June 15, 1965 W. R. CHRISTENSEN 3,188,997

MARINE PROPULSION SYSTEM

Filed Nov. 27, 1963 3 Sheets-Sheet 1

FIG. 1.

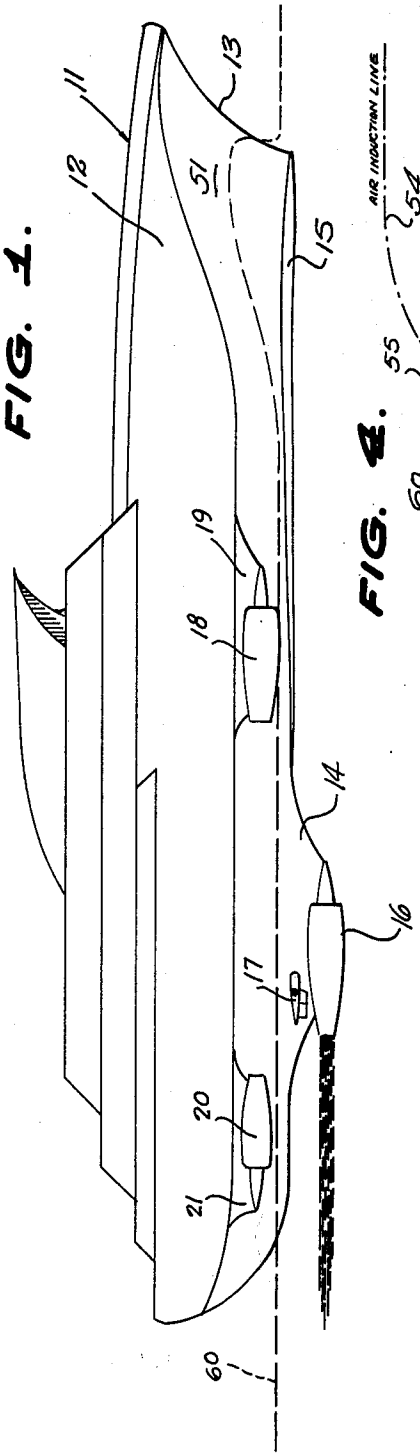


FIG. 4.

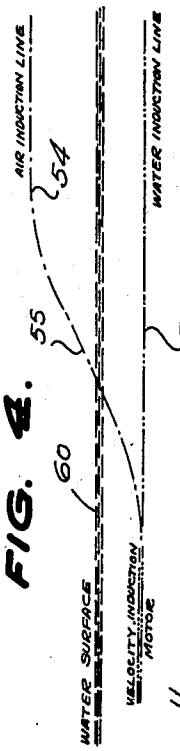
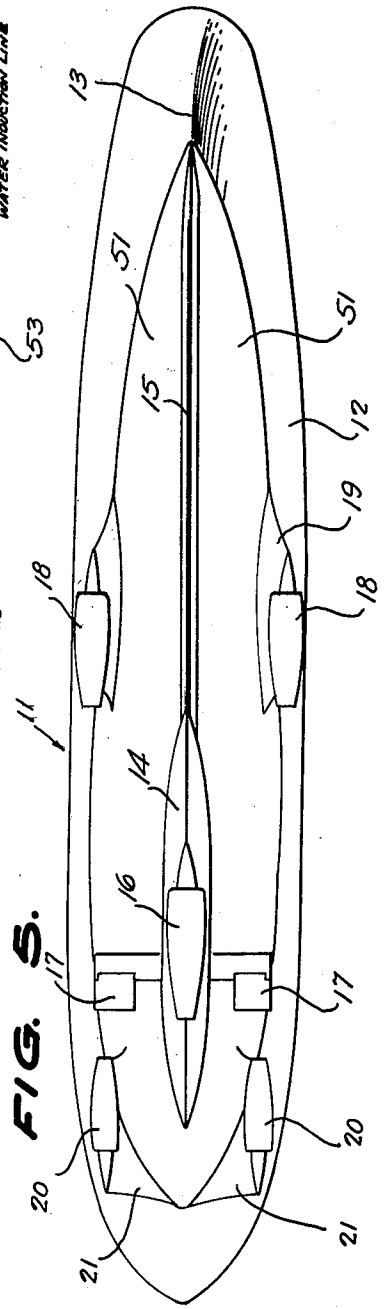


FIG. 5.



INVENTOR.
WILLARD R. CHRISTENSEN,
BY
McMorrow, Berman & Davidson
ATTORNEYS.

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MARINE PROPULSION SYSTEM

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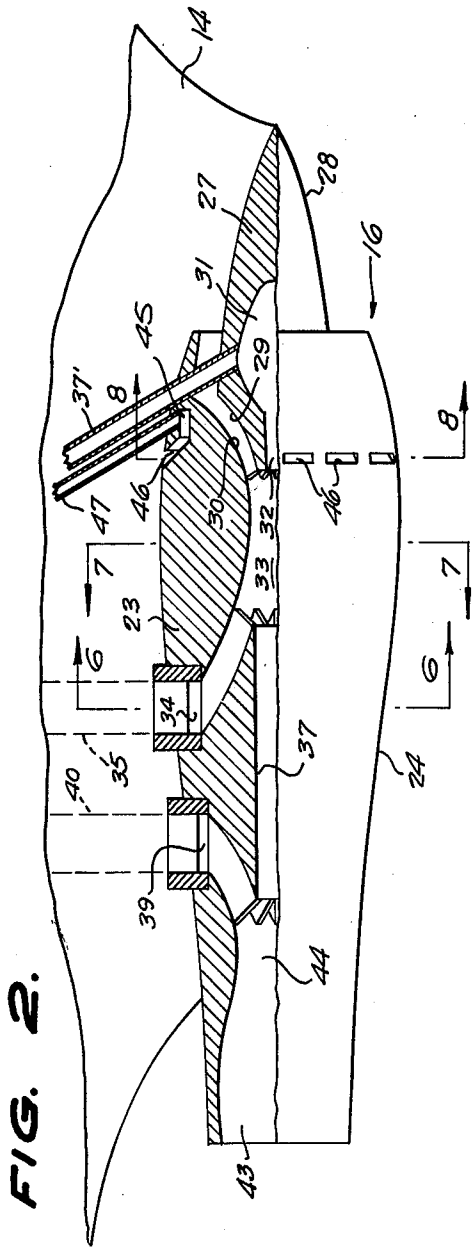


FIG. 2.

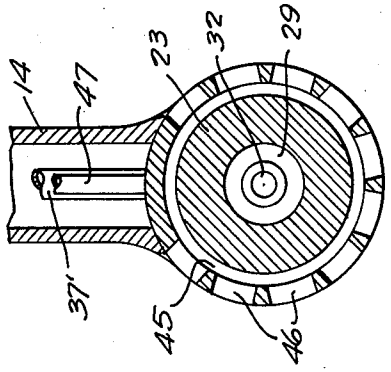


FIG. 8.

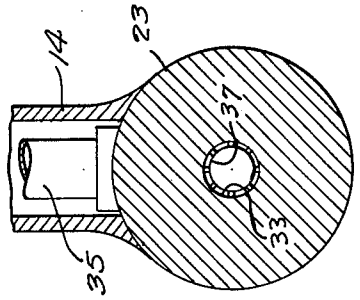


FIG. 7.

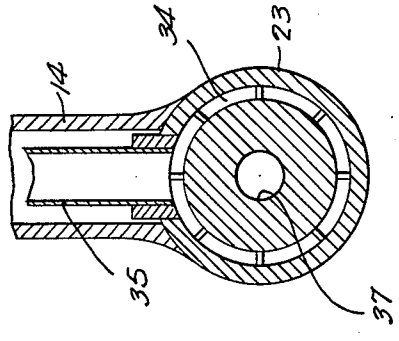


FIG. 6.

INVENTOR.
WILLARD R. CHRISTENSEN.
BY
McMorrow, Berman & Davidson
ATTORNEYS.

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MARINE PROPULSION SYSTEM

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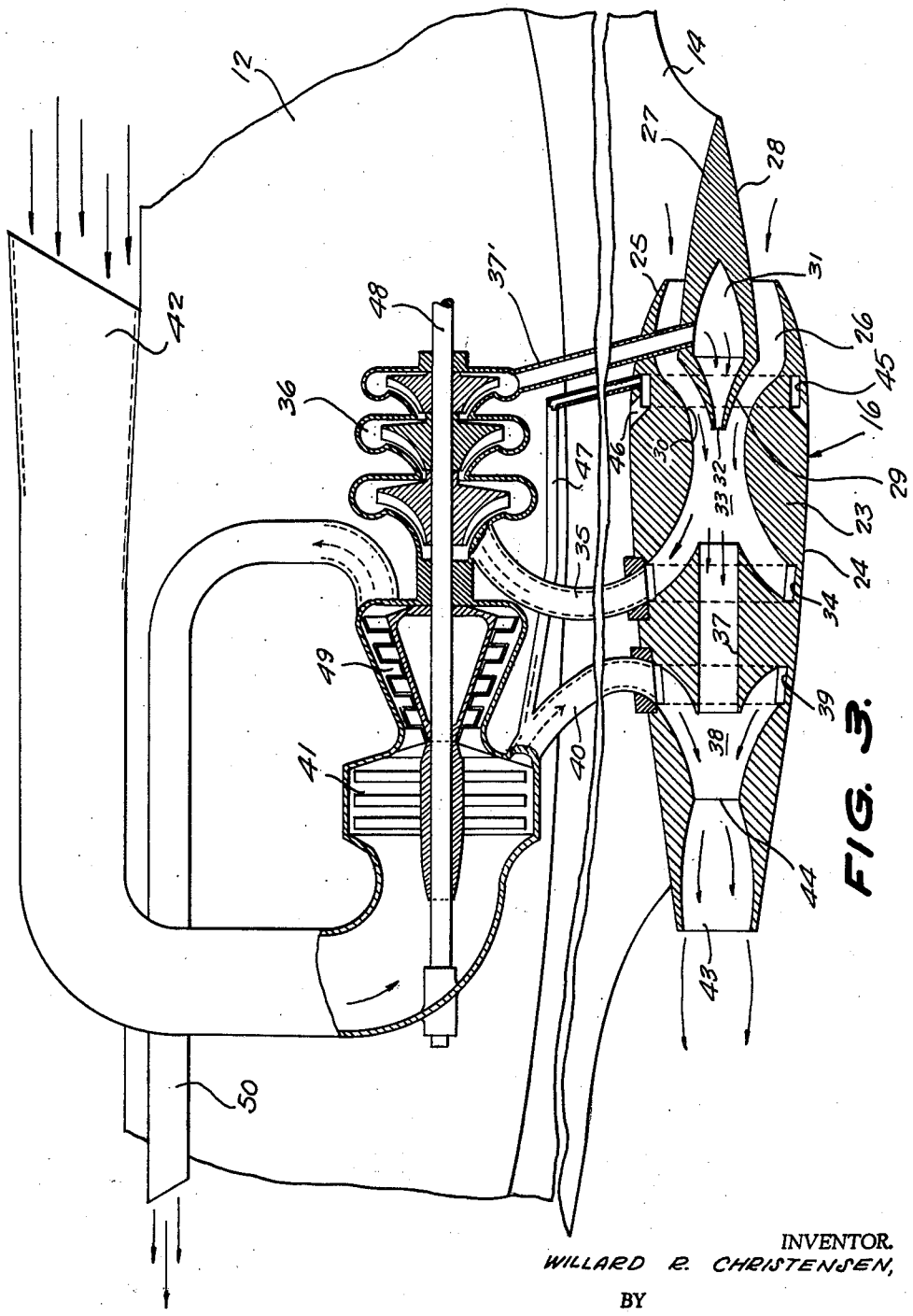


FIG. 3.

INVENTOR.
WILLARD R. CHRISTENSEN,
BY
McMorrow, Berman & Davidson
ATTORNEYS.

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3,188,997

MARINE PROPULSION SYSTEM

Willard R. Christensen, Dufief Mill Road, Rte. 3, Box 55, Gaithersburg, Md.

Filed Nov. 27, 1963, Ser. No. 326,416
16 Claims. (Cl. 115—11)

This invention relates to propulsion systems for water craft, and more particularly to a propulsion system employing jet-forming elements for propelling a craft though the water.

A main object of the invention is to provide a novel and improved propulsion system for a water craft which develops a direct thrust with minimum turbulence, which is relatively small in cross sectional area, thus offering minimum resistance to movement through the water, and which operates to produce rails or columns of high velocity streams beneath the surface of the water adjacent the craft and which uses these columns or streams for propulsion and to hold the craft stable.

A further object of the invention is to provide an improved marine propulsion system employing jet-forming devices, said system involving relatively simple components, providing high power and speed without requiring the use of cumbersome reduction gearing or propeller shafts, and being provided with means for minimizing skin friction between the craft and the water in which it is traveling.

A still further object of the invention is to provide an improved propulsion system for water craft which obtains a much greater power output per unit of weight than is obtainable in existing propulsion systems, which is capable of driving a craft at a much higher speed than conventional propeller-driven systems, and which develops high speed and driving force with minimum vibration.

A still further object of the invention is to provide an improved marine propulsion system employing a driving motor which establishes a water rail or column consisting of an extremely high velocity stream beneath the surface of the water and which includes means for creating a tubular wall of air around the stream and around the main body portion of the motor which reduces skin friction and forms an air cushion, thus providing smooth operation with relatively small frictional resistance to forward movement.

A still further object of the invention is to provide an improved marine propulsion system employing a jet-forming motor which establishes a rail or column comprising a high velocity stream of fluid beneath the surface of the water subject to the hull of the associated craft, the high velocity stream being used for propulsion and to hold the craft stable, the stream developing a powerful thrust which is transmitted to the craft to drive the craft forwardly, the propulsion stream being developed by mixing together high velocity water and air, whereby to form a propulsion jet, and the motor being provided with means to produce a tubular wall of air around the motor to minimize its wall friction and to act as a supporting cushion for the motor as it moves at high speed through the water.

Further objects and advantages of the invention will become apparent from the folllowing description and claims, and from the accompanying drawings, wherein:

FIGURE 1 is a side elevational view of a water craft

provided with an improved propulsion system according to the present invention.

FIGURE 2 is an enlarged longitudinal vertical cross sectional view taken through the main propulsion motor of the water craft shown in FIGURE 1.

FIGURE 3 is a longitudinal vertical cross sectional view, to a slightly smaller scale than FIGURE 2, showing the propulsion motor and its associated driving fluid generator, as employed in the water craft of FIGURE 1.

FIGURE 4 is a diagram showing the general manner in which induced air is mixed with water to form the propulsion stream for a motor such as that illustrated in FIGURES 2 and 3, and illustrating the relationship of the axis of said stream with respect to the water surface under normal conditions of operation.

FIGURE 5 is a bottom view of the marine craft of FIGURE 1.

FIGURE 6 is a transverse vertical cross sectional view taken substantially on the line 6—6 of FIGURE 2.

FIGURE 7 is a transverse vertical cross sectional view taken substantially on the line 7—7 of FIGURE 2.

FIGURE 8 is a transverse vertical cross sectional view taken substantially on the line 8—8 of FIGURE 2.

Referring to the drawings, 11 generally designates a marine craft which is provided with an improved propulsion system employing jet-forming units according to the present invention. The craft 11 comprises a suitably shaped hull 12 having the tapered bow portion 13 and provided with the depending relatively thin keel portion 14 which has a relatively shallow forward portion 15. The depending keel portion 14 is located substantially rearwardly of the vessel 11, and secured thereto is the longitudinally extending main propulsion motor 16, presently to be described. The main propulsion motor 16 is located in the central longitudinal plane of the craft 11 at the rear bottom portion thereof, and a pair of substantially horizontal laterally projecting stabilizing vanes 17, 17 are provided on the bottom of the hull laterally of the main propulsion motor 16. As shown in FIGURE 1, the stabilizing vanes 17 are located above the main plane of the propulsion motor 16 and laterally adjacent the rear portion of the propulsion motor.

A pair of auxiliary propulsion motors 18, 18 similar in construction to the main propulsion motor 16 are mounted on the hull 12 forwardly of and at opposite sides of the main propulsion motor 16, being supported on depending auxiliary keel portions 19, 19. The auxiliary propulsion motors 18 are located substantially at the normal water level or slightly below same when the craft is stationary, the propulsion motors 18, 18 being employed for starting the craft or for propelling it at a relatively slow speed through the water. As will be presently explained, when the craft is moving at high speed because of the thrust developed by the main propulsion motor 16, the auxiliary motors 18, 18 are lifted substantially clear of the water surface and are not relied upon for developing the main driving thrust, although they may be employed, if so desired, for stabilizing the craft.

A pair of reversing motors 20, 20 are provided at the rear portion of the hull 12, said motors being supported on depending auxiliary keel portions 21, 21 spaced laterally on opposite sides of the longitudinal vertical plane of the craft, the auxiliary motors 20, 20 being located substantially at the same level as the auxiliary motors

18, 18, namely, substantially at the level of the water when the craft is stationary or is moving relatively slowly. The auxiliary propulsion motors 20, 20 are employed to develop reverse thrusts for moving the craft in a rearward direction when required.

The propulsion motors 16, 18 and 20 are of generally similar construction, so that it is necessary only to describe the structure of one of said motors. Therefore, the description will be confined to the construction of the main propulsion motor 16 and its associated fluid driving means, it being understood that the auxiliary motors 18 and 20 are of generally the same construction and are provided with similar fluid driving means.

Referring now to FIGURE 3, it will be seen that the propulsion motor 16 comprises a longitudinally elongated main body 23 having a streamlined outer surface 24 which tapers rearwardly in a relatively gradual manner and which tapers forwardly in a relatively abrupt manner, as shown at 25, the body 23 being formed at its forward portion with an annular cavity 26. Rigidly secured axially in the front portion of the cavity 26 is a longitudinally elongated forwardly tapering head element 27 which is rigidly mounted with the depending keel element 14, for example, which is integrally formed therewith, and which extends through the cavity 26, thus giving the cavity its substantially annular form. The head member 27 tapers forwardly in a substantially gradual manner, the forwardly tapering portion, shown at 28, being of substantial length. The body 27 has a relatively abruptly tapering rear portion which is annular concave, as shown at 29, extending substantially parallel to the similarly curved annular inside wall surface of cavity 26, shown at 30. The member 27 is formed with a cavity 31 which communicates with the relatively reduced intermediate portion 33 of the cavity 26 through a nozzle element 32. It will be seen that a first venturi cavity is thus defined in the forward portion of the body 23. The annular cavity 26 merges with the reduced intermediate cavity portion 33, said cavity portion flaring rearwardly and leading to an annular cavity 34 located substantially at the mid portion of the main body 23 and connected by a conduit 35 to the intake of a water pump unit 36. The outlet conduit 37' of the pump unit 36 is connected to the cavity 31 of head portion 27, the pump 36 being arranged to discharge water at high pressure from the outlet conduit 37' into the cavity 31, the water being discharged thereupon through the nozzle 32 into the reduced intermediate portion 33 of the first venturi cavity of the body 23. A portion of the water is returned to the intake of the pump 36 through the conduit 35. Another portion of the fluid from the space 33 passes through a longitudinal central bore 37 provided in the body 23 and enters the forwardly flaring space 38 of a second venturi cavity provided in the rear portion of body 23. The forwardly flaring space 38 communicates with an annular cavity 39 provided in the body 23, said annular cavity being connected by a conduit 40 to the discharge end of an air fan unit 41 whose intake is connected with a forwardly facing air scoop 42 mounted on the hull 12.

The cavity 38 communicates with a rearwardly flaring cavity portion 43, defining a discharge nozzle, the cavity portion 38 communicating with the nozzle portion 43 through a substantially reduced intermediate cavity portion 44, thereby defining the second venturi system. Similarly, the annular cavity portion 26 at the forward end of the body 23 communicates with the main portion 33 of the body cavity through a reduced intermediate cavity portion, defining the first venturi system. As will be presently explained, a jet of high velocity fluid comprising mainly water discharges through the bore 37 into the cavity portion, is mixed with air from the conduit 40, and the resultant fluid mixture is then discharged at very high velocity from the nozzle 43 at the rear end of the motor.

The body 23 is formed substantially at its forward

portion of maximum diameter with an annular cavity 45 communicating with the evenly spaced rearwardly and outwardly inclined discharge passages 46 provided around the periphery of the body 23, and cavity 45 is connected by a conduit 47 to the fan outlet conduit 40, whereby air under discharge pressure from the fan assembly 41 is supplied to the cavity 45 and discharges at the forward peripheral portion of the body 23, being directed outwardly and rearwardly. As will be presently explained, this discharging air forms a tubular wall or channel of air around the body 23, similar to a tubular air bubble, which maintains itself for a substantial length rearwardly along the track of the motor and acts as a tubular air pocket therefor which minimizes skin friction and which provides an air cushion for smooth longitudinal forward movement of the motor body 23.

The fan assembly 41 and the water pump assembly 36 are driven from a common prime mover, the impeller portions of the assemblies 41 and 36 being mounted on a common shaft 48 driven by a gas turbine assembly 49. The gas turbine assembly 49 is of substantially conventional construction and is supplied with air from the output of the fan assembly 41, the exhaust from the turbine assembly 49 discharging rearwardly through a rearwardly opening exhaust conduit 50, so that the exhaust discharge from the turbine assembly 49 is also utilized for building up the propulsion thrust of the motor and associated assembly. While the specific form of the invention illustrated in the drawings shows the use of a gas turbine engine for driving the assembly, it should be understood that either steam turbines or diesel engines may be employed in place of gas turbines for the propulsion motors if so desired.

In operation, water is pumped into the space 31 and is discharged therefrom through the nozzle portion 32 into the relatively narrowed intermediate venturi cavity, the water being discharged rearwardly and increasing its velocity, creating suction which draws water from the exterior into the forward cavity portion 26. The entrained water may contain air when the motor is operating at its normal rating since it will be near the water surface under these conditions. The fluid drawn into the cavity 26 mixes with the water pumped into the space 33 and a portion thereof is returned to the pump 36 through the conduit 35, another portion thereof, which is substantial, being driven rearwardly at high velocity through the bore 37 into the forwardly flaring space 38 of the rear venturi cavity. The fluid discharging from the passage 37 mixes with the high pressure air from the conduit 40 and passes through the narrow intermediate venturi portion 44, thence being discharged through the rearwardly flaring nozzle portion 43 at high velocity and providing a powerful forward thrust. The fluid stream discharging from the nozzle 43 is contained substantially within the tubular wall or bubble of air developed along the surface 24 of the body 23 by the discharge from the jet orifices 46, so that the main propulsion jet from the nozzle 43 is contained within said air bubble and the body 23 is driven through this tubular bubble with relatively small skin friction. The tubular bubble also cushions the body 23 as it moves forwardly therethrough, acting as a track or channel for body 23.

It will be noted that the hull 12 has the sloped forward portions 51, acting as hydro-foils, so that the vessel is lifted as it moves forwardly. Forward motion is initiated by the auxiliary motors 18, 18, as well as by the main driving motor 16, but as the craft builds up speed, the auxiliary motors 18, 18 are lifted so that they are substantially at the surface of the water, with only the main propulsion motor 16 beneath the water surface, the main thrust being provided by the motor 16. The auxiliary motors 18, 18 may be employed for stabilization purposes, to prevent excessive rolling of the craft, and may cooperate with the stabilizing vanes 17, 17 to keep the craft in a substantially stable position as it travels through the water.

FIGURE 4 substantially illustrates the geometrical relationship between the streams of air induced into the motor **16** and the stream of water induced thereinto during the operation of the motor. Thus, the axis of induced water fed into the annular space **26** and passing through the motor is designated at **53**, whereas the axis of the stream of air induced into the motor and passing into the air scoop portion **42** is designated at **54**. The sloping portion **55** in a general way indicates that the air passes through the pump **41** and conduit **40** into the venturi space **38**, merging with the fluid discharged from the bore **37** in the narrowed intermediate portion **44** and ultimately discharging from the nozzle **43** together with the water and forming a propulsion jet therewith.

The rear venturi of the body **23** acts essentially as an air booster wherein the high pressure air stream from conduit **40** acts to build up the velocity of the liquid discharged from the bore **37** and at the same time to replace the cross-sectional area of the liquid which is lost as the liquid stream increases in velocity.

It will be noted that the provision of the tubular air bubble or wall around the body **24**, which is maintained for a substantial distance rearwardly of the body, prevents the formation of a vacuum at the rear portions of the hull, and instead provides a pressure area in this region. This effect combined with the positive thrust developed by the rearwardly discharging fluid from the nozzle **43** greatly increases the propulsion efficiency of the system.

As shown in FIGURE 1, it is expected that the main propulsion motor **16** will normally be beneath the water surface, so that relatively little air will enter into the annular space **26** under normal operation of the craft and that the fluid entering the forward venturi portion of the motor **16** will be mainly water. The induction of water into the forward venturi element of motor **16** is facilitated by making the head portion **27** in the form of a relatively gradually tapering point or needle. The direction of the water entering the forward end of the motor is abruptly changed as it reaches the rearwardly tapering portion **29** of head member **27**, and this water is entrained with the water discharging from the nozzle **32**. As above mentioned, the water then moves rearwardly at high velocity, a portion being recirculated through the pump **36** and the remainder being forced through the thrust bore **37** into the air booster venturi at the rear portion of the motor, where the high pressure air stream is at still greater velocity and at the same time replaces the cross sectional area lost as the water stream gains in velocity.

As will be readily understood, because of the location of the nozzle **32** in the forward venturi cavity of body **23**, the discharge of the high pressure water from nozzle **32** at high velocity creates a vacuum in the space **26** which induces the entry of water into said space through the open forward portion of the body **23**, past the needle-shaped forwardly tapering head member **27**.

As above mentioned, FIGURE 4 diagrammatically illustrates the geometrical relationship between the paths of the induced air and water passing into and through the propulsion motor of the present invention during normal operation thereof. Thus, in the case of the main propulsion motor **16**, under normal operating conditions thereof, namely, when the craft **11** has been brought up to normal cruising speed and assumes a position thereof illustrated substantially in FIGURE 1 with respect to the water level, indicated at **60**, the longitudinal axis of the propulsion motor **16** will be located a short distance below the surface **60**, as designated by the reference numeral **53** in FIGURE 4, and the air entering the motor through air scoop **42** will follow a path generally indicated by the reference numeral **55** which is continuation of the longitudinal axis **54** of air scoop **42**, leading into the propulsion motor **16**, wherein the path of movement of the induced air merges with the path of the induced water at the rear portion of the motor, namely, in the rear venturi chamber of body **23**.

As above mentioned, the propulsion motors cooperate with the hydro-foil surfaces **12** to provide a lifting effect which raises the craft to a position such that the main propulsion motor **16** is submerged and the auxiliary propulsion motors **18** and **20** are substantially elevated above the water surface, under normal cruising conditions. Under operating conditions, the main propulsion motor **16** has substantial buoyancy because it is enveloped in a tubular bubble or wall of air under pressure, so that it has a substantial lifting effect on the associated craft **11**. Thus, the hydro-foil surfaces of the boat may be made much smaller than they would ordinarily be with the usual types of propulsion devices.

It is to be further noted that the propulsion system of the present invention provides substantial advances over conventional propulsion systems, for example, over the propulsion systems employing screw propellers. Applicant's system provides a direct thrust, whereas the screw propeller swirls the water into a spiral, creating substantial turbulence and waste of power. Furthermore, for a given driving thrust, the propulsion motor of the present invention may be much smaller in cross sectional area than the over-all cross sectional area covered by a propeller-type propulsion motor, whereby the propulsion motor of the present invention offers less resistance to movement through the water.

It is to be further noted that the propulsion system of the present invention may be employed with a prime mover **49** of relatively high power without requiring cumbersome reduction gearing and propeller shafts. Thus by employing a gas turbine such as **49** the propulsion system of the present invention provides a much higher power output per unit of weight than in propulsion systems previously employed.

By using water and air in combination, as above described, the propulsion system of the present invention is somewhat analogous to that of turbo-jet aircraft engines. While such aircraft engines use air and fuel for rapid expansion, thereby producing thrust, a marine propulsion motor according to the present invention can approximate the operating conditions of a turbo-jet aircraft engine. However, while the escape velocities from the rear nozzle member **43** are not as high as those of turbo-jet engines, they are still ample for the intended purpose whereas the speeds of propeller-driven craft are limited by mechanical considerations, these limitations do not exist for jet-propelled craft, so that applicant's propulsion system can provide much higher speed than are obtainable with propeller propulsion systems.

A further important and obvious advantage provided by applicant's system is the elimination of vibration and shake which are frequently encountered in propeller-driven systems at high speeds, whereby the propulsion system of the present invenion provides much smoother operation, as well as higher speed than conventional propeller systems.

While a specific embodiment of an improved marine propulsion motor and propulsion system associated therewith have been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. In combination, a boat hull, a depending longitudinal keel member secured to the bottom of said hull, a propulsion motor secured to said keel member, said motor comprising a longitudinally extending body having a forwardly opening longitudinal venturi cavity in its forward portion, a hollow head member axially secured in said cavity and having a discharge nozzle opening into the intermediate portion of said cavity, said body having

a rearwardly opening venturi cavity in its rear portion, said body having a longitudinal passage connecting said venturi cavities, a water pump connected to said hollow head member to supply water under pressure to said first-named venturi cavity, and air pump means connected to the rear portion of said second-named venturi cavity to supply air under pressure to said second-named venturi cavity to mix with water discharging from said longitudinal passage and to provide a high velocity propulsion jet discharging from said rearwardly opening second-named venturi cavity.

2. In combination, a boat hull, a depending longitudinal keel member secured to the bottom of said hull, a propulsion motor secured to said keel member, said motor comprising a longitudinally extending body having a forwardly opening longitudinal venturi cavity in its forward portion, a hollow head member axially secured in said cavity and having a discharge nozzle opening into the intermediate portion of said cavity, said body having a rearwardly opening venturi cavity in its rear portion, said body having a longitudinal passage connecting said venturi cavities, a water pump connected to said hollow head member to supply water under pressure to said first-named venturi cavity, air pump means connected to the rear portion of said second-named venturi cavity to supply air under pressure to said second-named venturi cavity to mix with water discharging from said longitudinal passage and to provide a high velocity propulsion jet discharging from said rearwardly opening second-named venturi cavity, and forwardly facing air scoop means mounted on said hull and connected to the intake of said air pump means.

3. In combination, a boat hull, a depending longitudinal keel member secured to the bottom of said hull, a propulsion motor secured to said keel member, said motor comprising a longitudinally extending body having a forwardly opening longitudinal venturi cavity in its forward portion, a hollow head member axially secured in said cavity and having a discharge nozzle opening into the intermediate portion of said cavity, said body having a rearwardly opening venturi cavity in its rear portion, said body having a longitudinal passage connecting said venturi cavities, a water pump connected to said hollow head member to supply water under pressure to said first-named venturi cavity, air pump means connected to the rear portion of said second-named venturi cavity to supply air under pressure to said second-named venturi cavity to mix with water discharging from said longitudinal passage and to provide a high velocity propulsion jet discharging from said rearwardly opening second-named venturi cavity, said body having a circumferentially extending air cavity at its forward portion and being formed with a plurality of vent passages connecting said air cavity with the surface of the body, and means to supply air under pressure to said last-named air cavity, whereby to provide a cushion of air at the peripheral surface of said body.

4. In combination, a boat hull, a depending longitudinal keel member secured to the bottom of said hull, a propulsion motor secured to said keel member, said motor comprising a longitudinally extending body having a forwardly opening longitudinal venturi cavity in its forward portion, a hollow head member axially secured in said cavity and having a discharge nozzle opening into the intermediate portion of said cavity, said body having a rearwardly opening venturi cavity in its rear portion, said body having a longitudinal passage connecting said venturi cavities, a water pump connected to said hollow head member to supply water under pressure to said first-named venturi cavity, air pump means connected to the rear portion of said second-named venturi cavity to supply air under pressure to said second-named venturi cavity to mix with water discharging from said longitudinal passage and to provide a high velocity propulsion jet discharging from said rearwardly opening second-named venturi cavity, said body having a circumferentially extending air cavity at its forward portion and being provided with a plurality of outwardly and rearwardly inclined vent passages connecting said air cavity with the surface of the body, and means to supply air under pressure to said last-named air cavity, whereby to provide a cushion of rearwardly moving air at the peripheral surface of said body.

5. In combination, a boat hull, a depending longitudinal keel member secured to the bottom of said hull, a propulsion motor secured to said keel member, said motor comprising a longitudinally extending body having a forwardly opening longitudinal venturi cavity in its forward portion, a hollow head member axially secured in said cavity and having a discharge nozzle opening into the intermediate portion of said cavity, said body having a rearwardly opening venturi cavity in its rear portion, said body having a longitudinal passage connecting said venturi cavities, a water pump connected to said hollow head member to supply water under pressure to said first-named venturi cavity, air pump means connected to the rear portion of said second-named venturi cavity to supply air under pressure to said second-named venturi cavity to mix with water discharging from said longitudinal passage and to provide a high velocity propulsion jet discharging from said rearwardly opening second-named venturi cavity, said body having a circumferentially extending continuous air cavity at its forward portion and being formed with a plurality of vent passages connecting said air cavity with the surface of the body, and conduit means connecting the outlet of the air pump means to said last-named air cavity, whereby to provide a cushion of air at the peripheral surface of said body.

6. In combiation, a boat hull, a depending longitudinal keel member secured to the bottom of said hull, a propulsion motor secured to said keel member, said motor comprising a longitudinally extending body having a forwardly opening longitudinal venturi cavity in its forward portion, a hollow head member axially secured in said cavity and having a discharge nozzle opening into the intermediate portion of said cavity, said body having a rearwardly opening venturi cavity in its rear portion, said body having a longitudinal passage connecting said venturi cavities, a water pump connected to said hollow head member to supply water under pressure to said first-named venturi cavity, air pump means connected to the rear portion of said second-named venturi cavity to supply air under pressure to said second-named venturi cavity to mix with water discharging from said longitudinal passage and to provide a high velocity propulsion jet discharging from said rearwardly opening second-named venturi cavity, forwardly facing air scoop means mounted on said hull and connected to the intake of said air pump means, said body having a circumferentially extending continuous air cavity at its forward portion and being formed with a plurality of outwardly and rearwardly inclined vent passages connecting said air cavity with the surface of the body, conduit means connecting the outlet of the air pump means to said last-named air cavity, whereby to provide a cushion of rearwardly moving air at the peripheral surface of said body.

7. In combination, a boat hull, a depending longitudinal keel member secured to the bottom of said hull, a propulsion motor secured to said keel member, said motor comprising a longitudinally extending body having a forwardly opening longitudinal venturi cavity in its forward portion, a hollow head member axially secured in said cavity and having a discharge nozzle opening into the intermediate portion of said cavity, said body having a rearwardly opening venturi cavity in its rear portion, said body having a longitudinal passage connecting said venturi cavities, a water pump connected to said hollow head member to supply water under pressure to said first-named venturi cavity, air pump means connected to the rear portion of said second-named venturi cavity to supply air

under pressure to said second-named venturi cavity to mix with water discharging from said longitudinal passage and to provide a high velocity propulsion jet discharging from said rearwardly opening second-named venturi cavity, forwardly facing air scoop means mounted on said hull and connected to the intake of said air pump means, said body having a circumferentially extending continuous air cavity at its forward portion and being formed with a plurality of outwardly and rearwardly inclined vent passages connecting said air cavity with the surface of the body, conduit means connecting the outlet of the air pump means to said last-named air cavity, whereby to provide a cushion of rearwardly moving air at the peripheral surface of said body, and common drive means operatively connected to said water pump and air pump means.

8. In combination, a boat hull, a depending longitudinal keel member secured to the bottom of said hull, a propulsion motor secured to said keel member, said motor comprising a longitudinally extending body having a forwardly opening longitudinal venturi cavity in its forward portion, a hollow head member axially secured in said cavity and having a discharge nozzle opening into the intermediate portion of said cavity, said body having a rearwardly opening venturi cavity in its rear portion, said body having a longitudinal passage connecting said venturi cavities, a water pump connected to said hollow head member to supply water under pressure to said first-named venturi cavity, means to return a portion of the water in the rear portion of said first-named venturi cavity to the intake of said water pump, and air pump means connected to the rear portion of said second-named venturi cavity to supply air under pressure to said second-named venturi cavity to mix with water discharging from said longitudinal passage and to provide a high velocity propulsion jet discharging from said rearwardly opening second-named venturi cavity.

9. In combination, a boat hull, a depending longitudinal keel member secured to the bottom of said hull, a propulsion motor secured to said keel member, said motor comprising a longitudinally extending body having a forwardly opening longitudinal venturi cavity in its forward portion, a hollow head member axially secured in said cavity and having a discharge nozzle opening into the intermedinate portion of said cavity, said body having a rearwardly opening venturi cavity in its rear portion, said body having a longitudinal passage connecting said venturi cavities, a water pump connected to said hollow head member to supply water under pressure to said first-named venturi cavity, means to return a portion of the water in the rear portion of said first-named venturi cavity to the intake of said water pump, air pump means connected to the rear portion of said second-named venturi cavity to supply air under pressure to said second-named venturi cavity to mix with water discharging from said longitudinal passage and to provide a high velocity propulsion jet discharging from said rearwardly opening second-named venturi cavity, forwardly facing air scoop means mounted on said hull and connected to the intake of said air pump means, said body having a circumferentially extending air cavity at its forward portion and being formed with a plurality of outwardly and rearwardly inclined vent passages connecting said air cavity with the surface of the body, and conduit means connecting the outlet of the air pump means to said last-named air cavity, whereby to provide a cushion of rearwardly moving air at the peripheral surface of said body.

10. A marine propulsion motor comprising an elongated body having a forwardly opening longitudinal first venturi cavity in its forward portion, pump means to supply water under pressure into said first venturi cavity, said body having a rearwardly opening second longitudinal venturi cavity in its rear portion and having a longitudinal passage connecting the rear end of the first venturi cavity to the forward end of the second venturi cavity, and means to supply air under pressure to the forward portion of the second venturi cavity concentrically around the outlet of said longitudinal passage.

11. A marine propulsion motor comprising an elongated body having a forwardly opening longitudinal first venturi cavity in its forward portion, pump means to supply water under pressure into said first venturi cavity, said body having a rearwardly opening second longitudinal venturi cavity in its rear portion and having a central longitudinal passage connecting the rear end of the first venturi cavity to the forward end of the second venturi cavity, means to supply air under pressure to the forward portion of the second venturi cavity concentrically around the outlet of said longitudinal passage, and means to supply air under pressure to the peripheral surface portion of the body.

12. A marine propulsion motor comprising an elongated body having a forwardly opening longitudinal first venturi cavity in its forward portion, pump means to supply water under pressure into said first venturi cavity, said body having a rearwardly opening second longitudinal venturi cavity in its rear portion and having a central longitudinal passage connecting the rear end of the first venturi cavity to the forward end of the second venturi cavity, means to supply air under pressure to the forward portion of the second venturi cavity concentrically around the outlet of said longitudinal passage, and means to supply air under pressure to the forward portion of the peripheral surface of said body and to guide said air outwardly and reanwardly along the peripheral surface of the body, whereby a provide a rear wardly moving cushion of air along said peripheral surface.

13. A marine propulsion motor comprising an elongated body having a forwardly opening longitudinal first venturi cavity in its forward portion, a rearwardly opening forwardly tapered elongated chamber axially secured in the forward end of the first venturi cavity and projecting forwardly from the body, pump means to supply water under pressure to said chamber, whereby to discharge same into the first venturi cavity and induce the entry of water into the open forward end of the first venturi cavity, said body having a rearwardly opening second longitudinal venturi cavity in its rear portion and having a central longitudinal passage connecting the rear end of the first venturi cavity to the forward end of the second venturi cavity, and means to supply air under pressure to the forward portion of the second venturi cavity concentrically around the outlet of said longitudinal passage.

14. A marine propulsion motor comprising an elongated body having a forwardly opening longitudinal first venturi cavity in its forward portion, a rearwardly opening forwardly tapered elongated chamber axially secured in the forward end of the first venturi cavity and projecting forwardly from the body, pump means to supply water under pressure to said chamber, whereby to discharge same into the first venturi cavity and induce the entry of water into the open forward end of the first venturi cavity, said body having a rearwardly opening second longitudinal venturi cavity in its rear portion and having a central longitudinal passage connecting the rear end of the first venturi cavity to the forward end of the second venturi cavity, means to supply air under pressure to the forward portion of the second venturi cavity concentrically around the outlet of said longitudinal passage, and means to supply air under pressure to the forward portion of the peripheral surface of said body and to guide said air outwardly and rearwardly along the peripheral surface of the body, whereby to provide a rearwardly moving cushion of air along said peripheral surface.

15. A propulsion device comprising an elongated body having a forwardly opening front venturi cavity and a rearwardly opening rear venturi cavity, central passage means communicatively connecting the rear end of the

front venturi cavity to the forward end of the rear venturi cavity, pump means to supply liquid under pressure into the front venturi cavity, and means to admit gas under pressure into the intake portion of the rear venturi cavity concentrically around the outlet of said central passage means.

16. A propulsion device comprising an elongated body having a forwardly opening front venturi cavity and a rearwardly opening rear venturi cavity, central passage means communicatively connecting the rear end of the front venturi cavity to the forward end of the rear venturi cavity, pump means to supply liquid under pressure into the front venturi cavity, means to admit gas under pressure into the intake portion of the rear venturi cavity

concentrically around the outlet of said central passage means, and means to supply gas under pressure to the peripheral surface of said body to provide a cushion of gas along said peripheral surface.

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FERGUS S. MIDDLETON, *Primary Examiner.*