Feb. 10, 1970 R. A. STUBBLEFIELD 3,494,320

OUTBOARD MOTOR AND STEERING ARRANGEMENT

Filed April 4, 1968 3 Sheets-Sheet 1

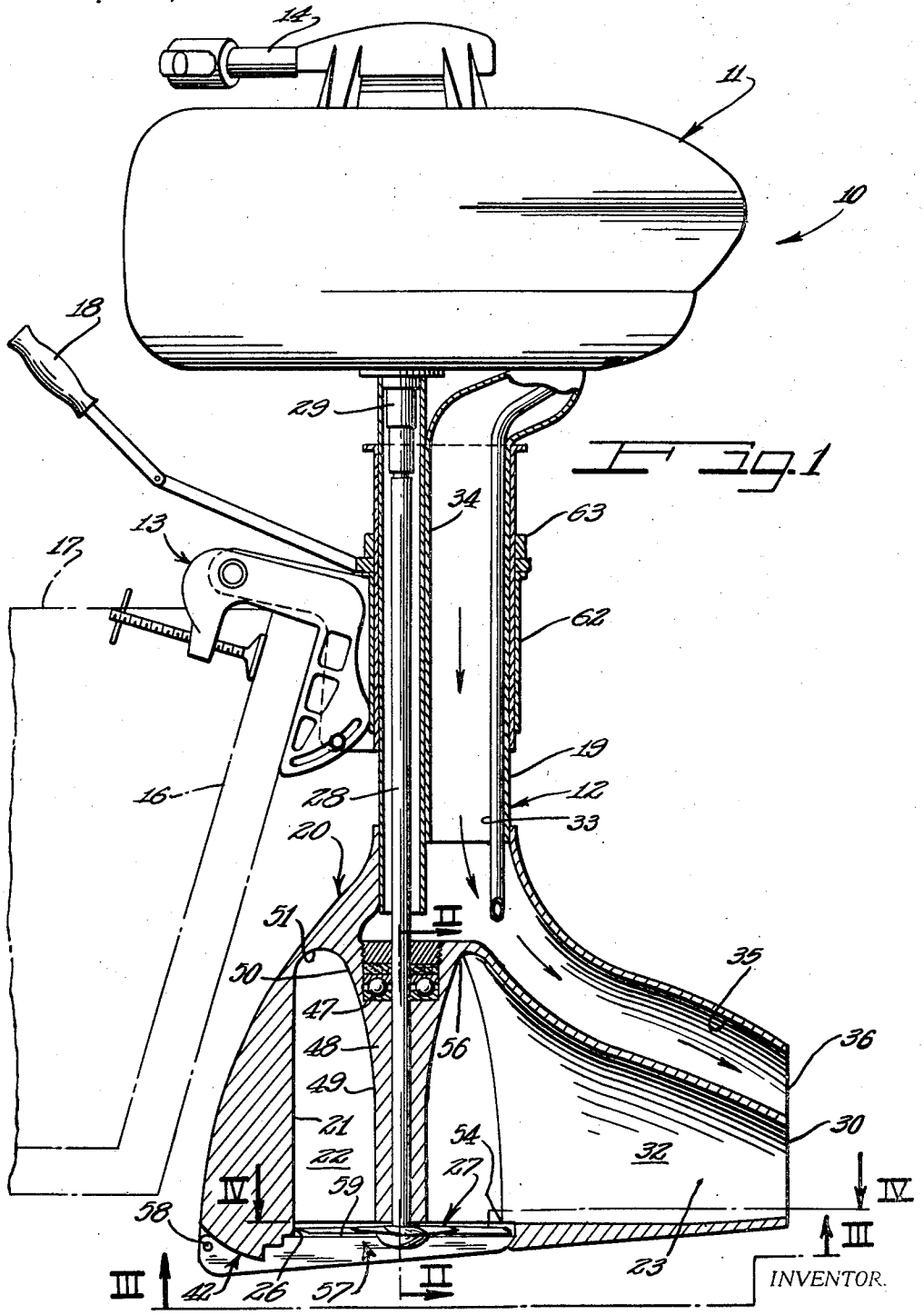


Fig. 1

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Fig. 3

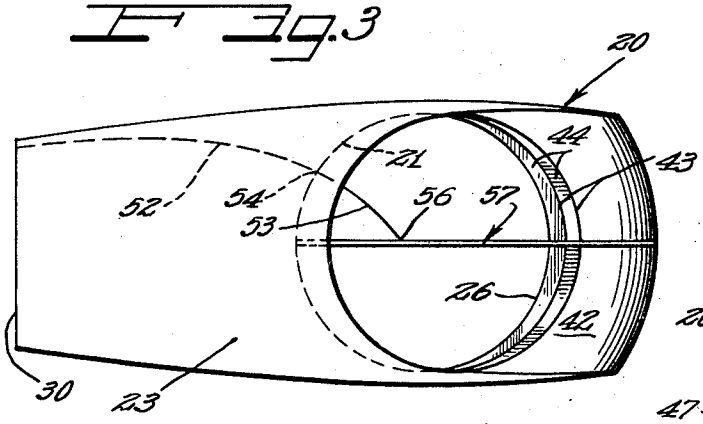


Fig. 4

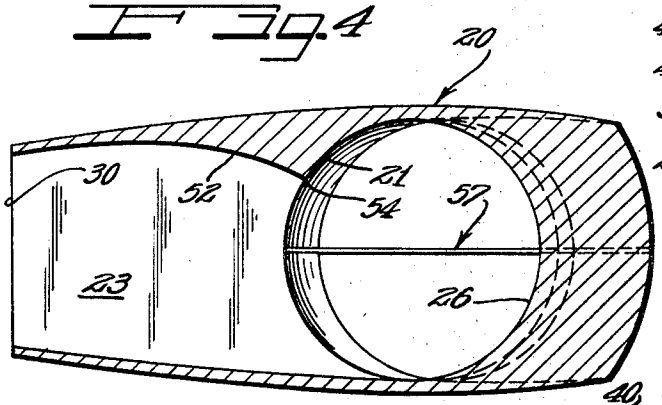
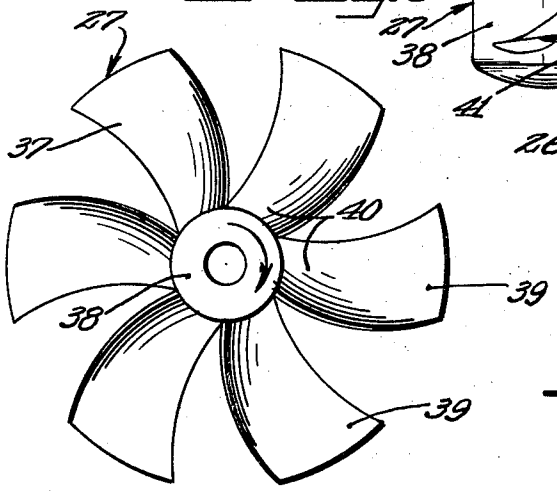


Fig. 6



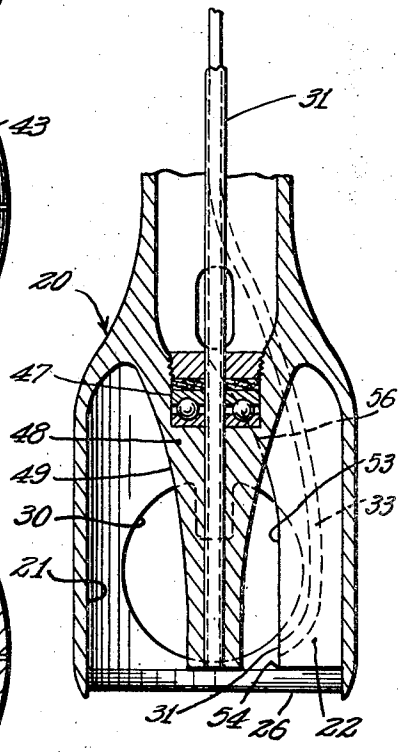


Fig. 2

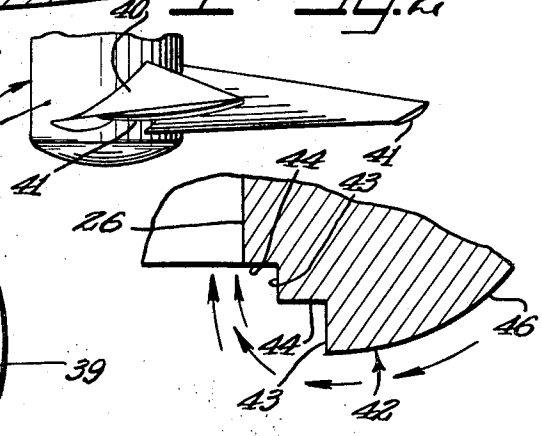


Fig. 7

Fig. 5

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OUTBOARD MOTOR AND STEERING ARRANGEMENT

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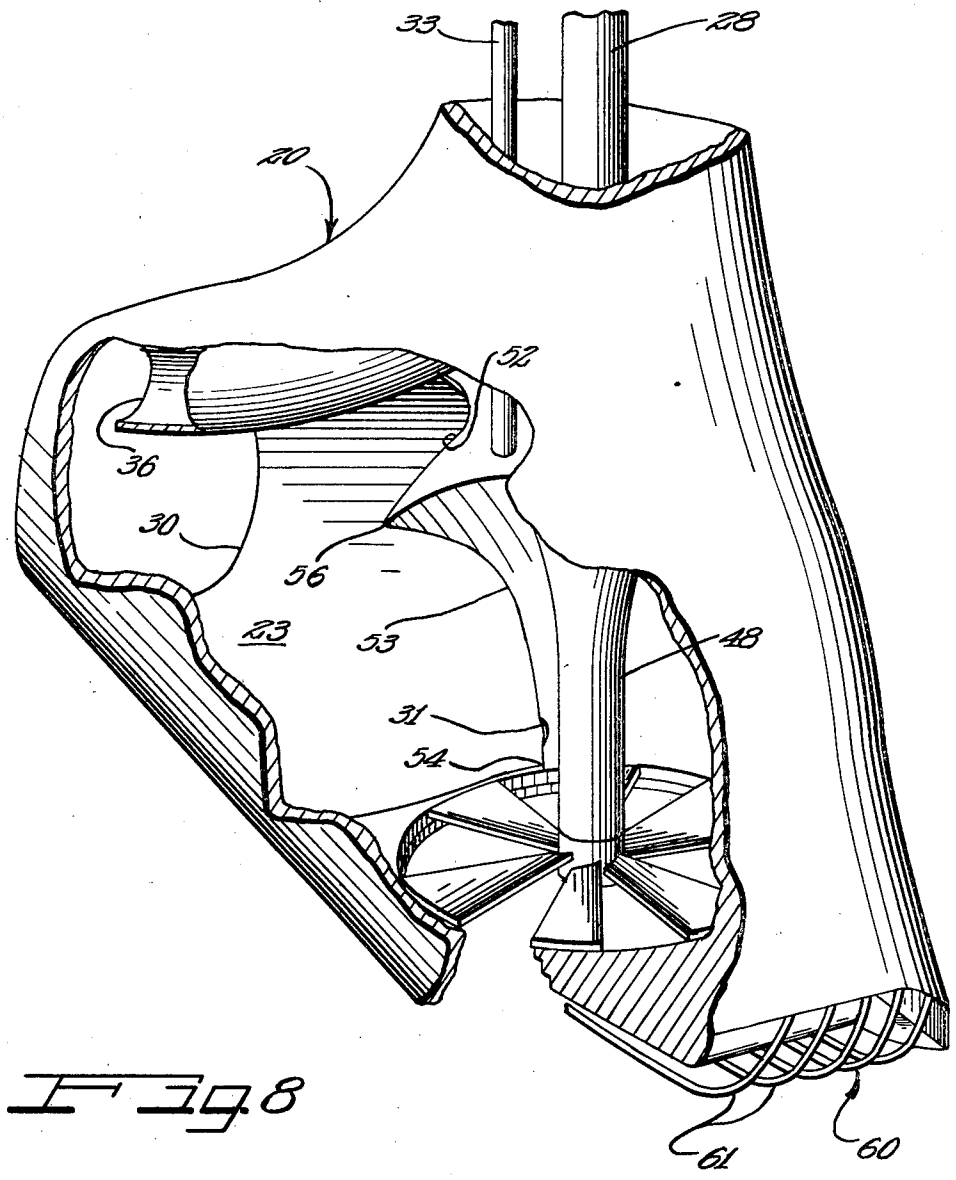


Fig 8

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3,494,320

OUTBOARD MOTOR AND STEERING ARRANGEMENT

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U.S. Cl. 115—18 14 Claims

ABSTRACT OF THE DISCLOSURE

A jet-propulsive outboard motor. The propeller is constructed and arranged to draw water up into the propeller chamber and to force it radially outwardly and upwardly into the jet discharge nozzle. Water steps are provided in the bottom wall of the lower housing to assist in lifting water into the propeller chamber. A conical drive shaft housing is formed in the propeller chamber to direct water flow and a water cutter is provided between the propeller chamber and the jet discharge nozzle to peel water out of the propeller chamber and into the jet discharge nozzle.

Background of the invention

The use of jet-propulsive power plants for driving watercraft is increasing in popularity for a variety of reasons, one of which is reduced maintenance due to the absence of a power propeller situated in the water below the boat and subject to damage caused by obstructions below the waterline.

On the other hand, such power plants are generally less efficient than the propeller driven type. For any given engine horsepower the speed available from a jet-propulsive power plant is substantially less than that available from a propeller driven power plant. This reduction in efficiency has been sufficiently great to deter more rapid growth in the field of water jet-propulsion for watercraft, particularly as concerns motor arrangements of the so-called "outboard" type.

An object of the present invention is to increase the efficiency of jet-propulsive outboard motor arrangements to the end that they may compare favorably both in performance and in cost of operation with the propeller driven outboard motors.

Summary of the invention

The present invention may be summarized as comprising an outboard motor for mounting on a boat and including an engine housed in an engine compartment and a lower housing depending from the engine compartment. A water pump comprising a propeller or axial inducer is mounted in a propeller chamber which is formed in the lower housing and which has an open lower end through which the water is drawn into the chamber. A jet discharge nozzle communicates with the propeller chamber and directs a jet of water from the propeller chamber horizontally out of the lower housing in a direction opposite the direction of movement of the boat, which jet provides the propelling force for the boat.

The propeller is adapted to force the water in the propeller chamber both upwardly and radially outwardly to the jet discharge nozzle. Water steps are formed in the bottom wall of the lower housing in front of the opening into the propeller chamber to assist in lifting the water into the chamber by providing a low pressure area immediately in front of the chamber opening.

The present invention further comprises such salient features as a water cutter between the propeller chamber and the jet discharge nozzle for peeling water from the chamber and directing it into the nozzle, an exhaust passageway for directing the exhaust gases and coolant

water from the engine to an outlet adjacent to and facing the same direction as the outlet of the jet discharge nozzle, a conical housing for the drive shaft in the propeller chamber, a weed guard covering the inlet opening in the propeller chamber and a weed cutter blade spaced in close proximity to the propeller to cut up any weeds or the like which pass through the weed guard.

The foregoing features enhance performance and reduce maintenance and thus an object of the present invention is to provide a jet-propulsive outboard motor having better performance characteristics and less maintenance problems than other outboard motors of the same general type presently known in the art.

Another object is to prevent any large solid matter such as weeds or the like from passing through the water flow passages of the outboard motor.

Another object is to provide a propeller constructed and arranged to lift the water on the suction side of the propeller and to force the water both upwardly and radially outwardly on the discharge side of the propeller.

Another object is to provide means in the bottom wall of the lower housing surrounding the opening to the propeller chamber for assisting in lifting water up into the opening in the propeller chamber.

Another object of the invention is to provide means for peeling off the water as it swirls in the propeller chamber and for directing it into the jet discharge nozzle with a minimum loss of power.

Another object is to provide an improved arrangement for exhausting gases and coolant from the motor.

A further object is to provide means for easily and quickly varying the position of the outboard motor in the water by adjusting the positioning of the motor on the transom of the boat.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings in which preferred structural embodiments incorporating the principles of the present invention are shown by way of illustrative example only.

Brief description of the drawings

FIGURE 1 is an elevational side view of a jet-propulsive outboard motor constructed in accordance with the principles of the present invention with the lower portion thereof shown in vertical section and with an exemplary boat transom on which the motor may be mounted shown in phantom.

FIGURE 2 is an enlarged fragmentary vertical sectional view of the propeller chamber with the propeller removed as viewed along lines II—II of FIGURE 1.

FIGURE 3 is a reversed bottom plan view with parts removed taken along lines III—III of FIGURE 1.

FIGURE 4 is similar to FIGURE 3 but is a sectional view taken along lines IV—IV of FIGURE 1 with the propeller and other parts removed.

FIGURE 5 is a plan view of the propeller of the present invention.

FIGURE 6 is a fragmental elevational view of the propeller shown in FIGURE 5 as viewed at right angles to the axis of the propeller.

FIGURE 7 is an enlarged sectional view of a portion of the lower housing adjacent the propeller chamber.

FIGURE 8 is an isomertic view of a portion of the lower housing with portions of the side wall and other parts cut away to show the relative disposition of internal parts.

Description of the preferred embodiments

In FIGURE 1 reference numeral **10** indicates generally a jet-propulsive outboard motor constructed in accord-

ance with the principles of the present invention. The motor **10** may be more particularly characterized as comprising an engine compartment **11**, a lower housing **12** and a mounting clamp assembly **13**.

The compartment **11** houses an engine of the usual two or four-cycle type. In the embodiment illustrated the engine is started by means of a rope wound around a pulley connected to the crankshaft and a starter handle **14** is mounted on the loose end of the rope. Of course the engine may be started by any other suitable means such as an electric motor starter and may also be of any of the commercially available sizes since the present invention is not limited to any particular ranges of horse power.

The motor **10** is shown mounted on a stern transom **16** of a boat indicated in phantom lines at **17**. A steering handle **18** extends from the lower housing **12** for turning the lower housing relative to the boat **17** in order to control the direction of steering.

The lower housing **12** comprises a vertically extending tubular shell **19** extending from the underside of the engine compartment **11** and a propulsion head **20** fixedly connected to the lower end of the shell **19**. A vertical cylinder wall **21** forms a water pump or propeller chamber **22** within the head **20** and a jet-discharge passageway or nozzle **23** extends at right angles to the propeller chamber **22** and is in communication therewith.

The lower end of the propeller chamber **22** is open as indicated at reference numeral **26** and a water pump such as a propeller **27** is mounted in the lower open end **26** for rotation about an axis aligned with the axis of the propeller chamber **22**. The propeller **27** is driven by a drive shaft **28** which extends through the lower housing **12** and which is connected by means of a coupling **29** to the crankshaft of the engine housed in the engine compartment **11**.

In operation the propeller **27** draws water up through the open lower end **26** of the propeller chamber **22** and forces the water upwardly and radially outwardly in a swirling motion to pass through the bore **24** and the jet-discharge nozzle **23** from which it is discharged through a jet outlet opening **30**. It is of course the propulsive thrust of the jet of water which issues from the opening **30** which impels the motor **10** and the board **17** in a direction opposite the direction in which the water issues from the opening **30**.

In order to provide coolant for the engine a port **31** is formed in a side wall **32** of the jet discharge nozzle **23** through which high pressure water enters from the propeller chamber **22** into a conduit **33** which extends through the shell **19** to the engine compartment **11**. The warmed coolant discharges into the upper end of an exhaust passageway which comprises a tubular sleeve **34** disposed within the shell **19** and a passageway **35** formed in the head **20** which opens to an exhaust outlet **36** disposed immediately above and opening in the same direction as the jet discharge nozzle opening **30**. The exhaust manifold of the engine also opens into the upper end of the sleeve **34** and is discharged along with the warmed coolant through the exhaust outlet **36**.

Referring to FIGURES 1, 5 and 6, I have discovered that improved results are obtained when the propeller is constructed and arranged so as to confer thereupon the ability to draw the water up into the propeller from below and then force the water both axially upwardly and radially outwardly in a swirling motion to the opening of the jet discharge nozzle. In the illustrated embodiment the propeller **27** is disposed below the opening **24** between the propeller chamber **21** and the jet discharge nozzle **23** and the propeller **27** is constructed to move the water upwardly in the propeller chamber **22** rather than merely radially outwardly.

To this end the propeller **27** comprises a plurality of blades **37** extending radially from a central hub **38**. The blades **37** are preferably of the backward curved type and the tips of the blades indicated at **39** extend at a slight

angle to a plane normal to the axis of rotation of the propeller whereas the inner portions indicated at **40** rise quite steeply near the hub **38**. The undersurfaces of the blades may be constructed in the form of a streamline fluid flow to provide a low pressure area beneath the blades to assist in drawing the water up into the propeller **27**. Streamline configuration of the undersurface **41** is also helpful in preventing cavitation below the propeller when the propeller is operating at high speed. The number of blades of the propeller may vary in accordance with variations in r.p.m., flow rates and pressure. An auger type axial inducer having flights or ramps winding longitudinally up through the chamber **21** and spun by the shaft **28** may also be preferred at higher r.p.m.

To further assist in raising the water up to the underside of the propeller **27** a bottom wall **42** of the lower head **20** is formed in a manner to provide a series of water steps around the leading portion of the propeller chamber opening **26**. As shown in FIGURES 1 and 7, the water steps comprise a series of alternately vertical and horizontal surfaces **43** and **44** which are disposed behind a downwardly curved surface **46** of the lower wall **42**. As the water passes around the curved surface **46** the water steps effect a degree of cavitation to impel the water to curve in the general direction of the steps, thus providing partial direction of the water into the lower open end **26** of the propeller chamber **22** and into the propeller **27**.

Referring again to FIGURE 1, the drive shaft **28** is journalled in a bearing **47** mounted in a lower shaft housing **48** extending axially in the propeller chamber **22**. The housing **48** is somewhat conically shaped and comprises an outer surface **49** which increases in diameter in an axial direction upwardly and which is also curved radially outwardly at the upper portion thereof as shown at **50** to overlap itself and to blend in a smooth transition portion **51** into the cylindrical wall **21** of the propeller chamber **22**. Thus as the water is moved by the propeller **27** axially upwardly the conical shape of the lower shaft housing **48** tends to direct the water radially outwardly to complement the radial component acting on the water as provided by the raised portions **40** of the propeller blades **37**.

I have discovered that the manner in which the water is discharged from the propeller chamber **22** to the jet discharge nozzle **23** markedly affects the thrust efficiency of the motor **10** and I have further discovered that the efficiency is increased if the water is in effect "peeled" out of the propeller chamber **22** and into the nozzle **23**.

As shown in the drawing and particularly FIGURE 8 the lower head **20** comprises an internal wall **52** in the jet discharge nozzle **23** which combines with the cylinder wall **21** to form a cutting edge **53** between the propeller chamber **22** and the jet discharge nozzle **23**. The cutting edge **53** faces a direction opposite the swirling motion of the water in the propeller chamber **22** and serves as a cleavage to cut or peel a portion of the swirling water and to change the direction thereof along the smooth curved wall **52** such that as the water leaves the jet outlet **30** the turbulence has been reduced. The cutting or peeling action of the edge **53** provides a substantial increase in thrust efficiency in the motor **10** and I attribute this at least partially to the reduction in turbulence and the smoother flow lines in the water as it moves from the propeller chamber to the jet discharge nozzle which is afforded by the cutting edge **53** and the smoothly curving side wall **52** of the jet discharge nozzle **23**.

I have also discovered that a change in curvature of the cutting edge **53** is accompanied by a corresponding change in efficiency. For example, assume that a center line of the jet discharge nozzle **23** is aligned and extends through the axis of the exhaust outlet **30** and intersects the axis of the propeller **27** at right angles. According to the principles of the present invention the preferred arrangement of the cutting edge **53** is such that an upper point **54** thereon is disposed in a plane in which the axis of

rotation of the propeller **27** as well as the centerline of the jet discharge nozzle **23** reside. From that point the cutting edge **53** curves diagonally down to a lower point **56** on the cylinder wall **21** at a position which is approximately 30 degrees off the centerline of the jet discharge nozzle **23** as viewed from the axis of rotation of the propeller **27**. This particular configuration of the cutting edge **53** is the preferred configuration based upon the tests which I have thus far conducted, but it should be understood that the thrust efficiency of the motor **10** is substantially increased even if the illustrated curvature of the cutting edge **53** is not provided, as long as the cutting edge itself is disposed in such a configurational relationship with respect to the propeller chamber **22** in the jet discharge nozzle **23** such that it effects a cutting or peeling action on the water as it swirls in the propeller chamber to direct the water in a smooth curved line away from the propeller chamber and into the jet discharge nozzle.

FIGURE 3 is a view up into the bottom of the propeller chamber **22**. The propeller, conical housing, etc., had been removed to show the relative disposition of the points **54** and **56** on the cutting edge **53**. The position of the water steps **43** and **44** are also shown in FIGURE 3 as surrounding the front portion of the propeller chamber opening **26**. FIGURE 4 also discloses the approximate position of the lower point **54** of the cutting edge **53** on the circumference of the wall **21** of the propeller chamber **22**.

In a jet-propulsive system for watercraft it is desirable to prevent matter such as weeds and the like that may be encountered in the water from passing in large pieces into the propeller. According to the principles of the present invention an elongated member **57** is hinged to the lower wall **42** of the head **20** by means of a hinge pin **58**. The member **57** may be locked in place by means of a snap lock or the like in the position thereof shown in FIGURE 1 to extend across the bottom of the propeller chamber opening **26** to intersect the axis of the propeller **27** at right angles. An upper surface **59** of the member **57** serves as a shearing blade and is disposed in very close spaced relation to the underside of the propeller blades **37** to perform a cutting action as weeds and the like are drawn up to the bottom of the propeller.

As shown in FIGURES 1, 3 and 4, the shearing member **57** is of reduced size in a transverse direction and is elongated in an axial direction, the result of which configuraton is to perform a stabilizing function on the water as it approaches the underside of the propeller **27**. As the water approaches the propeller a swirling or vortexing motion is imparted to it, but the cutting member **57** tends to impede such swirling or vortexing motion, thereby directing the water more directly axially into the opening **26** of the propeller chamber **20**.

As shown in FIGURE 8, a weed guard **60** is also hingedly mounted on the pin **58** and is constructed of a plurality of wire-like members **61** which extend from front to back of the jet head **20**. The weed guard **60** and the cutting member **57** may, of course, be hinged away from the propeller chamber opening **26** to provide access to the propeller **27** and are selectively locked into position by means of any suitable locking device such as a snap-lock.

It is noted that the propeller design shown in FIGURE 8 does not correspond identically to the embodiment of the propeller shown in FIGURES 1, 5 and 6, nor is the hinge pin **58** shown in FIGURE 1 identically disclosed in FIGURE 8. It should be understood that the somewhat diagrammatic illustration shown in FIGURE 8 is primarily for the purpose of illustrating the curvature of the cutting edge **53** and the relative disposition of the cutting edge with respect to the propeller chamber **22** and the jet discharge nozzle **23** and is not intended to conform to the other figures with respect to the propeller **27** and the shearing member **57**.

For most efficient operation of the motor **10** the distance which the jet discharge nozzle outlet **30** is disposed below the waterline, an increase in which increases efficiency, should be balanced with the drag caused by the submergence of the propulsion head, which drag also increases as the distance below the waterline at which the head is disposed increases. To attain optimum balance of these two effects the present invention contemplates the provision of means for raising, lowering and tilting the lower housing **12** without removing and changing the position of the clamp members **13**.

To this end the clamp members **13** are fixedly mounted on a guide sleeve **62** which surrounds the tubular shell **19** and which can move axially with respect thereto. The guide sleeve **62** may be selectively locked in place on the shell **19** by means of a split-ring clamp **63** or other suitable locking device such as a knurled jam nut which may be wedged into the end of the guide sleeve **62** around the shell **19**. As a result, although the guide sleeve **62** is stationarily connected to the clamp members **13** the lower housing **19** of the motor **10** may be selectively raised and lowered as conditions dictate to achieve maximum performance from the motor **10**.

Although minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably come within the scope of my contribution to the art.

I claim as my invention:

1. In a jet-propulsive outboard motor including a lower housing having a vertically extending substantially cylindrical wall forming a propeller chamber which is open at the lower end, water pump means rotatably mounted in said chamber for pulling water up through the open lower end and for swirling the water and forcing it upwardly and radially outwardly, and a jet discharge passageway opening into the chamber wall and extending radially therefrom, the improvement comprising means in said lower housing forming a water cutter dividing a portion of the propeller chamber and the jet discharge passageway and having a cutting edge extending vertically substantially the height of said propeller chamber and facing the direction of the swirl of the water to provide a cleavage for peeling the water out of the propeller chamber and into the jet discharge passageway.

2. The invention as defined in claim **1** and including means forming a cone-shaped member in said propeller chamber in axial alignment therewith and increasing in diameter from a point proximately spaced from said lower end to the upper end of said propeller chamber.

3. The invention as defined in claim **2** wherein said cone-shaped member comprises an outer surface which is arcuately shaped in an axial direction.

4. The invention as defined in claim **2** wherein said jet discharge passageway has a longitudinal centerline normal to and intersecting the axis of said propeller chamber and wherein said cutting edge extends from an upper point on the circumference of said cone adjacent the upper end of said propeller chamber and on the centerline of the jet discharge passageway down to a lower point on the cylindrical propeller chamber wall; which lower point is angularly spaced from the centerline about the axis of said propeller chamber.

5. In a jet-propulsive outboard motor including a lower housing having a vertical cylinder wall forming a propeller chamber which is open at the lower end, a jet discharge passageway extending radially from said propeller chamber and means forming a bore in said cylinder wall communicating said propeller chamber with said jet discharge passageway, the improvement comprising:

a propeller mounted in said propeller chamber for rotation about an axis coincident with said chamber axis,

said propeller being disposed below said bore and being constructed and arranged to lift water from the

lower open end and to raise it and force it radially outwardly through said bore into said jet discharge passageway,

the blades of the propeller being backwardly inclined in the direction of rotation.

6. The outboard motor as defined in claim **5** wherein the trailing edges of the blades of the propeller rise steeply at the propeller hub.

7. The outboard motor as defined in claim **5** wherein the lower walls of the propeller blades are of streamline fluid flow configuration to lift the water up through the lower open end of the propeller chamber.

8. The outboard motor as defined in claim **5** and including an elongated member mounted on the lower housing at the lower open end of said propeller chamber below said propeller and extending through and normal to the axis of rotation of the propeller, said elongated member having an axial dimension to provide an impediment to the swirling or vortexing of the water as it approaches the propeller at the inlet side thereof and to stabilize the flow of water into the propeller chamber.

9. The outboard motor as defined in claim **8** wherein said elongated member comprises a longitudinal side wall disposed in close spaced relation to the propeller blades to provide a weed shearing blade for cutting up weeds and the like before they pass through the propeller.

10. A jet-propulsive outboard motor comprising:

a lower housing,

means in said lower housing forming a vertical cylindrical propeller chamber having an open lower end and a jet discharge nozzle communicating with said propeller chamber at one side of the chamber and extending radially therefrom, said lower housing having a bottom wall extending substantially normal to the axis of said propeller chamber,

a propeller rotatably mounted in said propeller chamber for drawing water in through said open lower end and forcing it out said jet discharge nozzle, and

means in said bottom wall forming a plurality of water steps around the side of said open lower end opposite said jet discharge nozzle and spaced radially from one another with respect to the axis of said propeller chamber for providing a vacuum condition along said bottom wall ahead of said open lower end to tend to change the direction of the water approaching the propeller chamber from normal to the axis of said propeller chamber to parallel thereto.

11. The jet-propulsive outboard motor as defined in claim **10** wherein said step-forming means provides a series of alternately horizontal and vertical surfaces constructed and arranged to provide substantial cavitations along said bottom wall ahead of said lower open end of said propeller chamber.

12. A jet-propulsive outboard motor for mounting on a boat comprising:

an engine compartment,

a lower housing including a tubular shell depending from said engine compartment and including jet-propulsion means, and

clamp means on said lower housing for clamping the motor to a transom member of the boat comprising, a sleeve member surrounding said shell and movable axially and rotationally with respect thereto, means for selectively locking said sleeve member in place on said shell, and an adjustable transom clamp selectively pivotally mounted on said sleeve member.

13. The jet-propulsive outboard motor as defined in claim **12** wherein said locking means comprises a split ring clamp fixedly connected to said sleeve member.

14. The jet-propulsive outboard motor as defined in claim **12** wherein said locking means comprises a knurled jam nut threaded on the shell for jamming against one end of the sleeve member.

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