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Fisher

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[54] **BOAT STRUCTURE**

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[52] **U.S. Cl.** .... **115/34 R,** 115/35, 114/66.5 R, 114/66.5 P, 114/62

[51] **Int. Cl.** **B63b 1/38**

[58] **Field of Search** .... 115/35, 39, 37, 34, 115/34 C; 114/66.5 R, 66.5 PS, 62

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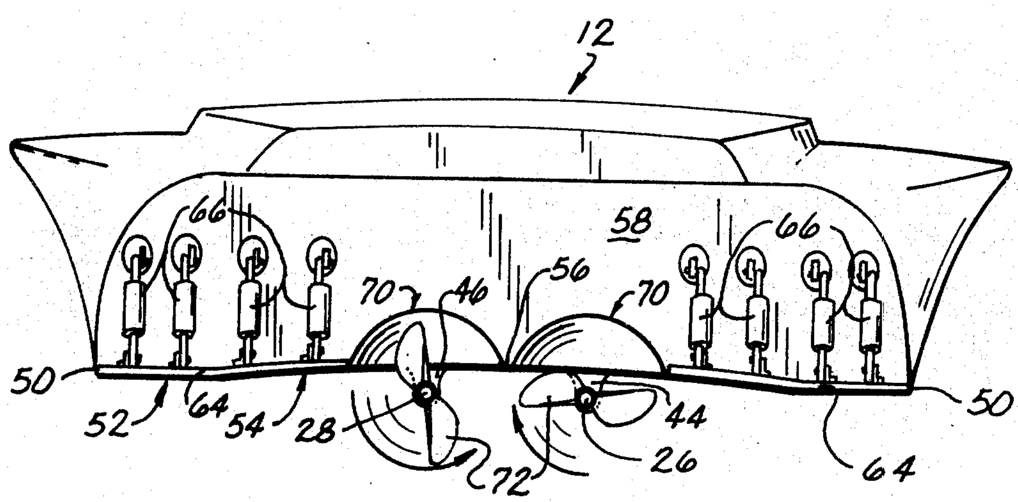
[57] **ABSTRACT**

The invention is a new boat structure and a method of boat propulsion. The hull has a propeller receiving cavity in the aft portion which is open to the bottom and the stern of the boat. It is of size and construction to receive only a portion of the propeller, and in operation the cavity is substantially out of the water. The boat has a power source to drive the propeller, and steering apparatus mounted in the hull to steer the boat. The new method of the invention provides a means of propulsion for a boat hull wherein in operation the driving propeller blade is in the water only approximately one half the time, and the cavity provided in the bottom of the stern of the boat hull out of the water receives the blade of the propeller during its travel out of the water. The preferred specific embodiment of the new method utilizes two such propellers in operation, turning on axis longitudinal to the longitudinal axis of the boat hull, substantially parallel and spaced on either side of the boat hull longitudinal axis, with the propellers rotating in opposite direction. A central cushion of air beneath the boat hull is provided in operation.

5 Claims, 5 Drawing Figures



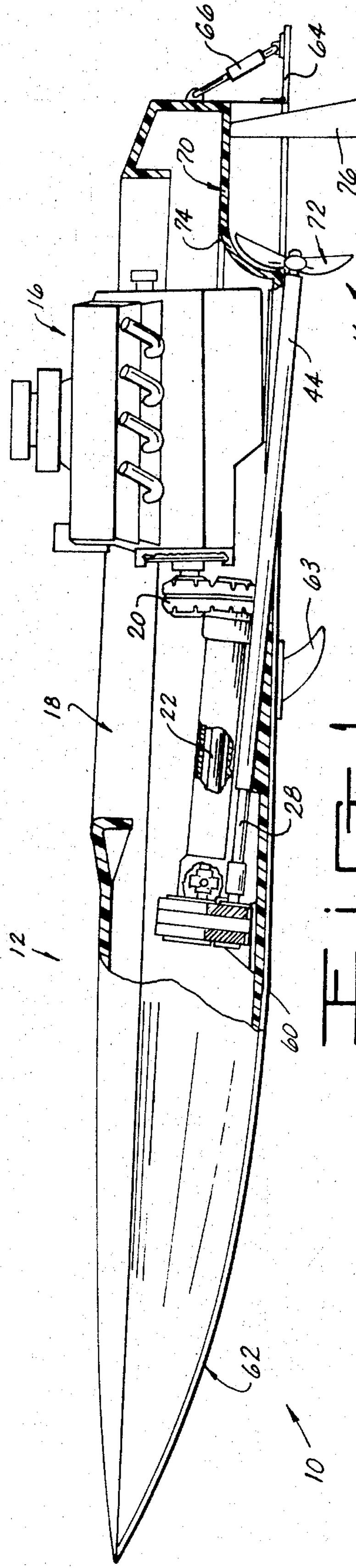


FIG. 1

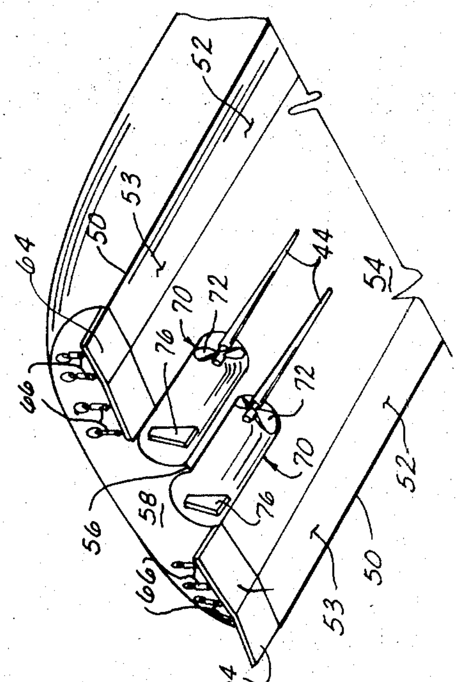


FIG. 3

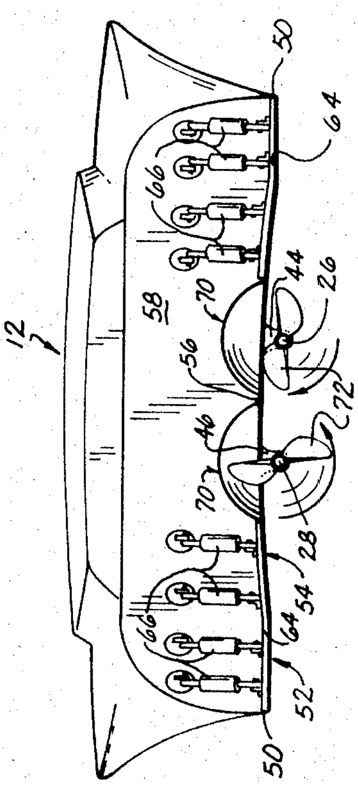


FIG. 2

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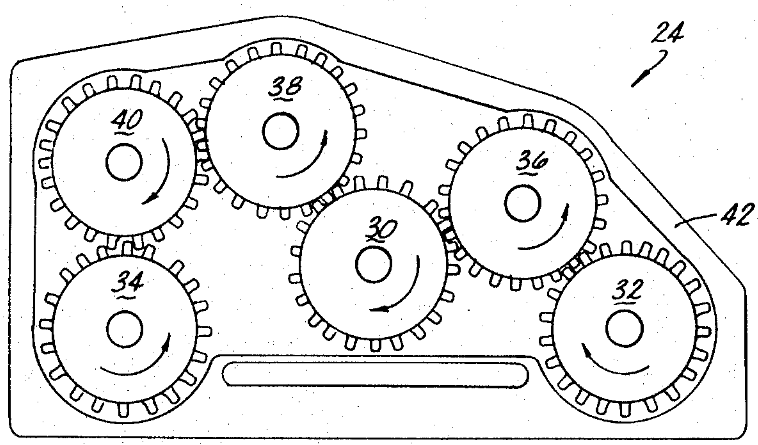

FIG. 4

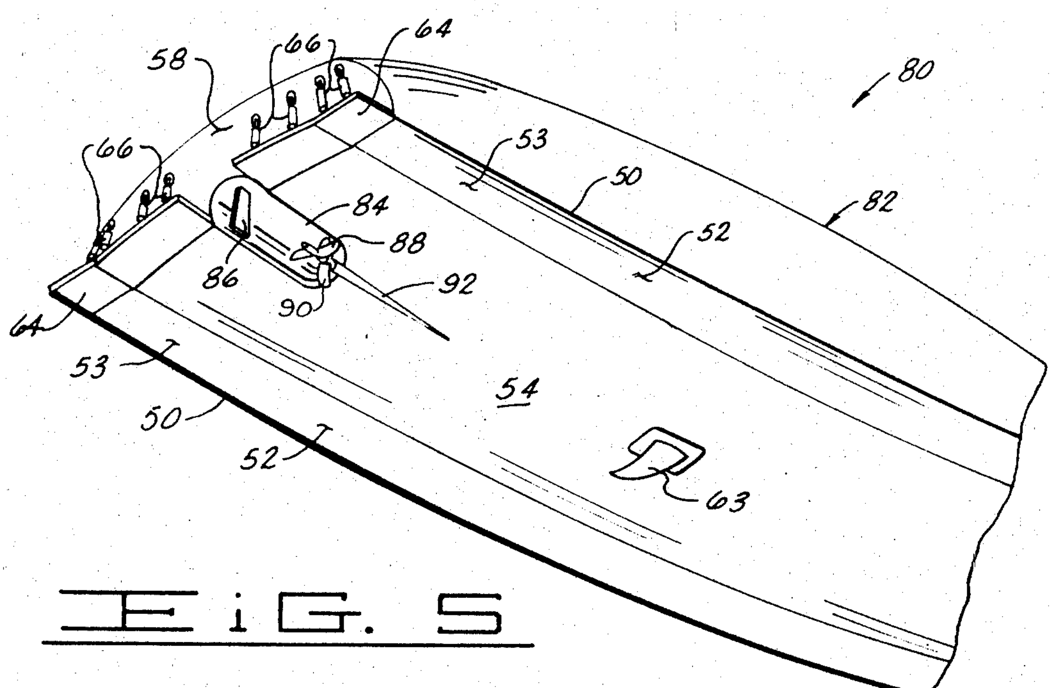

FIG. 5

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BOAT STRUCTURE

Numerous boat structures are known in the art which have the hull specially shaped in the propeller and rudder area, also boats having dual propellers are known. However, these boats with dual propellers and specially shaped hulls are primarily restricted to relatively larger slower moving vessels where low speed, manuverability and operation in shallow water are prime considerations. Also, these boats have the propellers totally enveloped in water when in operation. In the area of smaller inboard boats such as the runabout, pleasure craft and racing boats dual propellers have heretofore been unacceptable because of instability. The propellers extended below a conventional hull at a substantial angle so they will clear the bottom this produces substantial vertical forces when accelerating which lift the boat out of the water without providing any acceptable forward motion and unstable conditions. The smaller inboard boats as described conventionally have one propeller supported angularly below the hull which creates forces due to the difference in relative velocities of the boat and the propeller, these forces tend to turn the boat in the direction opposite to the rotation of the propeller. These forces are most apparent when the boat is increasing in forward speed and are present at all times, they are controlled by turning the rudder in the opposite direction to the force. Correcting the described condition creates a drag force on the boat hull and substantial forces on the rudder which in turn reduces the overall power efficiency of the boat. Additionally when under a high acceleration and when moving at a relatively high speed these conventional boats the forces in combination with engine torque can lift one side of the boat out of the water thus creating an unstable and dangerous condition since the tendency is to turn in the direction of the still waterboard side of the boat, also the forces are increased due to a greater angle between the relative velocities of the boat and the propeller

In a preferred specific embodiment, (1), of this invention a boat structure is provided including a hull and powering apparatus equipped with two counterrotating propellers operated from an inboard mounted engine. The hull includes two (2) cavities in the stern portion thereof to enclose in operation a portion of the propeller out of contact with the body of water and with the propeller in a position substantially perpendicular to the bottom of the hull. The bottom of the two cavity boat structure has an upwardly curved portion in the center area thereof and flat chine areas at the rear thereof. The powering apparatus includes an internal combustion engine coupled with a transfer device operable to rotate the propellers in counterrotating directions at the same rate.

In another preferred specific embodiment, (2), of this invention a hull of generally the same shape as the first described preferred specific embodiment is provided and a hull is provided which has one cavity in the rear thereof. The single cavity boat structure has a transfer device operable to rotate dual counterrotating propellers about a single axis with the propellers spaced substantially apart. The propellers are in operation partially contained within the single cavity and out of direct contact with the body of water.

One object of this invention is to provide a boat structure overcoming the aforementioned disadvantages of the prior art devices.

Still another object of this invention is to provide a boat structure which has dual counterrotating propellers partially enclosed in separate cavities and so oriented relative the boat hull that force from them is transmitted substantially in line with the boat hull and in the direction of motion.

Yet another object of this invention is to provide a boat structure having a single cavity in the hull to partially enclose dual counterrotating propellers therein oriented in line rotating about a single axis.

Still one other object of this invention is to provide a boat structure with dual propellers synchronized such that a blade is in the water at all times in normal optimum operation.

Yet another object of this invention is to provide a boat structure with very little water resistance having a hull with an upwardly curved center bottom portion and flat partially horizontal chine edge portions.

Yet one further object of this invention is to provide a boat structure having an engine and transfer device operable to rotate two propellers in counterrotating directions at a synchronous rate.

Various other objects, advantages, and features of the invention will become apparent to those skilled in the art from the following discussion, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a partially cutaway side elevation view of the two cavity boat structure exposing the engine, transfer device and one propeller cavity;

FIG. 2 is a rear elevation view of the two cavity boat hull with the engine and rudders removed showing the relative synchronous position of the propellers;

FIG. 3 is a perspective view of the bottom stern portion of the two cavity boat structure taken from behind;

FIG. 4 is a cross sectional diagram of the transfer gear box for the two cavity boat structure that connects the engine and propellers providing for synchronous counterrotation of same, and

FIG. 5 is a perspective view of the bottom stern portion of the single cavity boat structure taken from behind.

The following is a discussion and description of preferred specific embodiments of the boat structure of this invention, such being made with reference to the drawings whereupon the same reference numerals are used to indicate the same or similar parts and/or structure. It is to be understood that such discussion and description is not to unduly limit the scope of the invention.

Referring to the drawings in detail and in particular to FIG. 1 showing the preferred two cavity boat structure embodiment (1) of this invention; generally indicated at **10**. The boat structure **10** includes a hull **12** with two propeller containing cavities **14** integrally formed therein, engine **16** and transfer apparatus **18**.

The engine **16** is preferably a conventional high performance automotive engine converted for marine use. This type engine is commonly used in both pleasure and racing boats within the general nature of the herein described boat structures. It is to be understood the high performance engine described herein is not necessary to the invention but it is peculiar to this category of boat, a lesser performance engine will perform similarly.

The engine **16** is situated in the rear of the boat structure **10** with the normally referred to rear of the engine turned toward the bow of the boat. An angle drive unit

20 connects to the rear output of the engine 16 and a driveshaft 22 which is attached to the main gearbox 24. The main gearbox 24 is mounted in the hull 12 and is connected to the propeller shafts 26 and 28, right and left respectively. The main gearbox 24 is operable to rotate the propeller shafts 26 and 28 in counterrotating directions simultaneously and synchronously at the same rate and preferably at the same rate as the single input from the engine 16. The general arrangement of the main gearbox 24 is shown in FIG. 4, the input is to gear 30 clockwise, as shown, the output is from gears 32 and 34 clockwise and counterclockwise as shown. The input gear 30 meshes with idler gear 36 which meshes with one output gear 32; gear 30 also meshes with another idler gear 40 that meshes with the other output gear 34. This gearing arrangement preferably uses similar sized gears for interchangeability and to produce the desired one-to-one (1:1) input/output ratio. Also the main gearbox 24 preferably has a housing 42 enclosing the gears in an oil bath and equipped with a fresh water cooling system, not shown. The propeller shafts 26 and 28 attach the gearbox 24 and extend rearward and downward, they are enclosed in separate stuffing boxes 44 and 46 respectively which extend through the bottom of the hull and exit therebelow. The stuffing boxes enclose a substantial length of the propeller shafts and are oriented to position the shafts close to the hull bottom on the rear end thereof for reasons to be described. In practice a propeller shaft angle of approximately 4° relative the hull bottom has been found satisfactory.

The two cavity hull 12 as shown cut away in FIG. 1 is shaped on the upper portion like the class of conventional and popular runabout and racing boats. The majority of the two cavity hull structure embodiment is similar to the single cavity hull structure embodiment with substantially only the cavities being different. The bottom of the two cavity boat structure hull 12 is generally flat and has a sharp chine on the aft end, indicated at 50, which is carried forward and has a decreasing sharpness as the bottom of the hull is formed into the upwardly curved bow portion of the hull 12. The curvature of the bottom is shown in FIG. 2, it has chine edge portions 52 extending inward from the sharp chine 50 to an upwardly curved center portion 54. The chine edge portions 52 each have a rocker portion 53 on the aft end thereof. The rocker portions 53 are horizontally flat segments of the chine edge portions 52. In actual practice a two cavity boat has been constructed which is 16 feet in length; relative dimensions enumerated herein have been found acceptable in the herein described boat structures. In practice a chine edge portion width of approximately 8 inches and a rocker portion 52 length of approximately 38 inches has been found satisfactory.

The upwardly curved center portion 54 is a smooth arcuate curvature with the center point, indicated at 56, slightly above the rocker portion 53. In practice, three quarters of an inch has been found satisfactory for the center portion 54 height at the point 56. This bottom center portion 54 has substantially the same shape forward of the transom 58 with diminishing dimensions in the forward portion to blend, generally at 60, with the upwardly curved bow portion 62 of the hull. A fin 63 is supported below the center portion of the hull 12, it functions to give the boat a lateral surface below the surface of the water which provides for improved turning characteristics. The transom 58 is preferably fitted with a cavitation plate 64 extending aft a short distance from the transom and generally in line with the bottom of the hull 12. The cavitation plate 64 extends from the chine edge 50 to the outer edge of the propeller cavities 70 on both sides of the hull 12. The cavitation plate 64 is cantilevered from the transom 58 and adjusted in curvature by a plurality of turnbuckles 66 attached to the transom 58 and the aft edge portion of the cavitation plate 64. This adjustment of the cavitation plate 64 is provided as a means of trimming the boat for optimum performance since each individual boat has its own peculiar and slightly different characteristics.

As shown in FIG. 2 the two cavity hull 12 has two cavities 70 formed in the hull bottom. The cavities 70 are partially circular in cross section, rounded on the forward end and positioned symmetrically on the beam. The cavities 70 are adapted to receive a portion of the blades of the propellers 72 with a sufficient clearance between the propellers 72 and the wall 74 of the cavity. The propellers 72 extend below the bottom of the hull 12 preferably positioned so the rearmost edge of the propeller shafts 26 and 28 extending from the hub of the propeller to slightly below the horizontal level of the rocker portions 53. In practice a cavity length of approximately 20 inches has been found satisfactory. With the propellers positioned as described the propeller blade is within the cavity on the upper portion of its rotational path and a minimum of the stuffing boxes extend below the bottom of the hull 12 enclosing substantially all of the extended propeller shafts. The propellers 72 are positioned relative one another as shown in FIG. 2 with opposing blades of one propeller perpendicular to opposing blades of the other. Rudders 76 are vertically supported in the aft end portion of the cavities 70 from the top thereof and have linkage, not shown, to be simultaneously turned for steering.

In another preferred specific embodiment (2) of this invention a single cavity boat structure 80 is provided as shown in FIG. 5. The hull 82 of the single cavity boat structure 80 has substantially the same bottom curvature as the twin cavity boat hull 12 with the exception that it has one cavity 84 centrally positioned on the beam in the aft portion thereof. For convenience in description and similarity the chine 50, chine edges portions 52, transom 58, cavitation plate 64 and other components of the hulls which are common bear the same numerals.

The single cavity boat structure 80 is provided with dual-counterrotating propellers to operate in the single cavity 84. The cavity 84 is constructed similar to the twin cavities 70 having a partially circular cross section, rounded forward end and with a rudder 86 depending from the top center portion of the aft end of the cavity for steering. The single cavity boat structure 80 has a driving apparatus, not shown, operable from an engine to rotate two propellers 88 and 90 in opposite directions about a single axis synchronously at the same rate with the propellers spaced substantially apart. The propellers 88 and 90 are preferably mounted on concentric shafts, one inside the other and enclosed in a stuffing box 92 exiting the bottom of the hull 82 at a shallow angle similar to that of the twin cavity hull 12 as described supra. Additionally the single cavity hull 32 is fitted with a cavitation plate 64, similarly to the other hull 12. The cavitation plate 64 extends from the chine **50** to the edge of the cavity **84** and conforms with the curvature of the bottom of the hull **82** in the edge portions **52** and center portions **54**.

Advantages of the boat structures **10** and **80** of the herein described embodiments of this invention are best described in conjunction with the operation thereof. For convenience and due to similarity in operation of the signle cavity hull **80** and the twin cavity hull **12** only one need be described in detail. The twin cavity boat structure **10** of the first described embodiment (1) of this invention is hereafter described in detail.

When the twin cavity boat structure **10** is setting motionless in the water the hull is approximately one fourth below the surface of the water at this time the cavities **70** are filled with water. When the boat **10** is beginning forward motion the propellers **72** are rotated. As the propellers **72** rotate the portions thereof extending below the bottom cut into the body of water, push against the body of water moving the boat **10** forward. As the boat **10** increases in forward speed the bow portion rises out of the water and only the bottom portion of the hull **12** touches the water, then the cavities **70** are mostly cleared of water. As the boat **10** further increases in forward speed to an optimum condition the bottom is substantially out of the water and only contacts the undisturbed water surface on the aft end, specifically on the aforementioned rocker portions **53** of the chine edge portions **52**. In this optimum condition the cavities **70** are substantially clear of water, the upwardly curved center portion **54** is above the undisturbed surface of the water, the rocker portions **53** are contacting the water and the aft end portion of the stuffing boxes **44** and **46**, the lower portion of the propellers **72** and rudders **76** are in the water. Drag from the water is substantially reduced on the hull **12** as a result of only the rocker portions **53** contacting the water. Air passing under the hull **12** through the upwardly concave center portion of the hull **54** provides lifting forces on the boat **10** tending to reduce the drag and raise the boat **10** from the water. In this optimum condition a maximum amount of power is transmitted from the propellers **72** to the water due to the nearly perpendicular orientation of the propellers **72** relative to the velocity of the water. The more vertically positioned propellers reduces the amount of slippage or loss in efficiency that is encountered in conventional boats which normally have a higher angle between the propeller and relative velocity of the water. The propellers **72** are preferably two bladed as shown in the drawings and positioned with the major axis of the blades perpendicular. With the propellers **72** in this perpendicular arrangement one blade of one propeller is substantially within a cavity and the remaining blades and/or portions thereof are in the water. Also, the enclosed propeller shafts **28** and **29** eliminate drag forces created on conventional boats due to exposed propeller shafts. An additional advantage of this boat structure is that with the propellers in this arrangement they can be rotated at lower speeds, thus operate more efficiently due to less slippage. It has been found that propellers of a larger diameter and larger pitch than normally used on this class of boat can be used with the herein described boat structure. It has been found that the unstability tendency of the boat **10** to turn when one side of it is out of the water has been reduced. When one side of the boat **10** is lifted from the water the oppositely acting torque reaction from the propeller on the opposite side will force the raised side down to again contact the water. Another attribute to the dual counter rotating propellers is that the oppositely acting torque reactions of the propellers **72** equalize the turning tendency of single propeller boats thus the rudders **76** only function to steer and do not create the dragging force necessary for the torque turning correction.

Additionally, in practice it has been found that with the twin cavity boat structure **10** that propeller drag forces can be substantially reduced as compared with that of single propeller boats. The reduction in propeller drag forces is partially due to using propellers of larger diameter and greater pitch than these on the other boats and partially due to rotating the propellers at lower speeds due to the 1:1 ratio between the engine **16** and the propellers **72**.

In the manufacture of the boat structures **10** and **80** of the herein described embodiments, it is obvious that the hulls **12** and **82** can be easily constructed by conventional methods of fiberglass boat manufacture. Also the gearboxes, propellers, engines and other hardware are substantially all items common in marine hardware.

In the use and operation of the boat structures **10** and **80** of the herein described embodiments it is seen that same provides a boat structure utilizing dual counterrotating propellers driven by a single engine. The boat structure is provided with a cavity or cavities to enclose the upper portion of the propellers and has a bottom shaped to lift the boat mostly out of the water and operate the propellers partially in the water and at an angle for optimum performance. The boat structures **10** and **80** are desirable to provide easy handling, increased power transfer and efficiency, and have reduced drag characteristics.

Additionally a new method of propelling a boat is provided, and such is very advantageous. The new method of propelling a boat utilizes a propeller the blades of which are in the water only about one half the time, that is, in the water only throughout about one half the cycle of rotation. In the preferred method such dual propellers provide directional stability and maximum power transfer from the boat to the water by rotating the propellers in counterrotating directions at a slow rate, positioning them nearly perpendicular to the water and operating them so that the propeller blades contact the water only during travel through the lower quadrants. The method preferably provides for operation of the boat structure to contact the water only on the rocker portions along the aft chine edges of the hull thus supporting the hull above the water while an air cushion is provided below the hull to lift and/or support it above the water, thus reducing water drag forces on the boat.

As will be apparent from the foregoing description of the applicant's boat structures, relatively efficient and advantageous method and means have been provided to propel a boat. The boat structures of the herein described embodiments are easily constructed and provides an optimum of performance.

While the invention has been described in conjunction with perferred specific embodiments thereof, it will be understood that this description is intended to illustrate and not limit the scope of the invention, which is defined by the following claims.

I claim:

1. A boat structure comprising:

a. a hull structure having a somewhat flat bottom portion, a substantially vertical transom, and upturned and pointed bow portion, and

b. said hull structure has an upwardly curved center portion extended forwardly from said transom, each side of said curved center portion is integral through a chine edge with respective horizontal rocker areas whereby said boat in optimum operation in a body of water contacts said body of water substantially only on said rocker areas and said center portion is above said water, said center portion representing the major portion of the bottom of said boat adjacent said transom, and the curvature of same is such that in operation of said boat in said body of water a supporting cushion of air is formed between the water and the area of said boat hull having said curved center portion.

2. The boat structure as described in claim **1**, wherein:

a. said center portion and said rocker areas extend from the stern of said hull forward a short distance with constant dimensions and extend forward therefrom with diminishing dimensions to blend with said upturned bow portion of same,

b. a driving means mounted in a propeller receiving cavity in said hull structure operable to rotate a propeller, and

c. a steering means mounted on said hull structure operable to steer said boat, whereby said boat in operation has only a portion of said propeller therein said cavity and not in the body of water.

3. The boat structure as described in claim **1**, wherein:

a. said hull structure has a propeller receiving cavity which is partially cylindrical In transverse cross-section, has a partially rounded forward end portion and is integrally formed with said hull structure,

b. said cavity in the stern end portion thereof has a rudder pivotally mounted vertically and extending therethrough said cavity extending therebelow said hull bottom, and

c. a driving means in said propeller receiving cavity has a propeller with less than half of said propeller partially in said receiving cavity.

4. The boat structure as described in claim **1**, wherein:

a. said hull structure includes a cavitation plate extended rearwardly across the outer portions of said transom having a portion thereof positioned on opposite sides of said curved center portion to provide adjustable, additional support to increase the stability of the boat structure.

5. A method of propelling a boat having a hull, a propeller means, and a driving means therefore, comprising:

a. operating said propeller means in a vertical plane,

b. transferring energy to the water by said propeller means,

c. operating said propeller during the cycle of rotation with the propeller partially contained in the water and partially out of the water,

d. having a supporting cushion of air under a center portion of said hull and over a major portion of the width thereof at the stern thereof, said hull having horizontal aft rocker portions representing a minor portion of the bottom of said boat at the stern thereof and extended outwardly of said center portion, and

e. supporting the structure of said boat on said aft rocker portions in contact with the water when propelling said boat.

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