HYDRO-SKI BOAT STRUCTURE

Inventors: Louie Deprez Hargett, 743 Nellie Ave.; Ellis Rose, 327 Baldwin St.; Aught Boone Dial, Shoals Acres; Jewel Rose, Executrix of said Ellis Rose, deceased, all of Florence, Ala. 35630

Filed: July 28, 1971

Appl. No.: 166,943

U.S. Cl. .......... 114/66.5 H, 114/62, 114/66.5 R

Int. Cl. .............. B63B 1/20


References Cited

UNITED STATES PATENTS

2,144,111 1/1939 Higgins.......................... 114/66.5 P
2,296,977 9/1942 Brien............................. 114/66.5 S
2,344,619 3/1944 Lake.............................. 114/66.5 P
2,483,663 10/1949 Nowak............................ 114/62 X
2,844,339 7/1958 Stroukoff......................... 114/66.5 H X
2,996,030 8/1961 Lorson......................... 114/66.5 S
3,111,924 11/1963 Ecroyd et al.................. 114/66.5 R
3,230,918 1/1966 Compton......................... 114/66.5 H
3,288,096 11/1966 Swenson....................... 114/66.5 S
3,288,100 11/1966 Cox et al..................... 114/62 X

Primary Examiner—Duane A. Reger
Assistant Examiner—Barry L. Kelmachter
Attorney, Agent, or Firm—T. Eugene Burts

ABSTRACT

This invention relates to a boat structure, and it deals more particularly with a ski type of boat structure embodying improvement of the planing surfaces of the hydroskis. Provided, in combination with a suitable hull structure, adapted to remain partially submerged at zero speed or at low speed in the normal manner, are planing surfaces on the hull, designed to develop zero or small negative lift as the speed of the boat increases; and attached thereto are a pair of forwardly located hydro-skis and a rearwardly located hydro-ski, said forward hydro-skis having primary and secondary planing surfaces in angular relationship such as to first cause the hull to quickly leave the water surface upon increasing speed of the boat to achieve maximum planing efficiency and, secondly, substantially eliminate skidding on turns by means of introduction of pivotal drag through the angle of incidence of said secondary hydro-ski surfaces engaged in making a turn.

2 Claims, 11 Drawing Figures
HYDRO-SKI BOAT STRUCTURE

This is an original application directed to the invention under consideration.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The field of this invention resides broadly in the design of the boats adapted to achieve high speeds over water by reduction of the friction or drag usually encountered in the employment of a normal hull type of structure which is subject to the maximum resistance of the body of water and the further impeding effect achieved by cavitation set up by the inherent shape of the hull surfaces. Hence, boats adapted to travel at high speed over the surface of the water, rather than through the water, have been adopted by making use of certain aerodynamic principles in their adaptation to liquids rather than air.

A common application has been found in use of the hydrofoil boat, which makes the fullest use of its capabilities only if it is foil-borne through as much of the speed range of the craft as possible. Initially, top speed has been limited by the cavitation on the foil and the inability of the craft to become surface-borne immediately after its period of initial acceleration. Most of the advances in this field have been made through the use, heretofore, of V-type or leg-type hydrofoils. There are obvious disadvantages to this type of structure, primarily in the danger which lies in the possible breaking of the foil through striking a submerged object in the water. It is also then impracticable to beach this type of craft without retracting the foils to prevent their damage. Where skis have been employed, a disadvantage has been encountered in the tendency of the boat to skid sideways while making a turn, with the resultant danger of causing the hull to overturn, either due to exaggerated inertia on the turn or a "tripping" effect relative to the water and the attendant danger of overturning.

2. Description of the Prior Art

The prior art has heretofore been located generally in Class 114-66.5 and in Class 114-56, as well as in Class 114 and Class 9-18. A patent to Kregg, U.S. Pat. No. 2,748,400 discloses a hydrofoil aquatic device which consists essentially of a high speed pontoon buoyed by a plurality of vertically disposed hydrofoils in spaced relation. This type of device is completely different from the device disclosed in the instant invention in that it deals, obviously, with a hydrofoil whereas the present invention deals with a hydro-ski which is completely guarded in its vertical support structure to prevent breaking or damage to the structure due to a submerged object.

A patent to Beocerice, U.S. Pat. No. 2,890,672 discloses a hydrofoil device which, again comprises a plurality of vertically disposed fins or foils supported by a vertical structure which is unguarded in its attack upon the surface of the water, and therefore subject to the danger of breakage and damage from submerged objects. There is also no means provided in the structure to prevent skidding on turns equivalent to the secondary surfaces provided on the ski of the present invention.

A patent to Canazzi, U.S. Pat. No. 3,051,115, discloses a four point planing type of speed boat hull. While this disclosure reveals a secondary non-trip and spray rail, it does not disclose the type of secondary planing surface in a ski adapted to dig into the surface of the water and form a pivot around which the boat may turn with the minimum amount of skidding while planing with the hull completely out of the water. This patent is directed primarily to the structure of the hull itself and the tunnel effect of the hull, thereby causing air to lubricate the rear planing sections of the hull. This patent does not deal with the sophisticated development of a ski system adapted to provide the minimum number of points of suspension on the surface of the water, thereby decreasing the number of friction surfaces available for drag.

SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the present invention to provide in a boat structure means for the craft to become almost completely surface-borne immediately after its period of initial acceleration. A salient feature in connection therewith resides in our employment of a hydro-ski as the buoyant support structure for a boat, said hydro-ski members having a plurality of coacting planing surfaces arranged with an angle of attack relative to the water, at initial acceleration, such as to cause the boat to rise immediately through its primary lifting planes into surface cruising position on its secondary planing surfaces.

A further object of the invention is to provide a high-speed surface-borne boat structure adapted to negotiate turns at such speeds without skidding or a "tripping" effect relative to the water and the attendant danger of overturning.

An important feature to this end lies in our provision of a self-adjusting hydro-ski so endowed with secondary planing surfaces which assume an angle of attack on a turn, in normal position, such as to regulate the depth of plane of the ski and create a pivotal point at the properly banked attitude for the boat.

Another important object of the invention is to provide a hydro-ski boat structure that is stable at speeds in excess of 45 knots, and one which has less likelihood of damage from striking submerged objects.

Applicants have conducted numerous and extensive tests and have determined that a hydro-ski boat structure of the character described herein meets all of the handling qualities at a speed of 45 to 50 knots, which a good speed boat should possess. As opposed to the vertical leg type or V type hydrofoil boat, our hydro-ski displays distinct advantages over such structures. For example, there is less cavitation or destructive drag with the ski over the foil in our adaptation thereof, and our ski boat is safely maneuverable within the total speed range. It banks properly, even in tight turns, at top speed and, due to the unique design of the ski, does not skid out of the turn.

We have found that the best design for support of our boat structure, to provide maximum maneuverability, dictates the use of a system of forward and rearward skis, with the use of a pair of forward skis mounted in tandem with at least one separate rearward ski. It will be seen that the ski design is such that they are self-guarding as to their support members, and obviate the loss of a support through striking an object at high speed.

In the illustrated embodiment of the invention we provide a new type of hydro-ski boat which consists of a hull and two pairs of hydro-skis attached rigidly to the load carrying structure of the boat hull. The bottom surface of the hull as viewed lengthwise has laterally a
concave curvature, thus forming a tunnel. The lateral arc of curvature starts at zero at the bow, increases to a maximum at about 10 percent of the boat length, then decreases from said bow point to the stern, and it is essentially flat at the stern. The shape of the hull in the longitudinal plane is designed to develop zero, or a small negative lift, by leaving the upper surface of the hull essentially flat over most of the body, and only a small convex curvature at the forward portion. The lower side of the hull in the longitudinal plane consists of an s-shaped section extending to the quarter point of the longitudinal chord. From thereon the bottom surface is essentially flat. The forward pair of hydro-skis consist of a number of planing surfaces which serve two essential purposes. The primary surfaces plane on the water surface and provide the necessary lift for the boat. They are curved in a certain fashion, at certain critical angles, to form a decreasing angle of attack from the tip of the hydro-ski to its trailing edge. The secondary surfaces, which are inclined to the planing surfaces or set normal to them, provide the necessary side force for turning the boat, by creating a pivotal point, and prevent it from skidding out of the turn.

The rear pair of hydro-skis, in the embodiment shown, are also rigidly connected to the hull structure of the boat. However, they have a smaller track allowing the rear pair to run in the wake of the forward skis. They consist of one planing surface, which has, again, a decreasing angle of attack starting at the tip of the hydro-ski and approaching the trailing edge. The planing surface is flanked by a pair of upwardly inclined surfaces on each side thereof. In turn, the rear hydro-skis are planing sideways on the water surface in the direction of the thrust, which is provided by the outboard motor, or such other power source as may be used to propel the boat.

Low take off speed is a salient feature of such a structure, and is achieved by the large planing surfaces of the front skis having a relatively large angle of attack at the front portion of the ski. Thus the front pair of hydro-skis are elevated with increasing speed, causing an increased angle of attack of the rear hydro-skis, thereby developing more lift, and they also begin to rise. As the speed is further increased, the craft rises progressively out of the water, successively emerging the surfaces of the hull and skis which are no longer needed for lift.

At the highest speed, finally, the boat rides only on the rear portions of the planing surfaces of both front and rear hydro-skis at a rather low, or zero, angle of attack. The excess planing surfaces are no longer in contact with the water and are not causing any excess drag which would interfere with the performance of the boat.

It will be more apparent from the following description how the advantages of the structure coact to produce effective turning of the boat, as well as other objects and features which have heretofore been mentioned. Additional objects and features will appear as inherent in the structure as presented in this embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, in which like reference numerals are employed to designate like parts in the various views:

FIG. 1 is a side elevational view of an improved hydro-ski speed boat constructed in accordance with the principles of our present invention. The power plant or propulsion means, which could optionally be an outboard or other type of motor, is not shown in order that the boat hull may be better seen.

FIG. 2 is a bottom plan view of the boat hull and hydro-skis shown in FIG. 1.

FIG. 3 is a front elevational view thereof, along lines 3—3 of FIG. 1.

FIG. 4 is a rear elevational view thereof, along lines 4—4 of FIG. 1.

FIG. 5 is a partial transverse sectional view taken along line 5—5 of FIG. 1.

FIG. 6 is a partial transverse sectional view taken along the line 6—6 of FIG. 1.

FIG. 7 is a partial transverse sectional view taken along the line 7—7 of FIG. 2.

FIG. 8 is a fragmentary longitudinal sectional view taken along the line 8—8 of FIG. 11.

FIG. 9 is a fragmentary transverse sectional view taken along the line 9—9 of FIG. 2.

FIG. 10 is a fragmentary transverse sectional view taken along the line 10—10 of FIG. 2.

FIG. 11 is a perspective view of the forward starboard hydro-ski as shown in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more particularly to the drawings, the complete boat hull is generally designated by the numeral 20. The hull 20 is of substantially rectangular shape. The bottom 21, which is flanked by the sides 22 and the stern 23, is a three dimensional surface. The trace of the center-line of the bottom surface is shown in FIG. 1 as a dashed line. Its curvature, relatively s-shaped beginning at the bow 24, is concave—relative to the bottom of the hull—reaching its maximum at about 10 percent of the boat length. The curvature from this point decreases thereafter and becomes convex, with its maximum reached at about 25 percent of the boat length. The curvature then decreases again as the stern 23 is approached becoming essentially flat.

The transverse or lateral arc of curvature of the bottom surface 21, as shown in FIG. 5, begins at the bow 24 with zero curvature; and thereafter it changes to a concave curvature viewed from the outside of the boat hull 20, reaching its maximum at approximately ten percent of the length of the boat; and it decreases thereafter as the stern 23 of the hull is approached. The surface 25 is connected to the bottom 21 at approximately two-thirds the length of the boat and is longitudinally inclined to said surface of the bottom at a small angle of about 5° and terminates at the stern 23. The flanking wedge-like panels 26 are inclined outwardly and upwardly at an approximate angle of 45°, and are connected to bottom surface 21, stern 23 and surface 25 to form a rigid structure together with the stern 23, whereupon may be mounted an outboard motor or any other suitable power source, with an extended downwardly projecting propeller.

The forward pair of hydro-skis are attached rigidly to the load carrying structure of the boat by means of the struts 27 and 28 as shown in FIGS. 1 and 11. As best seen in FIG. 11, these skis have a primary planing surface 29. This surface is laterally straight and longitudinally bent to form an increasing angle of incidence.
from zero degrees at the trailing edge to approximately fifteen degrees at the tip. The inner side of the planing surface 29, as seen in FIG. 2, runs parallel to the center line of the boat hull to approximately 40 percent of the span of the surface 29. A sine-shaped line is thereafter the continuation up to about 50 to 52 percent of the span, extending outwardly to roughly one-half the width of the planing surface 29. From there on, the inner edge or side is parallel to the center line again up to the trailing edge.

The outer edge of the surface 29 is formed by a parabolic line making, at the tip, an angle of about 30° to 35° with the inner edge of said surface. The maximum width of surface 29 is obtained at about fifth percent of the span. From there on, the outer edge is straight and tapering off slightly, when the trailing edge of the surface is approached.

The secondary surface 33 flanks the outer side of the planing surface 29. It is inclined to the latter at an angle of approximately 45° and extends outwardly and upwardly. The width of the surface 33 tapers off at the ratio of approximately three to one as the trailing edge of the ski is approached.

To the upper edge of the surface 33 is attached to spray rail 34 which extends from the forward tip of the secondary surface to approximately half the span of the hydro-ski; then again tapering off to a smaller width at the end.

The complete inner edge of the primary planing surface 29 is flanked by a vertical secondary surface 36 to which the two supporting struts 27 and 28 are rigidly attached. Into the rearward inner cutout of the primary planing surface 29 another planing surface 35 is rigidly attached to the secondary surface 36, as best seen in FIG. 10. Surface 35 is elevated and out of plane with respect to the surface 29. It is furthermore inclined downwardly and inwardly by about 5°, so that the inner edge of the surface 35 has an elevation of approximately one-half inch over, or just above, the bottom level of the surface 29. The forward edge of 29 and the inner edge of 35 are a straight line as seen in FIG. 2. The forward tip of 35 is bevelled upward where it attaches to 36, to prevent a vacuum from developing behind the curved section of 36. In the lateral direction both surfaces 29 and 35 form a typical step as best seen in FIG. 10. An auxiliary pair of planing surfaces 31 and 30 are attached to the inner side of secondary surface 36. Both of these surfaces, in connection with the continuation 32 of the spray surface 34, extend to approximately 40 percent of the span of the forward hydro-ski. The lifting surface 31 is longitudinally inclined backwards and downwards at approximately 40 degrees, so that the rear edge has the same elevation as the forward tip of the planing surface 29.

The auxiliary planing surface 30 extends further backwards and is essentially horizontal, or it might be inclined at a rather small angle downwards. The ratio of the surface areas to each other is illustratively demonstrated in FIG. 2.

At top speeds, when the hull is completely emerged from the water, and the forward skis are planing on their appropriate minimum area — which is essentially the rearward portion of the planing surface 29 — the procedure for accomplishing a left turn involves the following movements relative to the functioning of the unique arrangement of our hydro-skis.

Upon giving left rudder control through the propulsion means, the boat begins to swing into the turn. The rear portion of the hull will naturally tend to swing to the right or outwardly. The forward skis will slip sideways, with their tips pointing into the turn, or to the left. The inner ski has slightly less speed, and consequently submerges slightly more than the outer ski — this is by common dynamics know to be approximately proportional to the velocity difference squared. This causes the surface 35 — due to the slightly downward inclined angle of 35 and the sideways of the water in the neighborhood of the trailing edge of the inner ski — to submerge further, until the surface is in an approximately horizontal and properly banked attitude.

Thus, the inner hydro-ski forms a true pivot point about which the boat turns. The outer hydro-ski will tend to rise more because of the slightly higher velocity — and the outwardly and upwardly inclined surface 33. It will actually rise up the wall of water being displaced thereby and therefore causes the hull to tilt and bank further to the inner side of the left turn.

For a right turn, exactly the opposite will occur, since a plane through the center line normal to the water surface is a plane specular symmetry.

The rearward pair of hydro-skis are of a simpler design. As previously stated, with some modification in the location of the propulsion means; that is, a positioning of the same by extension of a propeller, jet or fan, as the case may be, more to the rear to clear the trailing edge of the rearward ski, a single rear ski of the same design could be employed. This will be obvious from the operation and design of these skis.

The rear skis are also rigidly attached to the load carrying structure of the hull 20. The primary planing surface 37 is longitudinally curved similar to the planing surface 29 of the forward pair. Starting with essentially zero angle of incidence at the trailing edge of the rearward ski and gradually increasing to approximately 25° to 30° at the tip, the area of the planing surface 37 is approximately the same as that of the primary planing surface 29 of the forward hydro-ski. The sides of surface 37 are formed parallel to each other from about one-third of the length of the rearward ski to its trailing edge. The forward part is pointed and joins the supporting strut in a tip somewhat short of the attachment point of the strut 40 with the boat hull 20. The strut 40, together with the form piece 42 and the rear strut 41 are connected at a right angle to the surface 37 as shown in FIG. 1, such that the latter keeps its proper form. The strut 40 is rigidly connected to the hull 20, and the rear strut 41 is rigidly connected to a protrusion of the hull projecting from the bottom surface 21 downwards and formed by the side surfaces 43 and 44, the bottom plate 45, and part of the stern 23, as can best be seen in FIG. 4. The parallel sides of the planing surface 37 on each side of strut 41 are flanked on both sides by the secondary surfaces 38 and 39, which are inclined upwardly and outwardly or inwardly at an angle of about 30°. The surface 39 is a mirror image of the surface 38. Their sides are parallel from about 50 percent of the length of the rearward ski to the trailing edge of said ski. Their forward portion is pointed and joins the primary planing surface 37 smoothly at the point where the latter starts to decrease in width, as seen in FIG. 2.

The roughly convex shaft of the bottom plane of the rearward hydro-ski; formed by the surfaces 37, 38 and
the height of the secondary surface 33 in outward distance to prevent blowing of water into the boat.

It can be seen that our invention is well suited to meet the objects thereof, and that the modification shown is to be interpreted as exemplary, inasmuch as various modifications of the structure may be anticipated and are within the scope of the claims and the embodiment illustrated is not to be taken in a limited sense.

Having thus described our invention, we claim:

1. A hydro-ski boat structure of the character described, comprising, in combination:
   - an elongated substantially rectangular hull, in lateral section characterized by a concave bottom curvature, said curvature starting at zero at the bow and increasing to its maximum in proximal relation thereto and thence decreasing progressively to a substantially flat stern, the longitudinal curvature starting as concave at the bow, changing thereafter progressively to convex and decreasing to zero at the stern;
   - forward and rearward hydro-ski support members affixed to the bow and stern sections of said hull;
   - said ski members having a plurality of inner and outer planing surfaces planing during the forward movement of said hull through a body of water from zero speed through acceleration, to cause said hull to emerge from the water through alternating consecutive inner and outer planar action to support said boat structure on such planing surfaces at maximum propelled speeds at an optimum of minimum contact area on the surface of the water;
   - said forward hydro-ski member inner and outer planing surfaces comprising secondary and primary surfaces consisting of:
     - a first inner secondary surface (31) having a relatively high angle of incidence with said body of water affording accelerating lift to said structure;
     - a second inner secondary surface (30) in rearward spaced relation to said first surface having an angle of incidence in relation to said body of water and ski member to provide continued lift to said member to cause the same to emerge from the surface of the water;
     - an outer secondary surface (33) in lateral relationship thereto, having a relatively high angle of incidence with said body of water, affording continued lift to said member;
     - a primary outer planing surface (29) rearwardly thereof having a decreasing angle of incidence from its forward tip to its trailing edge such as to cause said ski member at maximum speed to plane on the minimum area of its trailing edge; and
     - a final inner secondary surface (35) in spaced relation to said primary surface, and laterally in relation thereto, having an angle of lateral incidence with respect to the water such as to cause the planing action of said ski member to be retarded in braking resistance when said boat structure is propelled into a turn.

2. In a boat structure of the character described, comprising a hull adapted to be supported on a body of water by hydro-skis in maximum planing attitude, the improvement comprising, in combination, forward hydro-ski members, having inner and outer planing surfaces, consisting of:
a first auxiliary inwardly disposed secondary surface (31), having a high angle of incidence with said body of water, affording accelerating lift to said ski member from zero speeds;
a second auxiliary inwardly disposed secondary surface (30) joined rearwardly to said first surface (31), having an angle of incidence in relation to said body of water to provide continued lift to said ski member to cause the same to emerge from the surface of the water;
a first outwardly disposed secondary surface (33), in lateral relationship to said first auxiliary secondary surface (31), having the forward point of its leading edge aligned with said first auxiliary surface, with a relatively high angle of incidence with said body of water, and tapering rearwardly downwardly as to said ski member, with its forward trailing edge terminating above said second auxiliary surface (30) and its rearward trailing edge terminating below said second auxiliary surface (30);
an outwardly disposed primary surface (29) joining the trailing edge of said first outwardly disposed secondary surface (33), having a relatively high angle of incidence at its forward edge and decreasing in incidence rearwardly to substantially zero at its trailing edge, with an inward cut-out at approximately 50% of its span; and
a final inwardly disposed secondary surface (35), joining laterally through a vertical surface (36) with the cut-out of said outwardly disposed primary surface (29), having its forward edge in alignment with said primary surface (29) but its plane rearwardly out of symmetry with said primary surface (29), elevated therefrom at its joiner through said vertical surface (36) thereto, and downwardly inclined inwardly toward said hull;
said planar surfaces being so disposed that, on a turning motion of said structure, the inwardly disposed secondary surface (35) of the ski in the direction of said turn is caused to dip beneath the surface of the water to decrease the velocity of said member and cause the opposite ski member to accelerate on its secondary and primary surfaces to achieve a pivotal effect about such ski member on which said turn is being made; and
a rearward hydro-ski member having planing surfaces consisting of:
a primary planing surface (37) having a relatively high angle of incidence at its forward tip decreasing to zero at its trailing edge to provide optimum minimum contact area at maximum planing attitudes;
secondary planing surfaces (38) (39) laterally disposed on the side of said primary surface (37) in either direction of outward turning movement, said secondary planing surface (38) (39) having a relatively high lateral angle of incidence in relation to said water and area of primary surface (37) to offer braking resistance in lateral movement of said ski member on a turn and prevent swinging of said hull.

* * * * *