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Coffey et al.

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[54] **CONTINUOUS FLOW HYDROFOIL CONFIGURATION**

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[52] **U.S. Cl.** ..... **114/66.5 H**

[51] **Int. Cl.** **B63b 1/18**

[58] **Field of Search** ..... 114/66.5 H, 66.5 R; 115/11, 14

[56] **References Cited**

UNITED STATES PATENTS

3,265,027	8/1966	Brown et al.	114/66.5 H
3,348,514	10/1967	Davis	114/66.5 H

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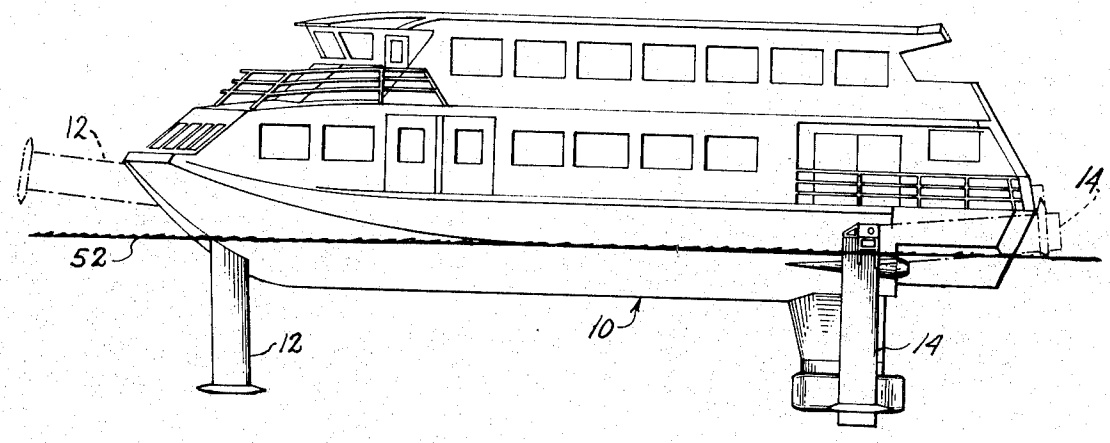
[57] **ABSTRACT**

A hydrofoil support arrangement for a hydrofoil boat incorporating a water jet propulsion ducting mechanism for foil-borne and hullborne operations. The arrangement employs a hydrofoil strut assembly which is pivotally mounted to the boat for pivoting the assembly to a foil-submerged or foil-emerged position. The foil strut assembly utilizes a center strut or column which has a first inlet and internal duct for feeding water to the propulsion means during foil-submerged conditions. A second hull inlet in the duct is provided which opens upon foil-strut retraction, thus replacing the first inlet so that continuous water input at the foilborne and hull-borne operations is maintained. The foil strut overall assembly adds to structural strength, and the outer struts act as efficient end plates to the lifting foil surfaces thereby reducing the tip vortex formation and increasing the system efficiency.

8 Claims, 4 Drawing Figures



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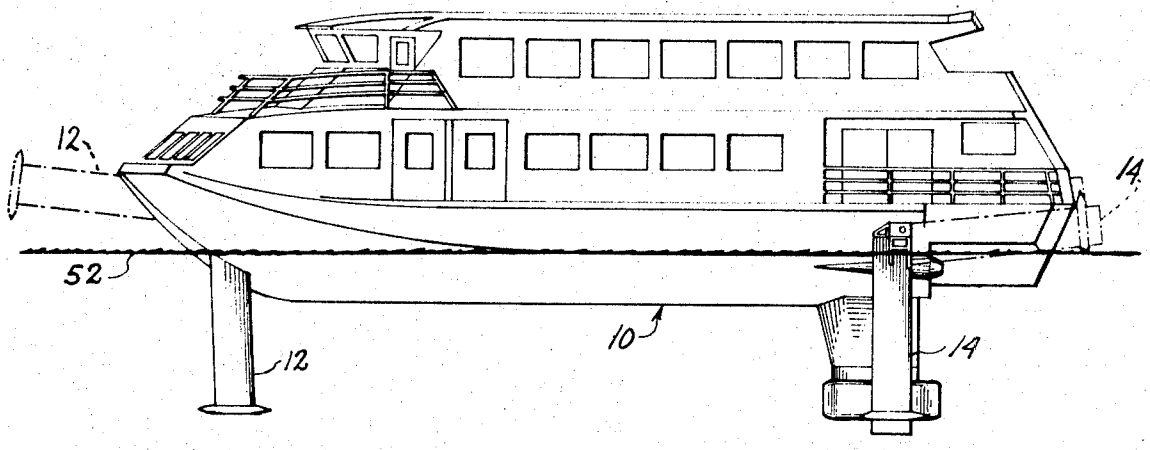


Fig. 1

Fig. 2

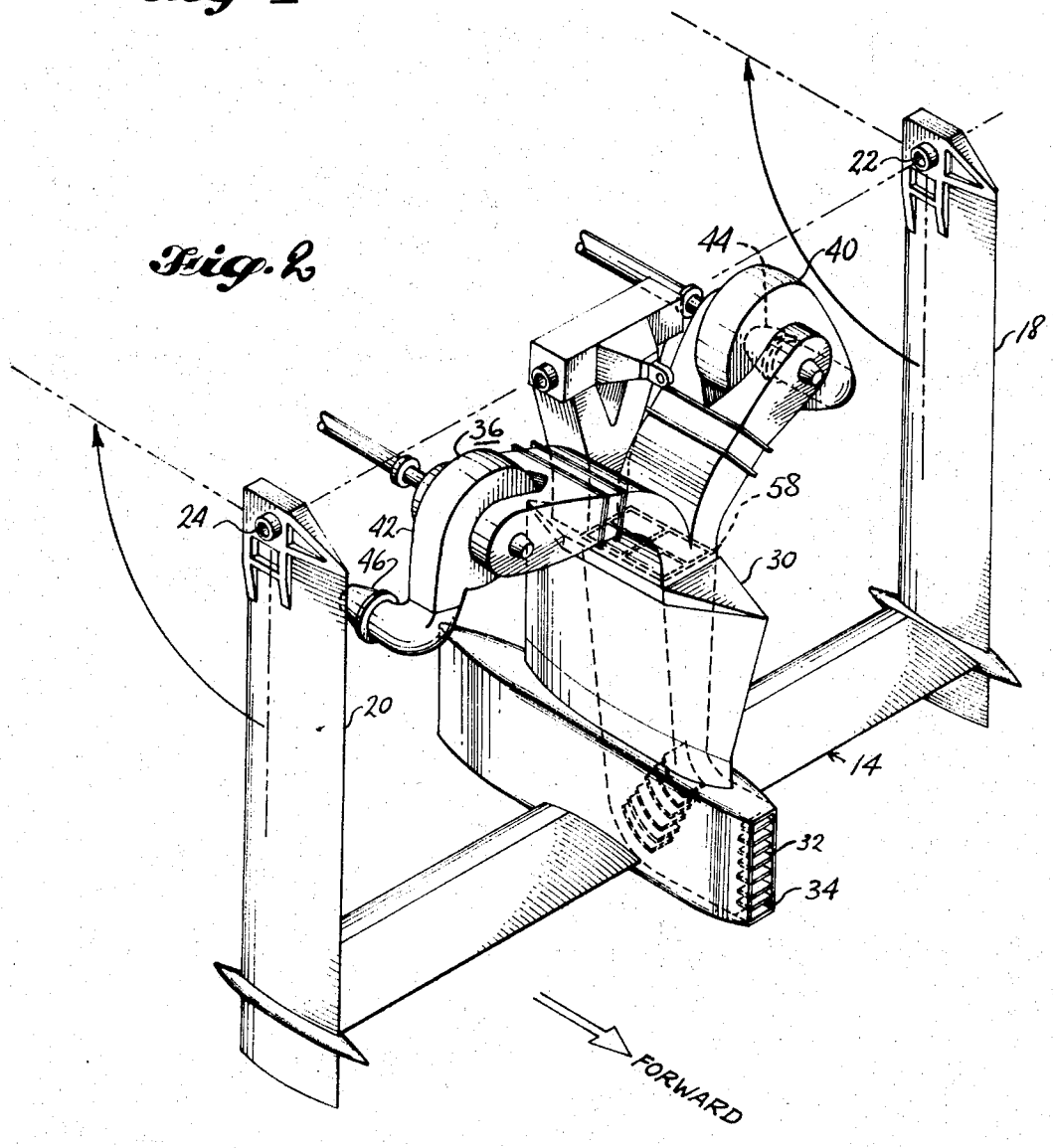


Fig. 3

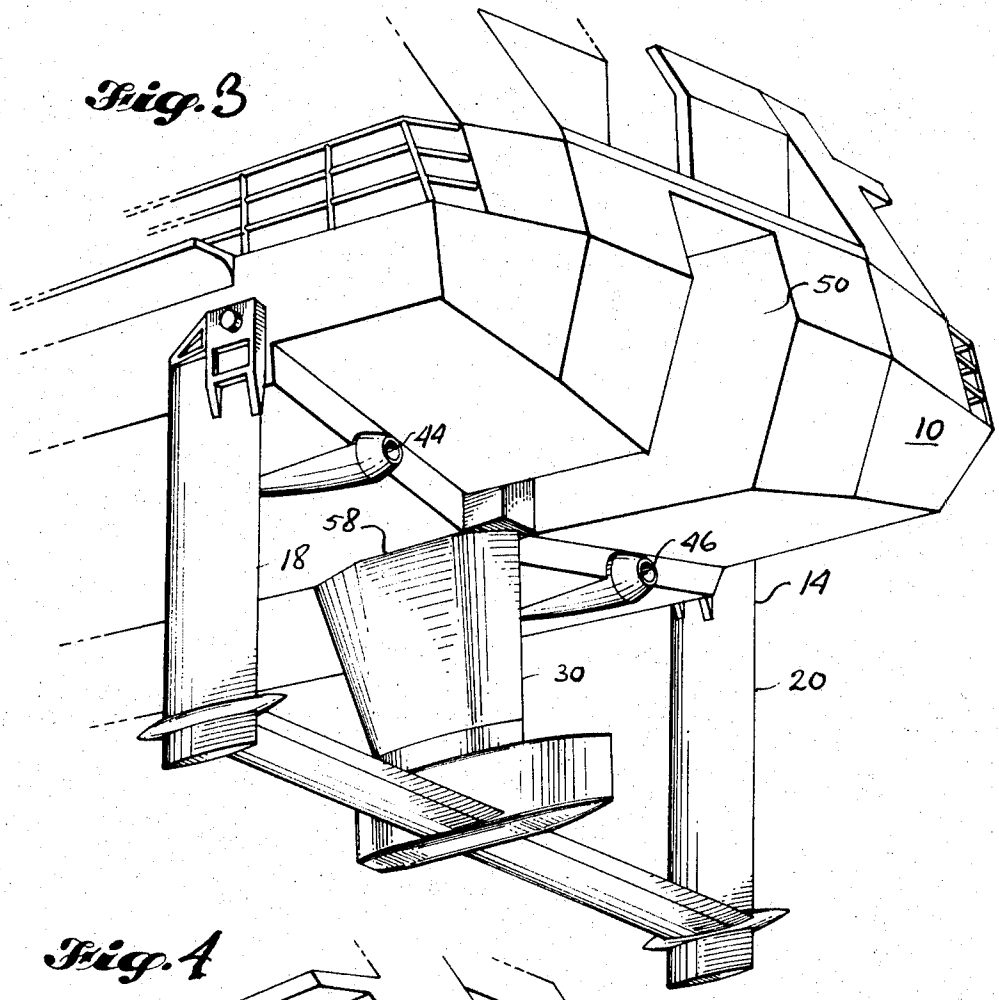
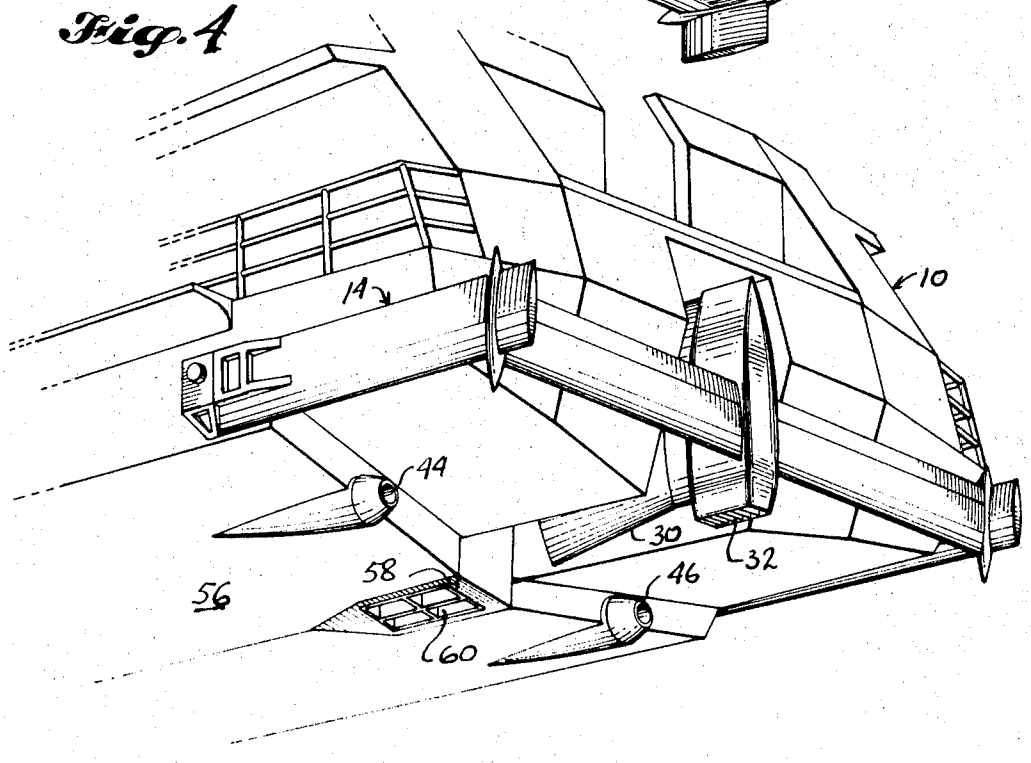


Fig. 4



CONTINUOUS FLOW HYDROFOIL CONFIGURATION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to hydrofoil craft and more particularly to a hydrofoil strut assembly that is pivotally arranged for submerged and emerged conditions with means for providing continuous water input for its water jet propulsion system.

2. Description of the Prior Art

The invention relates to a fluid intake means for providing sea water to a water jet propulsion system for propelling a hydrofoil craft at foilborne or hullborne conditions. The fluid intake means comprsies a non-structural aft strut or column pivotally mounted on the hull of a hydrofoil craft. The strut includes a simple conduit means which comminicates between a scoop or inlet at the free end of the strut and a fluid pump mounted on the hull of the craft whereby seat water is scooped into the conduit means and efficiently discharged rearwardly by the pump to produce a liquid jet stream for propulsion of the craft. Furthermore, an alternate inlet is formed at the hinging area of the non-structural strut when in retracted position.

The following references were found as being of interest in this case:

3,055,331	Singelmann	9/25/62	114-66.5
3,143,097	Meyerhoff	8/4/64	114-66.5
3,165,084	Gongwer	1/12/65	114-66.5
3,265,027	Brown et al.	8/9/66	114-66.5
3,283,737	Gongwer	11/8/66	60-222
3,285,214	Patton, Jr.	11/15/66	60-221
3,326,163	Davis	6/20/67	114-66.5
3,348,514	Davis	10/24/67	114-66.5

The Gongwer patent of of particular interest in this case and relates to a jet propulsion system for a surface water craft in which the showing of a fluid intake means appears to be analogous to the fluid intake means shown in the present invention. Gongwer appears to show a simple non-structural conduit means including a scoop or inlet **20** fixed to and extending from the bottom surface of a surface water craft whereby the arrangement of the conduit means provides for the efficient operation of a liquid jet propulsion system **12** for propelling the surface water craft. It is noted that the conduit means are fixed to the ull of the craft rather than adapted to a pivotally mounted non-structural strut.

The two patents to Davis and the patent to Singelmann are of general interest for their showings of various forms of water jet propulsion systems for hydrofoil crafts in which an aft structural strut rather than a non-structural strut includes a conduit means communicating between a suction inlet in a strut and the suction inlet of a pump for providing increased efficiency of a propulsion system. Davis '514 shows the suction inlets **20** in the struts communicating with the suction inlets of pumps **24** mounted within a hydrofoil craft hull. The Davis '163 and Singelmann patents show a pump mounted within the strut and communicating between suction and discharge passages within the strut for increasing the efficiency of the jet propulsion system.

The remaining patents are of general interest for their showings of various forms of propulsion systems for water jet propelled hydrofoil crafts in which the structural struts include a suction inlet for providing liquid to a propulsion system of a hydrofoil craft.

From the above-cited prior art, it appears that a hydrofoil strut assembly that employs a water inlet on a non-structural center positioned strut or column pivotally mounted to a hull and simulataneously and automatically provides for an alternate inlet means during retraction or fold-up of the strut assembly is new and novel in the art.

SUMMARY OF THE INVENTION

The invention relates to a pivotally mounted hydrofoil strut assembly employing a center strut or column used as liquid inlet means and a left and right strut. The free ends of the struts and column are interconnected by foil sections into one hydrofoil strut-foil assembly which extends downwardly during the foilborne operations and retracts sternwards during hullborne operations of the boat.

One of the major advantages that is accomplished by this type of construction appears in the fact that the hydrodynamic effect of the struts at the ends of the foils is similar to that of end plates, cutting down tip vortices and diminishing the induced drag, thereby increasing system efficiency. The interconnected arrangements of the struts with the foils also provide for a structurally lighter yet stronger and more stable arrangement, and, in addition, provides for a configuration with less hull-strut interference as compared with prior art single foil strut devices. The overall effect that is hereby produced will increase the load versus power effectiveness by an appreciable factor.

Assuming now that a hydrofoil boat being foilborne enters a harbor area, at which time a reduction in draft is required, then the water-jet power propulsion should be reduced and the foil-strut assembly will completely submerge and the boat becomes hullborne. The foil-strut assembly will then be retracted by pivotally folding the strut arrangement towards the stern of the boat. As soon as the foil-strut arrangement is retracted, a second inlet for the water jet propulsion means is opened at the hull strut area. Thus, a continuous water flow input towards the water propulsion means is provided for. The hydrofoil boat being hullborne is now maneuvering itself with its water jet propulsion at a reduced draft through the harbor facilities and as soon as deeper water is entered the reverse action will take place by first pivoting the foil-strut assembly into the extended or foil-borne position, and thereafter the water jet propulsion power is increased so that the hydrofoil boat becomes foilborne and continuous water or liquid is upplied to the water jet propulsion by the center column water intake means. As show and explained hereinafter, the supplied liquid or water is ducted to a pair of centrifugal type of water pumps which are further connected to its individual nozzle so that a right and a left nozzle for water jet propulsion will provide forward thrust to move the hydrofoil boat.

It is therefore an object of the present invention to provide for a hydrofoil support arrangement for a hydrofoil boat which incorporates a water jet propulsion system and which support arrangement is provided with a central column with water inlet means.

It is another object of the present invention to provide for a hydrofoil support arrangement having pivotal mounting means so that a foilborne and hullborne operation of the boat is provided for with means for continuous supply of water to the propulsion system at the foilborne and hullborne conditions.

It is another object of the present invention to provide for a hydrofoil support arrangement that is pivotally mounted, has means for continuous water intake for its propulsion system, and has struts so arranged as to act as hydrodynamic end plates to the lifting foil so as to reduce tip vortice induced drag.

In general, a hydrofoil support arrangement for a hydrofoil boat utilizing water jet propulsion for foilborne and hullborne operations is provided for, which comprises a hydrofoil strut assembly pivotally mounted to said boat for pivoting the assembly to a downward foil-submerged position and for pivoting the assembly to an emerged-foil position. The strut assembly is provided with an inlet and duct means for receiving water for said propulsion means at said submerged position, and the arrangement will provide for a second inlet for the propulsion means upon retraction of the strut assembly so that a continuous water input at the submerged and emerged foil positions is provided for.

Additional objects and features will become evident from the following description taken in conjunction with the accompanying drawings.

THE DRAWINGS

FIG. 1 is a side view of a hydrofoil boat showing hydrofoil support arrangement in its submerged or extended position.

FIG. 2 is a perspective forward view of the hydrofoil aft strut assembly including its liquid intake means and propulsion system.

FIG. 3 is a perspective aft view of the stern portion of the hydrofoil boat which in particular illustrates the exterior propulsion means as well as the specifically designed stern body configuration adapted for receiving the retracted hydrofoil aft assembly.

FIG. 4 is a perspective view of the stern of the hydrofoil boat when hullborne and when the hydrofoil assembly is folded in a retracted position.

DESCRIPTION AND OPERATION OF THE INVENTION

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1 the preferred embodiment of a hydrofoil boat **10** with a forward hydrofoil assembly **12** and an aft hydrofoil assembly **14** in an extended position. When hullborne, the hydrofoil boat **10** is provided with means to pivot the hydrofoil assembles **12** and **14** in a retracted position. This type of a position is shown in FIG. 1 in phantom-line fashion and shows the foil-strut assemblies above the hullborne water line. The propulsion means for the hydrofoil boat **10** comprises a pair of controlled liquid output nozzles located at the underneath stern hull area. In order to achieve a good understanding of the aft hydrofoil assembly, the illustration in FIG. 2 shows the aft strut assembly from a front or forward location and in addition the integral water propulsion system. The hydrofoil assembly **14** comprises a right-hand strut **18**, a center column **30** and a left-hand strut **20** which are pivotally mounted outside of the hull side of the hydrofoil boat **10** by pivot points **22** and **24**, respectively. The center column **30** includes an intake duct **32** with vanes **34** to guide the liquid in a predetermined and controlled fashion towards the propulsion and pumping means **36**. In the preferred embodiment as illustrated, there is shown a dual type of arrangement where there is one centrifugal pumping means **40** at the right side and a similar pumping means **42** at the left side. Each pumping means **40** and **42** compresses the water to a higher pressure and, accordingly, feeds the water to the output or nozzles **44** and **46** located at starand portboard, respectively. The output as well as the direction of each individual nozzle can be regulated by the deck officer on duty; however, the means to control the output as well as the steering or direction of the nozzles is not illustrated since such means are well known in the propulsion art. Referring now to FIG. 3, part of the poopdeck, as well as the hull-stern portion of the hydrofoil boat is provided with a cut-out configuration **50** which serves to receive the center column **30** when placed in the retracted position so that a minimum of drag is obtained when the hydrofoil boat is hullborne. As a matter of fact, this configuration and unique design remove the complete aft hydrofoil assembly **14** above the water line. The pivoting of the aft hydrofoil assembly **14** is all about one axis which is above the hullborne water line **52.** As a reult, when the hydrofoil assembly **14** is pivoted in the retracted position as shown in FIG. **4,** the intake means **34** is now inaccessible for liquid input to the propulsion means and therefore a second inlet means has to be provided for so that the same propulsion power is being maintained. Therefore, the present configuration provides at the center strut or column **30** pivotal mounting with the hull **56** a hull-strut junction **58** having a second inlet **60** which becomes available as soon as the hydrofoil assembly **14** is folded in the retracted aftwards position as shown in FIG. **4.** This inlet **60** continues to provide liquid to the pumps **40** and **42** in the same manner as when the water was flowing through the duct **34** so that a continuous water flow to the propulsion means is provided for without any interruption. The overall unique arrangement of the hull-stern portion area provides for 1) the fold-away of the aft hydrofoil strut assembly, 2) continuous water intake, 3) submerged positioning of the water propulsion nozzles, during in-harbor maneuvering, in a most efficient manner when the hydrofoil boat **10** is hullborne. Furthermore, the arrangement provides for a non-structural center strut or column with water intake means which provides for 1) one hull-strut interference only, 2) stronger structural assembly for horizontal foils, 3) thin, non-resistant side struts reducing drag to minimum, acting as end plates and cutting down tip vortices. The overall effect of the advantages of this novel comination projects a load-power effectiveness that is twice that of prior art competitive arrangements.

Having thus described the many useful and novel features of the continuous flow aft hydrofoil configuration in connection with the accompanying drawings, it will be seen that the several useful objects for which it was designed have been achieved. Although but a single specific form of theinvention has been illustrated and described herein, it is realized that certain changes and modifications therein may occur to those skilled in the art within the broad teaching hereof; hence, it is our intention that the scope of protection afforded hereby shall be limited only insofar as said limitations are expressly set forth in the appended claims.

Now, therefore, we claim:

1. A hydrofoil support arrangement for a hydrofoil boat having a hull that carries water jet propulsion

means for foilborne and hullborne operations, comprising:

a. a foil-strut assembly pivotally connected to said boat hull for pivoting said assembly to a downward foil-submerged position and also to an upward emerged position;

b. the hull being provided with water passage means leading to said propulsion means;

c. said foil-strut assembly being provided with a water-receiving inlet and duct means connecting the inlet with said passage means to supply water to the passage and propulsion means while said assembly is in said submerged position;

d. and said passage menas having a water-receiving inlet for supplying water to said propulsion means when the foil-strut assembly is pivoted to said emerged position so that continuous water input for said propulsion means at said submerged and emerged foil positions is provided for.

2. A hydrofoil support arrangement for a hydrofoil boat as claimed in claim **1**, wherein said passage inlet is submerged only while said boat is hullborne.

3. A hydrofoil support arrangement for a hydrofoil boat as claimed in claim **1**, wherein said pivotal connection of the foil-strut assembly to said hull is on an athwart axis located above the boat waterline during hullborne operation.

4. A hydrofoil support arrangement for a hydrofoil boat as claimed in claim **1**, wherein said foil-strut assembly is the aft foil-strut assembly of the boat and said pivotal connection is on an axis athwart the hull, and said assembly is pivoted sternwards from it submerged to its emerged position, said assembly being substantially completely emerged in said emerged position.

5. A hydrofoil support arrangement for a hydrofoil boat as claimed in claim **1**, wherein said foil-strut assembly comprises struts connected at their free ends by a hydrofoil section supporting between the struts a center column provided with said first-mentioned inlet and duct means.

6. A hydrofoil support arrangement for a hydrofoil boat as claimed in claim **5**, wherein said center column in said emerged position exposes said passage inlet.

7. A hydrofoil support arrangement for a hydrofoil boat as claimed in claim **5**, wherein said duct means connects said inlets with each other while said foil-strut assembly is in submerged position, and said center column swings said duct means away from said passage inlet when said assembly is pivoted to emerged position, whereby said passage inlet is exposed.

8. A hydrofoil support arrangement for a hydrofoil boat as claimed in claim **7**, wherein said first-mentioned inlet faces forward adjacent said foil section, and said passage inlet is in the bottom of the hull.

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