June 17, 1969 C. D. VAN PATTEN 3,450,085

HYDROPLANE BOAT HULL

Filed May 10, 1967

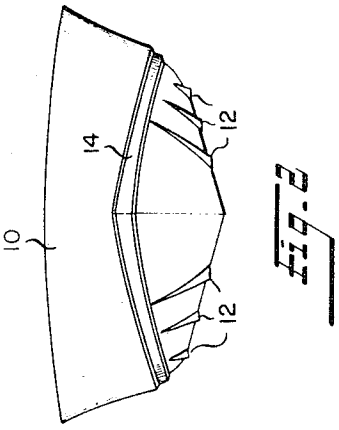


Fig. 2

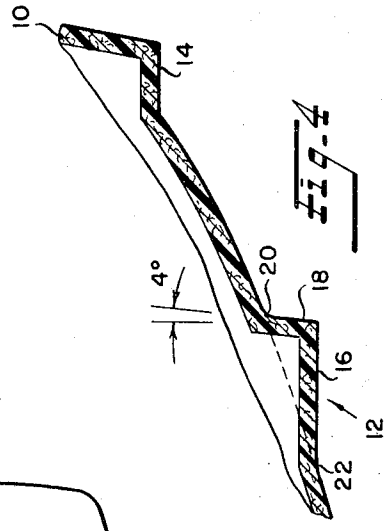


Fig. 4

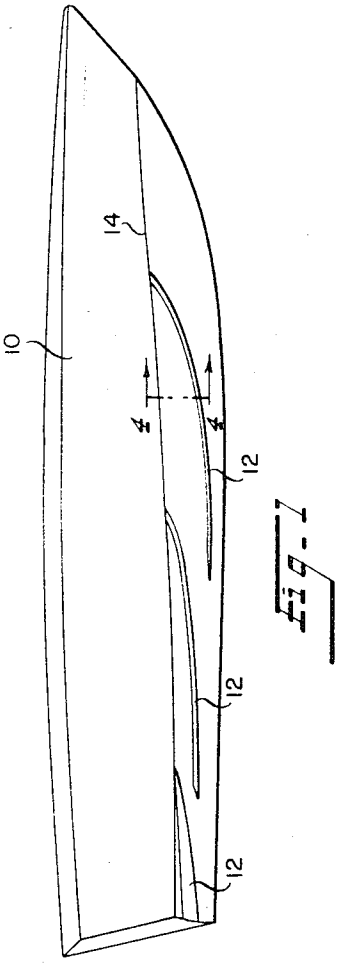


Fig. 1

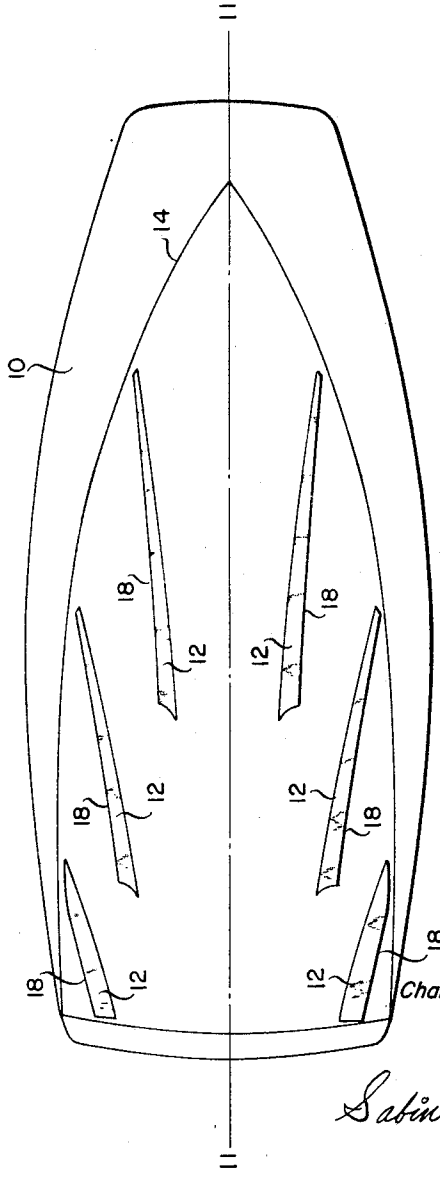


Fig. 3

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HYDROPLANE BOAT HULL

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10 Claims

ABSTRACT OF THE DISCLOSURE

A polyparaboloid hull form having applied to or integrally formed with the hull bottom, edge effect devices or separators symmetrically disposed on opposite sides of the keel at angles to the plane of symmetry, converging aftward. Said devices are triangular in cross section with one side normal to the plane of symmetry of the hull, so as to cause flow separation of the water from the hull.

BACKGROUND OF INVENTION

Field of the invention

The invention pertains to hydroplane boat hulls, whether for pleasure, commercial, or military use.

Description of the prior art

Certain previously patented inventions embody some of the elements of applicant's invention. For example, the relatively sharp outboard edges and aftwardly converging relationship of the separators on the hull bottom are shown by Eddy Patent No. 1,935,622, Eddy and Van Patten Patents Nos. 2,039,585 and 2,039,586, and by Van Patten, applicant herein, Patent No. 2,423,860, but in no prior patent known to applicant is the transversely horizontal side of the substantially triangular-in-section separators shown wherein the separators are splayed in complementary relationship to the hull's plane of symmetry and converging toward the after end of the hull, with the outboard edges of such separators as sharp as practical to provide a flow separator.

SUMMARY OF THE INVENTION

The present invention uses the triangular-section element on the hull bottom primarily as a flow separator and only secondarily as a pressure distribution adjuster. Furthermore, in the present invention the pressure distribution is adjusted principally for controlling the longitudinal, rather than the transverse, trim of the hull at planing speeds. This form of boat possesses inherent transverse dynamic stability which is a result of the flow separation function of the triangular-section elements. The separators are preferably used on a hard-chine hull having convex transverse sections, polyparaboloidal and oriented outboard and complementary about a longitudinal and vertical plane of symmetry, although it will be understood that these separator devices could be adapted for application to or embodiment in other forms of hulls such as those having round bilges, concave transverse sections, etc.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing forming part of this application and wherein like reference characters indicate like parts:

FIG. 1 is a side elevation of a boat hull embodying the invention;

FIG. 2 is a front elevation of FIG. 1;

FIG. 3 is a bottom plan view of the hull shown in FIG. 1; and

FIG. 4 is a section on the line 4—4 of FIG. 1, slightly enlarged.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention comprises the application to or integral formation with a polyparaboloid hull form of "edge effect devices" which are triangular in cross section, and applied to the boat bottom, an equal number on opposite sides of the plane of symmetry, each at an angle thereto. This angle is important as any variation in the angularity of each device with respect to the plane of symmetry makes a difference in effect. Theoretically, the best results would be had by arranging the angles of the "edge effect devices" so that the riser edges come as close as possible to a right angle with the line of water at any point without interfering with atmospheric access to the downstream side of said devices, especially at low and medium speeds, with a consequent reduction of flow separation and a "fatter" drag curve.

From a practical standpoint, the angles that the "edge effect devices" make with the plane of symmetry, or with the lines of water flow, are a compromise such as will initiate flow separation relatively low in the speed range and at the same time produce relatively massive flow separation in the upper part of the speed range.

Viewed in plan, the angle of the separator edge with the hull's plane of symmetry may range from a minimum of 1° to a maximum of 69°. This angle preferably increases with each aftwardly succeeding complementary pair of separators. This successive increase may be of a constant rate or of an increasing or decreasing rate.

Viewed in plan, the separator riser edges may be straight or curved lines. If they are curved, the splay angle mentioned above would be that measured between the plane of symmetry and a chord intersecting the ends of the separator riser or that measured between the plane of symmetry and corresponding tangents to the riser edge.

The basic hull form required for the logical application of the "edge effect devices" of my invention is a very special one. Theoretically, this hull form may be referred to as a "polyparaboloid" shape, and is somewhat like a conventional high dead-rise "deep V" hull. My new hull form differs from the deep V form in having a distinctly sharper garboard region, and in the elimination of the straight sectioned, substantially "flat" chine area of the bottom in favor of a definitely convex parabolic configuration. These differences are markedly noticeable in riding comfort and sea-keeping abilities. The deep V shape tends to pound severely in quartering seas, on or off the wind, whereas the polyparaboloid form is relatively soft riding on any heading with respect to sea and wind.

Both the polyparaboloid and the deep V forms are drier running, i.e., take less spray aboard, are softer riding, and are more seaworthy than the current "cathedral" form of rectangular boat. The cathedral hull takes annoying spray aboard because of its excessive length of submerged chine. The spray comes off the chines far forward and at relatively low velocity. Appreciable wind on the beam tends to fling this spray aboard, annoying the passengers. In contrast, the polyparaboloid hull, as well as the deep V hull is comparatively dry-running because the spray leaves the chines farther aft, at relatively high velocity, and at a low angle. By the time the wind can pick up this spray, the boat is "long gone," and the spray falls harmlessly in its wake.

In the drawings, the novel form of hull is shown at **10** and as before stated this hull can be defined as a hard chine hull having convex transverse sections, paraboloidal and oriented outboard, and complementary about a longitudinal and vertical plane of symmetry indicated by the line **11—11**, FIG. 3. To the bottom of this basic hull form are subimposed a complementary pair, or pairs, of substantially triangular-section separators or steps **12**,

which extend from substantially the chine **14** of the hull, progressively increasing in width, and converge aftward as clearly shown in FIG. 3. The separators are preferably molded integrally with the hull, although they could be provided separately and applied to a hull with a good strong tension type of marine glue. As shown in FIG. 4, the bottom surfaces **16** of these separators are substantially horizontal transversely throughout their length, except for a short portion of their forward ends where it is necessary or convenient to fair them into the basic hull surface or the chines **14**. The riser surfaces **18** of these separators **12** face outwardly and aft and are substantially vertical with said bottom surfaces, and the intersection of said bottom and riser surfaces is as sharp as may be structurally practical.

While the foregoing hull form is preferred for the application of my improved separator devices, they may be applied with beneficial effect to hulls of other basic form, such as those having round bilges, concave, convex or sigmoidal transverse sections, and the like.

Also they may be applied with advantage to hydroplane hulls of the form having substantially transverse steps which divide them into a forebody and an afterbody, and in some cases one or more middle-bodies.

The substantially transversely horizontal surface of these separators **16** have a varying transverse dimension if the riser height is maintained constant with a varying hull deadrise. They will also have a varying riser height if the transverse dimension is held constant with the said varying hull deadrise.

A geometric definition of a practical range of this riser height for hydroplane hulls may be expressed as follows:

$$H=\frac{K\Delta}{B\sqrt{V}} \text{ (non-dimensional)}$$

where:

H=Riser height
Δ=Gross displacement (weight) of vessel
B=Maximum breadth between chines
V=Speed of advance
K=Riser height coefficient

And, where:

H=Inches
Δ=Pounds
B=Inches
V=Knots

Then: The value of K, for practical hulls of this form, lies between 0.0660 and 0.8050, with the requirement in the case of relatively sharp (small radius) separator edges being toward the smaller value, and the requirement in the case of large-radius separator edges being toward the greater value.

However, the functioning of such a separator device requires atmospheric access to the region immediately downstream of the raiser surface, and this is sensitive to the riser height. Thus it is considered most practical to employ an adequate minimum riser height for each separator and to maintain this constant, except for the short faired portion at the forward end, as set forth above. As a geometric and structural practicality, a fillet of minimum radius is used as at **20** at the intersection of the riser surface **18** with the basic hull surface. For hydrodynamic and structural reasons, a fillet of relatively large radius is used as at **22** at the intersection of the separator bottom surface **16** with the basic hull surface.

It will be noted that the most forward pair of separator devices **18—18** are the longest, they are the narrowest at their forward end, progressively widen in plan view toward their after end, and are located approximately midship of the overall boat length. In relation to the plane of symmetry **11—11** they converge aft theretoward at the least angle, and are the closest to said plane.

The most rearward pair of the separator devices are the shortest, they are the farthest from said plane **11—11**, converge theretoward at a greater angle, terminate adjacent the transom of the boat, and are the widest at their aft end.

The intermediatae pair of the separator devices is in length between the lengths of the other two pairs, they converge toward the plane of symmetry at an intermediate angle.

In other words, in the hull illustrated the pairs of separator devices are located on opposite sides of the plane of symmetry progressively greater distances, fore to aft, they converge toward said plane at progressively greater angles and the after ends of the forward pair of separators, overlap the forward ends of the intermediate pair of separators. Likewise, the after end of the intermediate pair overlap the forward end of the most rearward pair of separator devices. In other hulls utilizing the invention this overlap of adjacent pairs of separators may not be necessary.

A common characteristic of all separators is that they all start with the narrowest end near the chine **14**, they progressively widen aftward and they overlap each other. Only the aft pair of separators terminates adjacent the transom of the boat in the design illustrated, but they may not be the case in other designs at other specific loadings.

The function of the design and arrangement of these separators **12** is to cause flow separation at planing speed, the resulting cavity being filled principally by atmosphere. Flow separation of a fluid from a surface is promoted by any relatively abrupt or sharp interruption of the longitudinal continuity of the surface because of Newton's first law of motion. The water flowing across the separator bottom surface tends thus, on reaching the riser edge, to continue on a straight line, separating itself from the skin of the boat. The cavity occurring downstream between the riser and adjacent boat bottom fills principally with atmosphere. This flow separation reduces the area of wetted surfaces, but more importantly it reduces the load induction effect consequent upon flow along a relatively smooth and longitudinally convex surface. Reduction of the load induction effect is equivalent to reducing the gross displacement materially, the performance is improved rather dramatically both in speed and in the ability to carry exceptionally heavy payloads at speed.

This configuration gives the architect control in the arrangement of the hydrodynamic pressure distribution or pattern under the boat's bottom. The exigencies of center of gravity location are thus much less stringent, permitting a wider latitude in payload placement and allowing much larger engines to be placed in the extreme stern without destroying the boat's inherent balance and stability.

Another important result of this configuration is the ability to operate efficiently at a much lower trim than any comparable boat. This is due to lower wetted area and reduced load induction effected by the separator devices. Aside from the aesthetic value of a nearly level high speed trim, the advantage of the lower trim lies in much softer riding in choppy water, since, at this trim angle, the hull presents a much "easier" shape to the waves being traversed, and the aft seat passengers have a much better view ahead than is the case with most other types.

From the foregoing description, taken in connection with the accompanying drawing, it is believed the teaching thereof will be sufficient to enable one versed in the art to adapt the invention to hulls of differing form than that here illustrated, and to otherwise utilize the basic concept of the invention.

I claim:

1. A hydroplane boat hull having a transom stern, a stem, sides having lower edge portions defining a chine extending generally horizontally from stem to stern, and

a bottom, pairs of triangularly shaped flow separator devices on said bottom on opposite sides of the longitudinal plane of symmetry of said hull, said devices extending from adjacent said chine aft, splayed in complementary relationship to said plane of symmetry and converging aft, said pairs of devices progressively increasing in width aft in plan view.

2. The hull structure set forth in claim 1 wherein said pairs of devices progressively diminish in length aft.

3. The hull structure set forth in claim 1 wherein the most aft pair of devices is substantially greater in width in plan view than any other pair.

4. The hull structure set forth in claim 1 wherein said pairs of devices are spaced at progressively greater distances aft from said plane of symmetry.

5. The hull structure set forth in claim 1 wherein said devices are disposed with one side substantially horizontal or normal to said longitudinal plane of symmetry.

6. The hull structure set forth in claim 1 wherein the outboard riser edges of said devices are relatively sharp and aftwardly converting.

7. The hull structure set forth in claim 1 wherein said bottom is of convex parabolic configuration.

8. The hull structure set forth in claim 7 wherein said bottom has a sharp garboard region.

9. The hull structure set forth in claim 1, wherein the outboard riser edges of said devices at any transverse section are substantially parallel to said longitudinal plane of symmetry.

10. The hull structure set forth in claim 1, wherein the

height of the riser edges of said devices falls within the following formula:

$H=K\Delta/B\sqrt{V}$ (non-dimensional)

where:

H=Riser height
Δ=Gross displacement (weight) of vessel
B=Maximum breadth between chines
V=Speed of advance
K=Riser height coefficient

And, where:

H=Inches
Δ=Pounds
B=Inches
V=Knots

Then: The value of K, for practical hulls of this form, lies between 0.0660 and 0.8050, with the requirement in the case of relatively sharp (small radius) separator edges being toward the smaller value, and the requirement in the case of large-radius separator edges being toward the greater value.

References Cited

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