14. The area between the flexible and rigid inserts and the edge of the blades 12 is filled entirely by the rubber shell 36.

The rubber will in a similar manner fill the spaces and interstices existing within the members of the flexible inserts 23 and 24 (Figs. 7 and 9).

Since the propeller, to be practical, must develop sufficient rigidity to provide thrust while at the same time have enough flexibility that it will deflect under any excessive load such as striking a submerged rock or becoming fouled with weeds, the rubber should be of maximum softness, i. e. flexibility consistent with having the capacity to transmit the desired torque. Thus, an outboard motor propeller for trolling will be of relatively high flexibility while an inboard motor propeller for general use will be of relatively less flexibility. In addition to selecting rubber of proper flexibility, it will be understood that the flexibility of the blade may also be controlled by proper designing of both of the inserts as to size and shape and selection of material to provide flexible inserts of the desired size and stiffness.

Operation

The hub core 1 provides a rigid, wear resisting means of transmitting torque from the driving shaft (not illustrated), passing through the central opening 2 thereof, to the remainder of the propeller unit.

When the rubber is molded about the hub core 1 it bonds thereto to form a single operational unit. As the propeller is rotated, it develops thrust on its parts in the direction of the arrow (Fig. 2). That portion of the thrust load carried by the rubber shell 32 is transmitted to the hub core 1 by means of the steps 3. The vertical faces 38 of these steps provide direct support for the rubber shell at right angles to the direction of the thrust load and relieve the shell of its load in evenly distributed proportions.

The major portion of the thrust load is transmitted from the blades to the core by the inserts 5. Besides transmitting the thrust load, the rigid inserts provide support for the rubber shell 36 of the blades. Inasmuch as rubber without support is both too flexible and too low in ultimate tensile strength to provide a satisfactory propeller over four inches in diameter, these rigid inserts are necessary to overcome this difficulty. The flexible inserts 9, 23 or 24 pick up the load created by the extended portions of the blades and transmit it to the rigid inserts 5. They supplement and overcome the absence of tensile strength in the unsupported rubber without materially affecting its flexibility characteristics. They are designed to permit, when necessary, a large portion of the blade to deflect without tearing. The openings 11 in the insert 9 and the numerous interstices created by the coil 14, or the spaces between the wires in Figure 7, or between the rings 25 in Figure 9, provide a large number of individual anchorages for the rubber shell assuring a firm bond between the shell and the inserts.

It will be understood that many other types of flexible inserts, and insert material, such as high grade kraft paper, or wood or hemp fibers, may be used in addition to that herein specifically illustrated, provided only it is properly flexible and will permit rubber to bond to it, either by chemical action directly to a smooth surface or by entering suitable interstices.

As in the case of the hub, a sufficient space is provided between the inserts and the edge of the blade 12 to assure tapering the thickness of the blade towards the edge while maintaining efficient hydrodynamic characteristics.

The rubber shells 32 and 36 provide a smooth, all rubber surface for the propeller which will not foul in weeds since the weeds will freely slide off. The entirety of the blades has sufficient stiffness to transmit the torque for which the propeller is designed but it will be sufficiently flexible to avoid injury to itself upon striking obstructions such as submerged logs or rocks.

Several other variations may be made from the specific structures herein disclosed, especially in size and stiffness characteristics, without departure from the principles of my invention and hence the hereinafter appended claims should be interpreted to cover such variations excepting where the claims by their own terms expressly provide otherwise.

I claim:

1. A composite axial flow marine propeller comprising in combination: a metallic hub core with an exterior surface divided into circumferential steps of radius progressively increasing in one direction along the axis of said hub core; a plurality of rigid inserts integral with said hub core and projecting radially therefrom; a flexible insert composed of a plurality of layers of cloth bonded together mounted upon and projecting radially from the ends of each of said rigid inserts; a resilient coil along the periphery of said flexible insert; a rubber shell having a smooth hydrodynamically shaped exterior surface surrounding said hub core and bonded thereto; a blade-shaped rubber shell surrounding each of said combinations of a rigid insert and a flexible insert and integral with said hub shell.

2. A composite axial flow marine propeller comprising in combination: a metallic hub core; a plurality of rigid inserts affixed to said hub core and projecting radially therefrom; a flexible insert composed of a plurality of layers of cloth bonded together mounted upon and projecting radially from the ends of each of said rigid inserts; a resilient coil along the periphery of said flexible insert; a rubber shell having a smooth, hydrodynamically shaped exterior surface surrounding said hub core and bonded thereto; a blade-shaped rubber shell surrounding each of said combinations of a rigid and a flexible insert and integral with said hub shell.

3. A composite axial flow marine propeller comprising in combination: a metallic hub core; a plurality of rigid inserts affixed to said hub core and projecting radially therefrom; a flexible insert mounted upon and projecting radially from the ends of each of said rigid inserts; a resilient coil along the periphery of said flexible insert; a rubber shell having a smooth, hydrodynamically shaped exterior surface surrounding said hub core and bonded thereto; a blade-shaped rubber shell surrounding each of said combinations of a rigid and a flexible insert and integral with said hub shell.

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