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J. S. LEONARD ET AL
LOWER UNIT FOR BOAT MOTORS OF THE TYPE HAVING
DOWNWARDLY DIRECTED DRIVE SHAFTS

2,743,698

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2 Sheets-Sheet 1

Fig. 1.

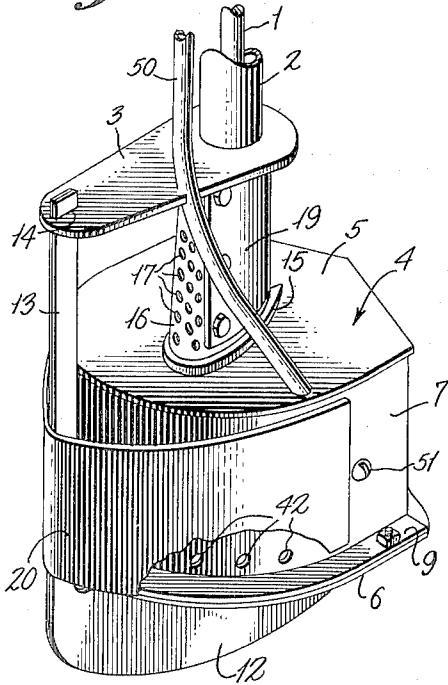


Fig. 2.

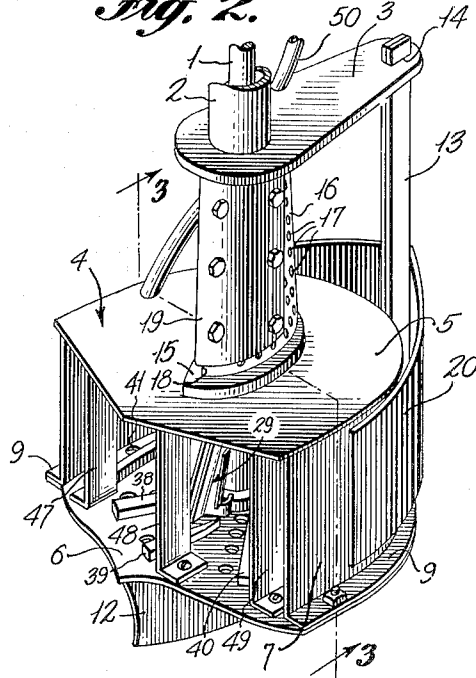
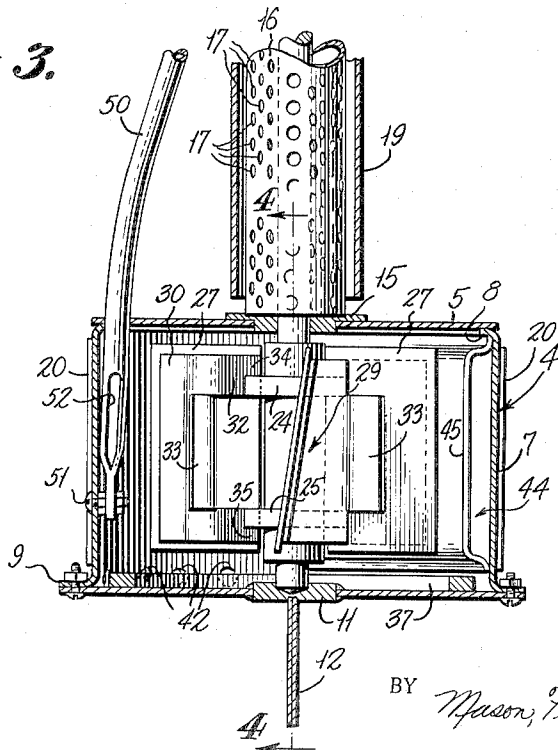


Fig. 3.



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Fig. 4.

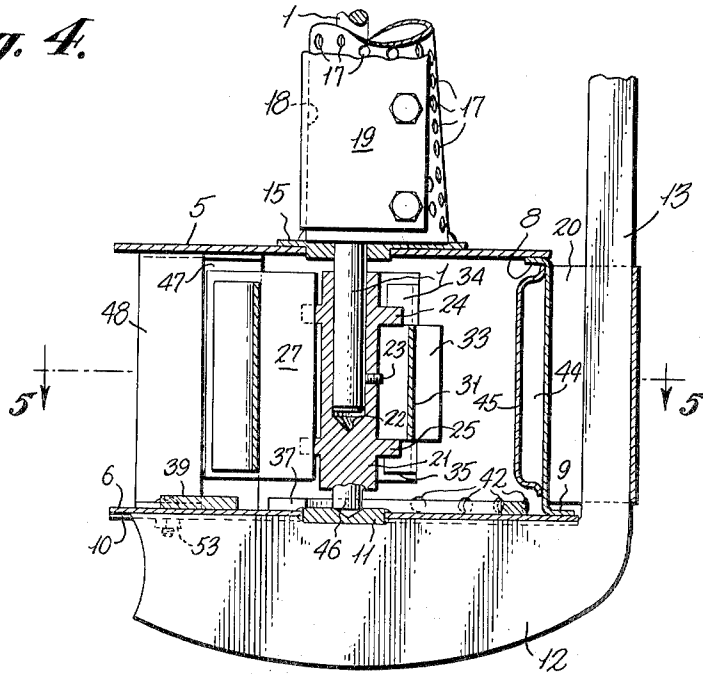


Fig. 5.

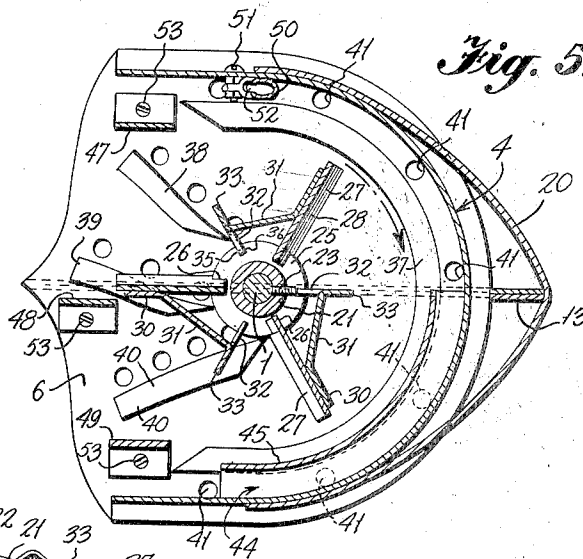
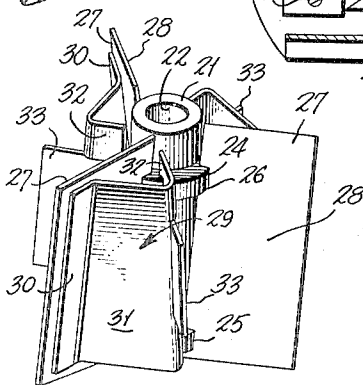


Fig. 6.



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LOWER UNIT FOR BOAT MOTORS OF THE TYPE HAVING DOWNWARDLY DIRECTED DRIVE SHAFTS

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8 Claims. (Cl. 115—16)

This invention relates to that type of boat motor, whether inboard or outboard, in which the drive shaft descends vertically or nearly so, into the water. Since the invention does not concern itself with the internal combustion engine or its controls, but solely with a cluster of structurally integrated and operatively associated instrumentalities surrounding the lower portion of the drive shaft, it will be referred to herein as well as in the title, as a lower unit for outboard or inboard motors.

The general purpose of this invention is to eliminate many of the encumbrances that beset the conventional type of lower units of boat motors, thus giving more efficient performance.

One of the objects of the invention is to replace the screw propeller, and the bevel gearset which is required in the line of drive, by a radially vaned impeller wheel directly connected to the drive shaft, thus doing away with the chore of greasing the gears and the nuisance created by the presence of grease on the lower parts of the motor, and which is particularly obnoxious in outboard motors which have to be carried or laid in the boat.

Another object of the invention is the provision of a housing about the impeller wheel protecting the latter from weeds, cavitation, etc., being open at the rear and rotatable whereby steering is accomplished through the selective direction of the thrust of the water column discharged from the housing.

Still another object of the invention is the provision of a rudder on the housing, constituting steering means auxiliary to the discharging water column, and providing steerway when the boat is travelling under momentum with the motor cut off, as when approaching a dock.

A further object of the invention is the novel construction of a housing and the instrumentalities therein by which the efficiency of operation of the impeller wheel is enhanced.

Still another object of the invention is the provision of a water scoop within the housing in the path of thrust of the impeller wheel, through which water is positively pumped by the impeller wheel to the jacket of the engine.

Another object of the invention is the novel integrated lower unit as shown and described, incorporating a muffler above the housing, and a rudder beneath the housing having a stem at the front extending throughout the height of the housing and muffler whereby the housing and muffler are protected from being struck by obstructions encountered in the forward movement of the boat.

Other objects of the invention will appear as the following description of a practical embodiment thereof proceeds.

In the drawings which accompany and form a part of the following specification, and throughout the several figures of which the same reference characters have been used to denote identical parts:

Figure 1 is a perspective view of the lower unit of

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a boat motor embodying the principles of the invention, the view being a forward aspect;

Figure 2 is a similar view from the rear;

Figure 3 is a transverse section taken along the line 3—3 of Figure 2;

Figure 4 is a longitudinal section taken along the line 4—4 of Figure 3;

Figure 5 is a cross-section taken along the line 5—5 of Figure 4;

Figure 6 is a perspective view of the impeller wheel.

Referring now in detail to the several figures, it will be understood that the shaft 1 is the lower portion of the rectilinear drive shaft of an internal combustion engine, not shown, and that the surrounding sleeve or casing 2 is conventional, its upper end, not shown, being associated with the engine and rotatable by a tiller handle, not shown, said casing being a conduit for the exhaust of the engine.

The lower unit may be said to begin with the supporting plate 3, which is elongated in a fore and aft direction, having a circular hole towards its rear, of the same diameter as the inside of the casing 2, coaxial with said casing, said supporting plate being welded perpendicularly to the lower end of said casing. At a distance below the supporting plate 3 is the wheel housing 4, consisting of spaced top and bottom plates 5 and 6 in planes parallel to the supporting plate, and a side plate 7. The side plate encloses the front and lateral portions of the housing 4, leaving the rear of the housing open. The side plate is inwardly flanged about its upper edge and outwardly flanged about its lower edge, the respective flanges being indicated at 8 and 9. The flange 8 is welded to the top plate 5 and the flange 9 bolted to the bottom plate 6. The top and bottom plates are circular forward of a transverse diameter intersecting the axis of the drive shaft, and rearwardly of said diameter the lateral sides of said top and bottom plates are parallel. The bottom plate 6 extends outwardly beyond the upright portion of the side wall 7 so as to provide a seat for the flange 9.

The underside of the bottom plate is formed with a longitudinal groove 10 thereacross, in the medial vertical longitudinal plane of said housing, interrupted in the region of the center of the bottom plate to allow the thrust bearing 11 to intervene. The rudder 12 is seated in this groove and welded to the bottom plate along the joint formed between the rudder and the sides of said groove. The rudder extends forward of the bottom plate for some little distance, its forward end being formed as an integral stem 13 of rectangular cross-section, extending upwardly parallel to the drive shaft, and having a considerable depth dimension in a fore and aft direction. The upper end of the stem 12 passes with friction fit through a correspondingly shaped slot 14 in the supporting plate 3, and terminates a short distance above said supporting plate. As shown, the rudder, including the stem, are made of two plates of metal in surface contact, congruently related, and welded together, but obviously the rudder could be made of a single integral piece.

The top plate 5 has a bearing 15 for the drive shaft inserted in an aperture in the top plate and welded to the latter. The thrust plate 11 which receives the lower end of the hub of the impeller wheel is inserted in an aperture in the bottom plate 6, and also welded in place.

Between the supporting plate 3 and the top plate 4 is the muffler shell 16, the same being welded or otherwise secured at its upper end to the supporting plate, surrounding the hole in the latter that registers with the casing 3, and thus being in communication with said casing. The muffler shell is of ovate cross-section, with its larger end toward the front of the unit. The wall of

the shell at the rear, indicated at 18, extends downwardly parallel to the axis of the drive shaft. The forward part of the wall flares forwardly in a downward direction, the capacity of the shell progressively increasing to allow expansion of the exhaust gas within said shell. The flat upper face of the bearing 15 is of such size and shape as to afford a seat for the lower end of the muffler shell which is welded thereto. The forward end of the muffler shell is provided with a pattern of perforations 17, extending both heightwise and circumferentially, allowing escape of the exhaust gas at different pressure levels. A baffle 19 surrounds the rear portion of the shell 16, being in contact therewith at the extreme rear, and flaring away from the shell in a forward direction at both sides. It extends forwardly a sufficient distance to overlie a portion of the pattern of perforations on each side, in spaced relation thereto, and has the usual silencing effect on such gas as issues from the overlain perforations. The baffle 19 fits close against the supporting plate 3, but at the bottom it is spaced above the top plate 5 and bearing 15 so as to afford an avenue of escape for some of the gas in the zone of the bottom of the muffler. In use, the muffler generally operates partly submerged.

A curved V-shaped shield 20 embraces the rudder stem 13, having the middle of the bight portion in free contact with the rudder stem, and having its ends welded to the side wall of said impeller wheel housing at opposite sides thereof, terminating substantially in the vertical transverse diametrical plane which demarks the circular portion of said side wall from the parallel rear portions of said wall. The shield 26 stream lines the forward portion of the lower unit in the zone of the wheel housing.

The impeller wheel comprises a hub 21, having a bore 22 extending partway therethrough which fits the lower end of the drive shaft, being secured to the latter as by the set screw 23. The lower end of the hub includes a conical extension 46, the apex of which rests in the center of a recess in the thrust plate 11. The hub is formed with upper and lower spaced collars 24 and 25, provided with slots 26 at circumferential intervals of 120°. Radial vanes 27 are seated in said slots and against the hub, being welded to the respective collars. Said vanes are set at a small angle to the vertical, with their leading faces 28 tilted slightly upwardly. Vane supports 29 are secured to the trailing faces of the vanes. These supports have terminal flanges 30 in surface contact with the vanes near their peripheral ends, and being welded thereto, reinforcing the vanes. The supports are bent dihedrally, forming broad webs 31 at a steep angle to the vane with which they are associated and are formed with inner flanges 32, which have their middle portions 33 bent outwardly in radial directions and oppositely inclined with respect to the vanes 27. The remaining upper and lower portions 34 and 35 of the flanges 32 are seated in slots 36 in the hub collars 24 and 25, intermediate the vane slots 26, and welded to the respective collars. The impeller wheel when mounted in the housing 4 is spaced from the bottom plate 6 thereof to make room for a plurality of baffles fixed to the inner face of said bottom plate. These baffles, which are of the same height, comprise a U-shaped baffle 37, having its bight portion circular and concentric with the axis of the drive shaft, symmetrically arranged with respect to a medial longitudinal vertical plane through the housing, its bight portion being spaced from the forward part of the side wall of the housing and outside of the projected path of rotation of the impeller wheel. The other baffles 38, 39 and 40 radiate outwardly from points adjacent the hub, toward the rear opening of the housing.

Referring to Figure 5, the impeller wheel is shown rotating in a clockwise direction, with the upwardly inclined faces of the vanes leading, so that there is an upward thrust upon the water which fills the housing. This water is taken in through apertures 41 in the bottom plate 6 between the baffle 37 and the adjacent part of the housing side wall, and through other apertures 42 in the

portion of said side wall to forward of the baffle 37 and below the top of said baffle, the purpose of this baffle being to guide the water upward into the zone of rotation of the impeller wheel. The rotation of the impeller wheel across the tops of the baffles 38, 39 and 40 tends to create a vacuum at the sides of said baffles from which the impeller vanes retreat, drawing up water through apertures 43 in the bottom plate adjacent said sides of said baffles. Thus the water supplied to the impeller wheel comes from the level of deepest submergence of the housing and is free from admixture with air, generally known as "cavitation."

The skeletal construction of the vane supports 29 provides passages for incoming water, upwardly through the impeller wheel, particularly along the central portion thereof, which supply it to the several vanes through openings in the supports between the hub and the outwardly directed portions 33 of the vane supports. The water is thrown centrifugally, some of it directly rearwardly through the rear open end of the housing, and the most of it against the side wall of the housing, about which it travels in the direction of rotation of the impeller wheel and is discharged through the opening at the rear.

In order to relieve the vanes 28 of some of the resistance due to turbulence incident to direction change of the water thrown against the housing side wall, an open ended water tunnel 44 is provided for conducting some of the water in a smooth flow out of contact with the tips of the vanes. This tunnel is formed by the provision of a partition 45 within the housing, extending substantially the full height of the zone traversed by the vanes, uniformly spaced from said side wall, coextensive with its forward circular portion and terminating within the housing parallel to the parallel portions of said side wall. Said partition is bent outwardly at the top and bottom, forming flanges which are secured to said side wall. Water is driven into one end of the tunnel 44 by the impeller wheel, and discharged from the opposite end rearwardly in a direction parallel to the medial longitudinal vertical plane of said housing.

At its rear, the housing is provided with vertical baffles 47, 48 and 49, bridged between the top and bottom plates 5 and 6 and secured to said plates, the means for securing them to the bottom plate being detachable, and as shown, being bolts 53. Said baffles are of appreciable width in a direction parallel to said medial longitudinal vertical plane and direct the discharge water in a column parallel to said plane, preventing to a great extent its fan-like discharge, minimizing lateral force components against the ambient water, and thereby intensifying the propulsive and steering efforts of the motor.

A pipe 50 extends from the water jacket of the engine, not shown, and enters the housing 4 through a hole in the top plate 6 adjacent one side thereof and preferably in the transverse axial plane of said housing. Said pipe extends downward within the housing adjacent the side wall thereof, being secured to said side wall by means such as the bolt and nut 51, shown in Figure 3. Said pipe has an elongated opening 52 through that side which faces in a direction opposite to that in which the impeller wheel rotates, and in the zone of traverse of the portions 33 of the vane supports, so that the latter act as a pump in driving water into said opening, supplying cooling water under pressure through said pipe to the engine jacket. Since the portions 33 are oppositely inclined to the vanes, they nullify the upward flow of the water that they impinge, intensifying the centrifugal thrust of the water toward said opening.

In order to gain access to the impeller wheel for the removal or replacement of the same, it is necessary merely to remove the bolts that secure the bottom plate 6 and the bolts that fasten the lower ends of the baffles 47, 48 and 49 to the bottom plate. This frees the unit consisting of the bottom plate and rudder, which unit can

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be removed by driving the stem 13 of the rudder through the slot 14 in the supporting plate in which the stem 13 is frictionally fitted. This gives access to the set screw 23, the loosening of which permits the impeller wheel to be slipped off of the lower end of the drive shaft and removed through the open bottom of the housing.

While we have in the above description disclosed a practical embodiment of the invention, it will be understood by those skilled in the art that the specific details of construction and arrangement of parts, as shown and described, are by way of example and not to be construed as limiting the scope of the invention.

What we claim is:

1. In a boat motor of the type having a drive shaft extending substantially vertically downwardly, and a dirigible casing surrounding said drive shaft the lower portion of said casing constituting a muffler having perforations in its front side, a lower unit therefor comprising a housing about the lower portion of said drive shaft below said muffler portion fixed relative to said casing so as to be dirigible therewith, said housing comprising spaced top and bottom plates perpendicular to said drive shaft, and a U-shaped side wall between said plates and connected thereto having its bight portion forward, and being open at the rear, a rudder extending downwardly from the lower face of said bottom plate in the medial longitudinal vertical plane of said housing secured to said bottom plate, said rudder including a stem extending upwardly forward of the muffler portion of said housing, a supporting plate fixed to said casing above said muffler portion engaging said stem, and a propeller within said housing directly mounted on the lower end of said drive shaft.

2. In a boat motor of the type having a drive shaft extending substantially vertically downward with a propeller at its lower end, a rigid casing unit therefor comprising a casing for surrounding the drive shaft, said casing including a housing for the propeller and a tubular portion above said housing and fixed thereto, the lower part being a muffler having perforations in the front side, the upper part functioning as a conduit for conducting exhaust gas to said muffler, said housing comprising spaced top and bottom plates perpendicular to said drive shaft, and a U-shaped side wall between said plates and secured thereto having its bight portion forward and being open at the rear, said casing unit including a rudder extending downwardly from the lower face of said bottom plate in the medial longitudinal vertical plane of said housing and fixed to said bottom plate, said rudder including a stem extending upwardly forward of said housing, and a supporting plate fixed to said casing above said muffler portion engaging said stem.

3. In a boat motor as claimed in claim 2, said casing unit including a U-shaped shield in the zone of the side wall of said housing having its bight portion freely embracing the stem of said rudder in free contact with the forward side of said stem and having its ends contacting said side wall at opposite sides thereof and being secured thereto.

4. In a boat motor of the type having a drive shaft extending substantially vertically downward with an impeller at its lower end, a rigid casing unit therefor comprising a casing for surrounding the drive shaft including a housing for the impeller, and a tubular portion above said housing and fixed thereto, the lower part of said tubular portion being a muffler, having perforations on the front side, the upper part of said tubular portion being a conduit for conducting exhaust gas to said muffler, said housing comprising spaced top and bottom plates perpendicular to said drive shaft, and a U-shaped side wall between said plates and connected thereto detachably secured to one of said plates and having its bight portion forward and being open at the rear, a rudder extending downwardly from the lower face of said bottom plate in the medial longitudinal vertical plane of said housing,

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fixed to said bottom plate, and a supporting plate fixed to said casing at the top of said muffler shell, said rudder including a stem extending upwardly forward of said housing and muffler constituting a guard for both, said stem being detachably engaged by said supporting plate.

5. In a boat motor of the type having a drive shaft extending substantially vertically downwardly, and a dirigible casing surrounding said drive shaft, a lower unit therefor comprising a housing about the lower portion of said drive shaft fixed relative to said casing so as to be dirigible therewith, said housing comprising spaced top and bottom plates perpendicular to said drive shaft, and a U-shaped side wall between said plates and connected thereto having its bight portion forward and being open at the rear, a vaned impeller wheel within said housing directly mounted on the lower end of said drive shaft, an upwardly extending baffle of substantially circular curvature concentric with said impeller wheel, fixed to the inner face of said bottom plate forwardly of said impeller wheel beyond the path of traverse thereof and spaced from said side wall, said baffle terminating heightwise below the level of the bottom of said impeller wheel, said housing being formed with water inlet holes outwardly of said baffle and below the top thereof.

6. Lower unit for a boat motor as claimed in claim 5, said bottom plate being provided also with spaced baffles to the rear of the axis of said impeller wheel, radiating from said axis, terminating heightwise below the level of the bottom of said impeller wheel, said bottom plate being provided with water inlet holes adjacent each of said last mentioned baffles on the side of each from which the vanes of said impeller wheel retreat.

7. In a boat motor of the type having a drive shaft extending substantially vertically downwardly, and a dirigible casing surrounding said drive shaft, a lower unit therefor comprising a housing about the lower portion of said drive shaft fixed relative to said casing so as to be dirigible therewith, said housing comprising spaced top and bottom plates perpendicular to said drive shaft, and a U-shaped side wall between said plates and connected thereto having its bight portion forward and being open at the rear, a vaned impeller wheel within said housing directly mounted on the lower end of said drive shaft, and an open ended arcuate water tunnel within the forward part of said housing circumscribing the path of traverse of said impeller wheel, having its open end spacing the open end of said housing and its inlet end positioned to receive water impelled by said impeller wheel.

8. In a boat motor of the type having a drive shaft extending substantially vertically downwardly, and a dirigible casing surrounding said drive shaft, a lower unit therefor comprising a housing about the lower portion of said drive shaft fixed relative to said casing so as to be dirigible therewith, said housing having water inlet and water discharge openings, an impeller wheel within said housing comprising a hub having an axial bore part way therethrough from its upper end receiving the lower end of said drive shaft, and having a conical bearing at its opposite end, said hub being formed exteriorly with spaced collars, a plurality of radial vanes at equally spaced circumferential intervals, bridging said collars, seated in slots therein, and fixed to said hub, said vanes having their leading faces upwardly inclined, a support at the rear of each vane, said support being bent to form an outer flange in surface contact with the associated vane near the tip, and fixed thereto, an intermediate web, at a steep angle to said vane, and an inner flange fixed in slots in the respective collars, the middle portions of said inner flanges being bent radially outwardly, a cooling water supply tube for the engine jacket of the motor extending into said housing and being secured therein adjacent the path of traverse of said impeller wheel, having an elongated opening communicating with the bore of said tube, said opening being in the zone traversed by said outwardly bent portions of said vane supports, said portions being inclined

oppositely to the inclination of said vanes whereby to nullify the upward component of force of the vanes, with respect to the water impinged by said portions, augmenting the circumferential thrust delivered to the water by said portions, toward said opening.

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