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2,995,104 8/1961 Mills..... 114/56
 3,148,652 9/1964 Canazzi 114/56 X
 3,259,092 7/1966 Kara, Jr. 114/56 X

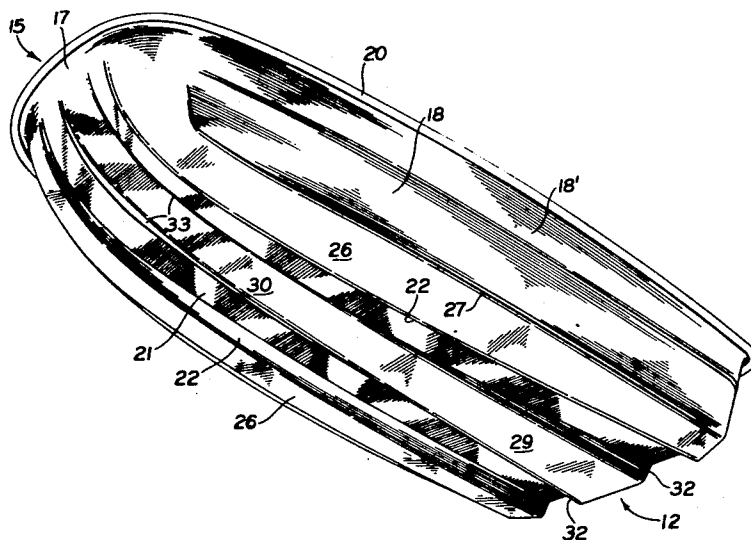
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[54] **PLANING BOAT HULL**
14 Claims, 12 Drawing Figs.

[52] U.S. CL..... **9/6,**
114/66.5
 [51] Int. CL..... **B63b 3/00**
 [50] Field of Search..... **9/6, 6.5, 7;**
114/56, 63, 66.5 R, 66.5 P; 115/39

[56] **References Cited**
UNITED STATES PATENTS
 2,989,939 6/1961 Tatter..... 114/56

ABSTRACT: A planing type boat hull for maintaining a substantially constant trim angle throughout a slow to moderate speed range, said hull having a flat-bottomed central longitudinal tunnel with its sidewalls tapering outwardly from bow to stern to gradually increase the tunnel width, and a central lifting surface extending longitudinally throughout said tunnel, said lifting surface being inclined to the tunnel bottom to form a channel extending forwardly of the medial portion thereof and forming an inclined plane projecting downwardly from the tunnel bottom and extending rearwardly of the medial portion.



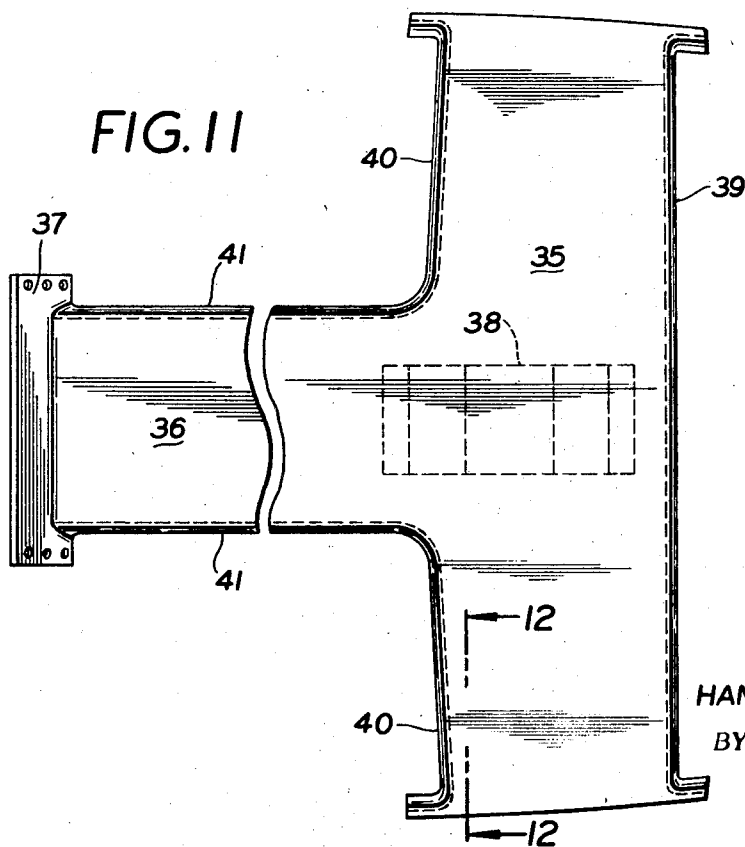
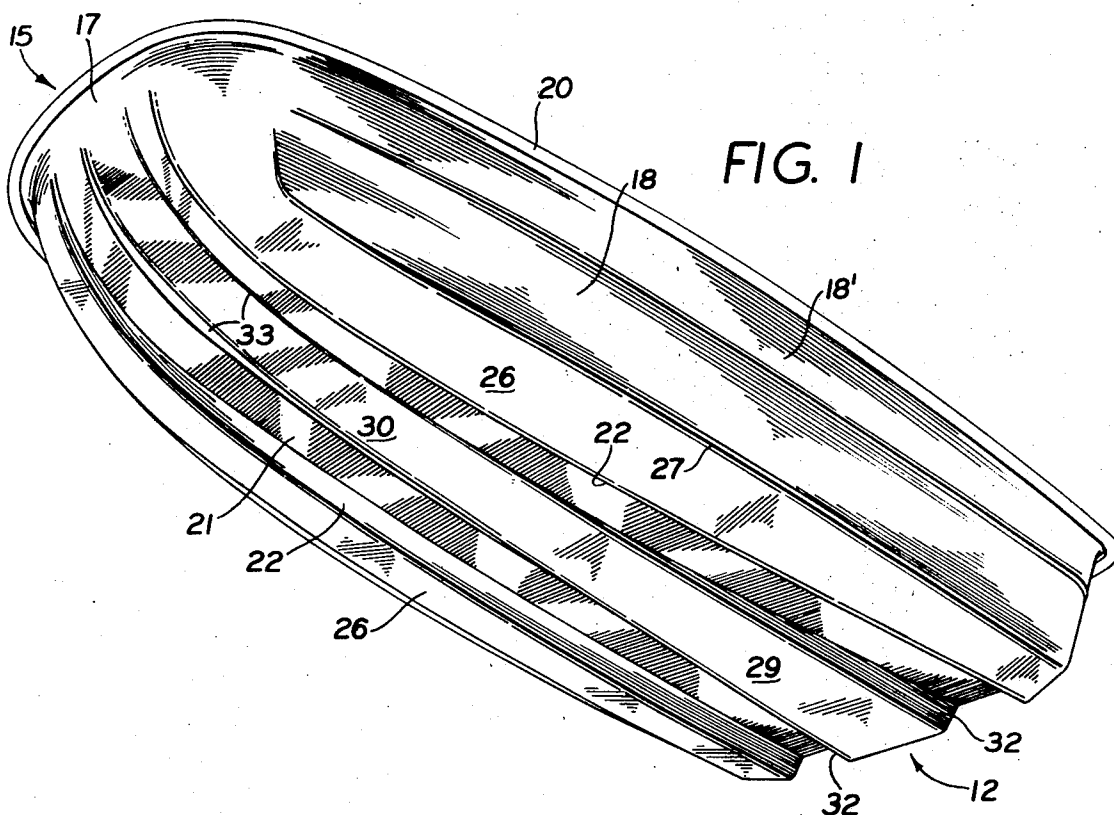
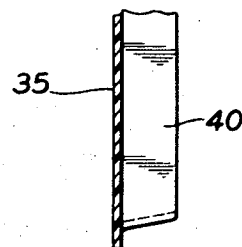


FIG. 12



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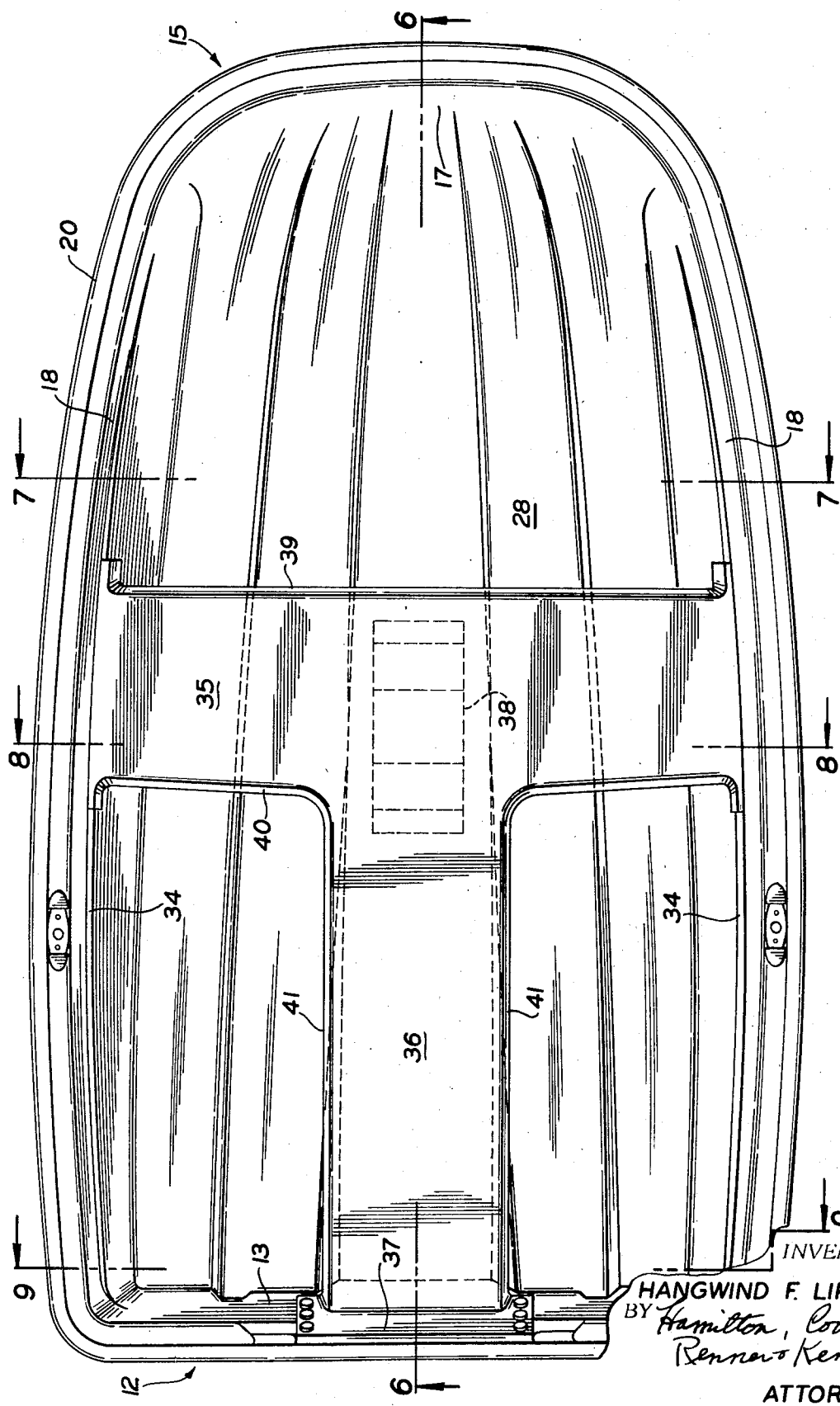


FIG. 2

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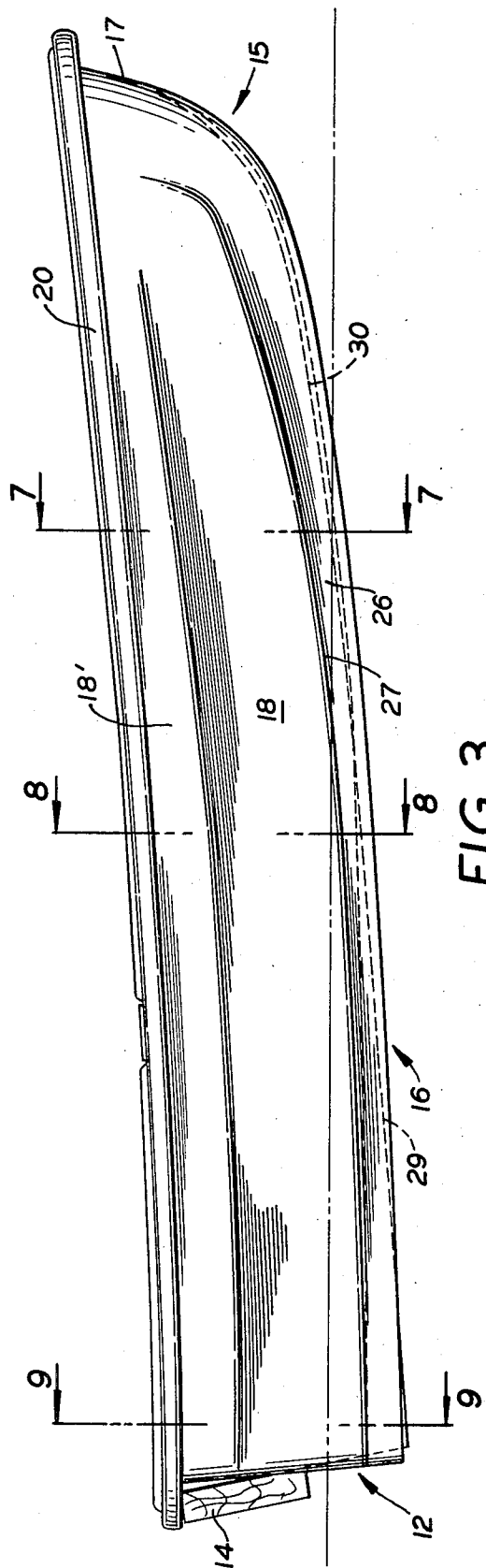


FIG. 3

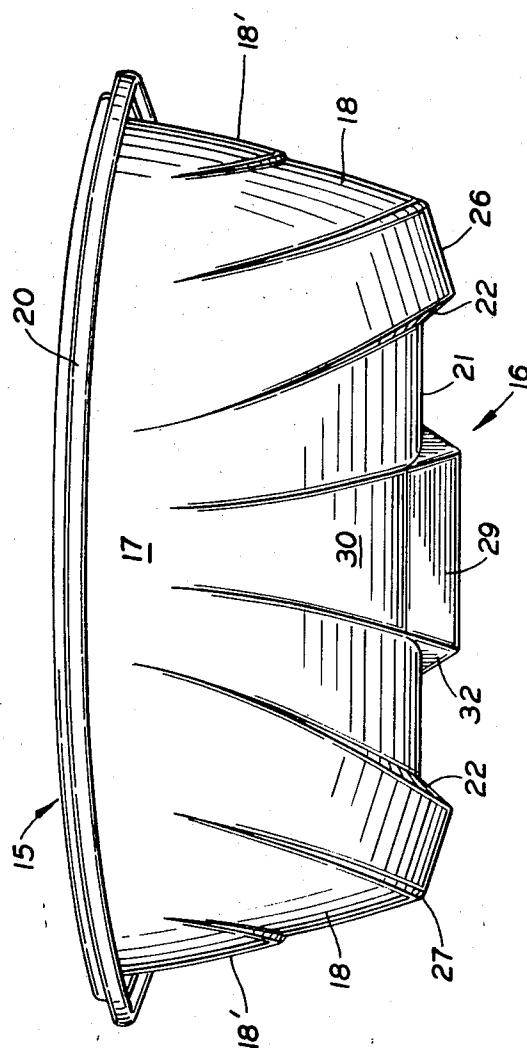


FIG. 4

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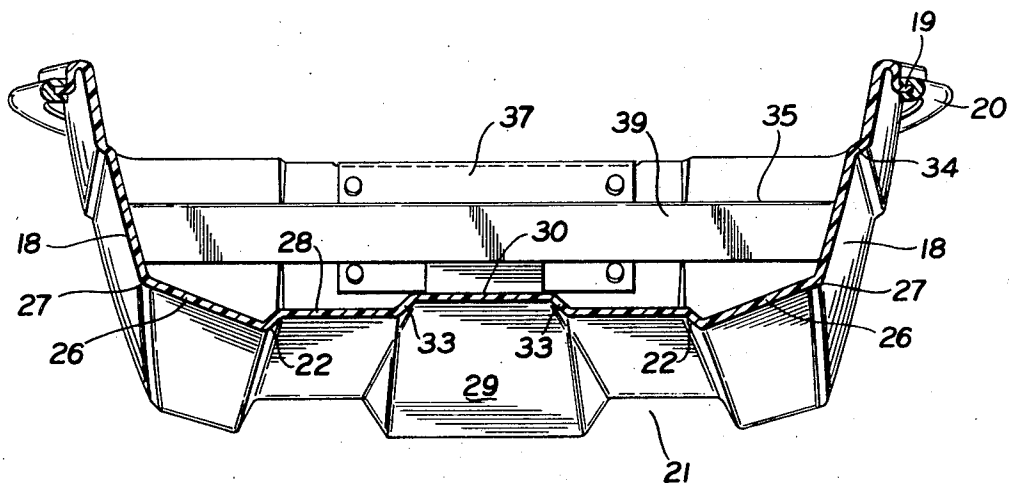


FIG. 7

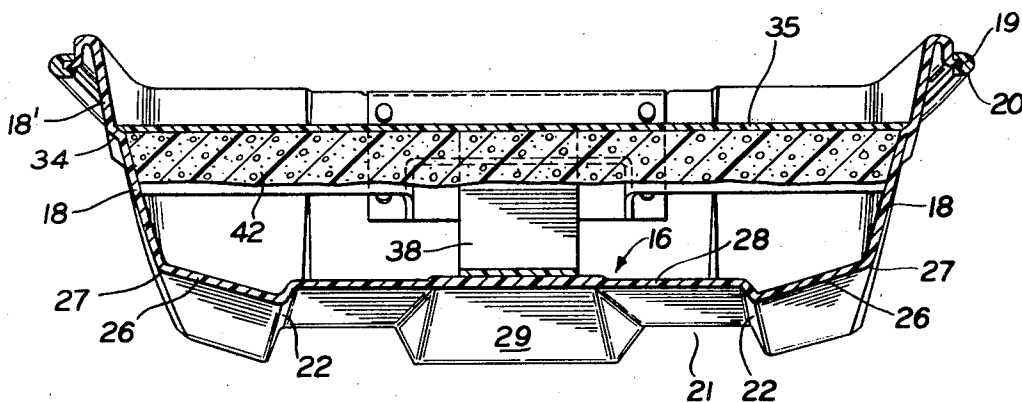


FIG. 8

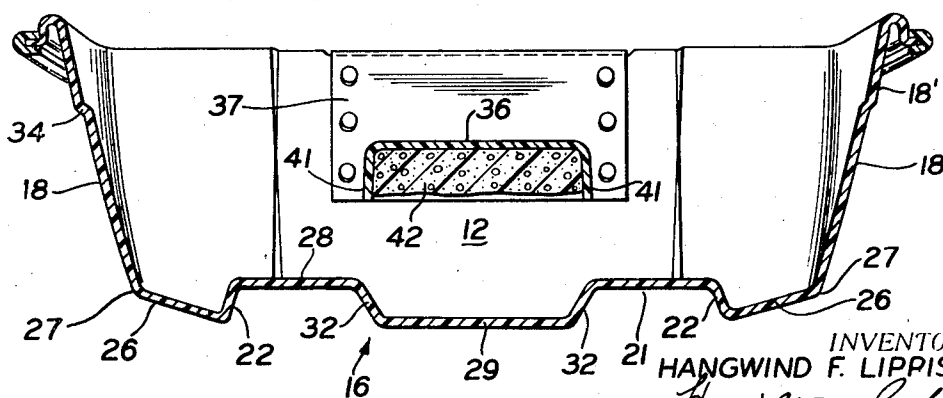


FIG. 9

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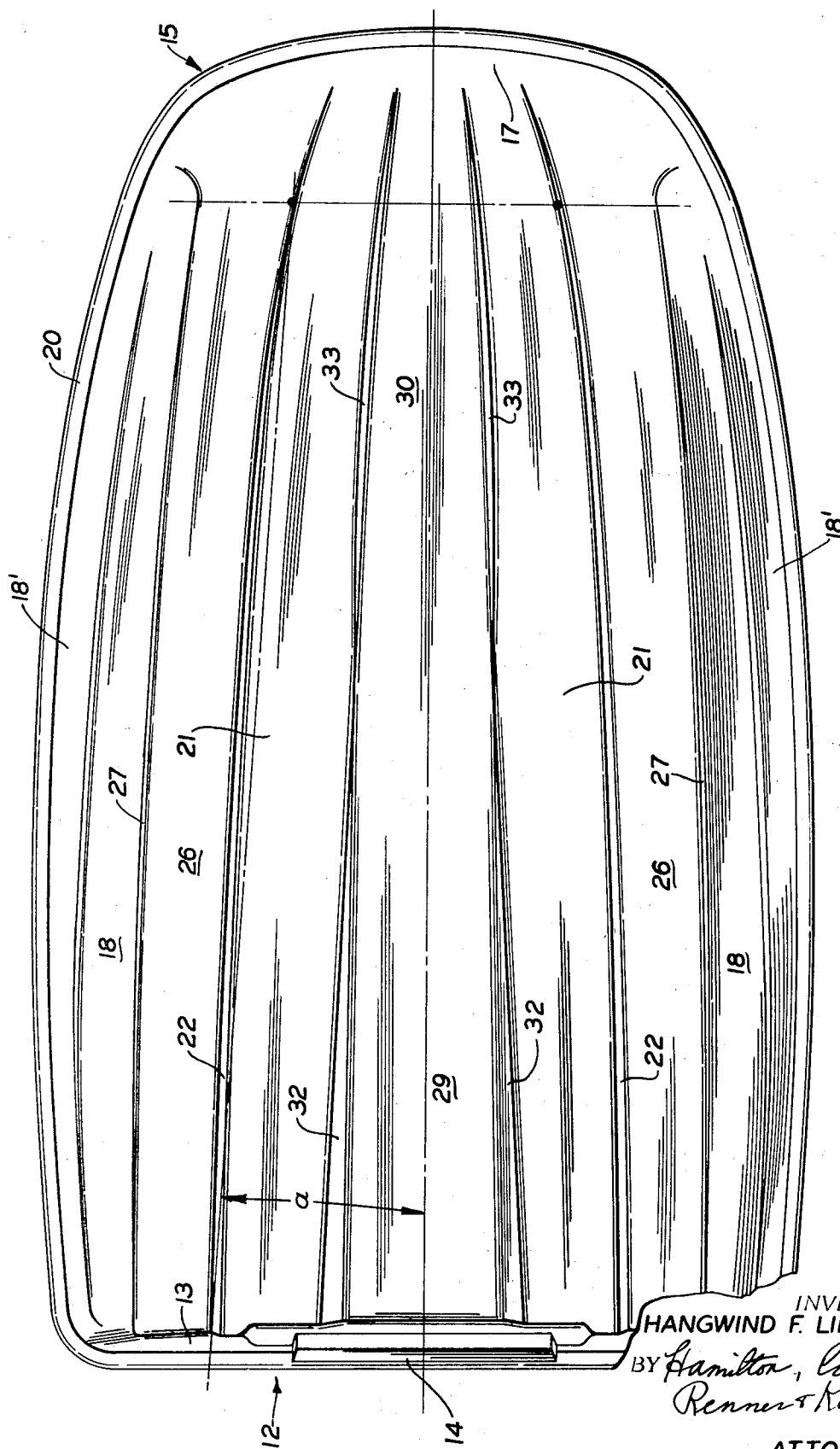


FIG. 10

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PLANING BOAT HULL

BACKGROUND OF THE INVENTION

Flat-bottomed hulls, as distinguished from Vee-bottomed hulls, are well known to have minimum draft due to large displacement, and good planing characteristics because there is maximum reduction in the amount of wetted surface with a consequent reduction of drag as the speed increases. However, such hulls lack stability and will slide or skid dangerously on turns until the chine on the wetted side of the hull catches, at which time the chine tends to act as a fulcrum and hurl the top side of the boat and occupants outward. Moreover, such a hull produces a rough ride since most of its support is from the water and only a small amount of air is trapped under the hull as a cushion.

As this type of hull is propelled forwardly, the flow of water along the bottom surface is directed downwardly, generating lift, and the greatest lifting effect is at the forward area of the wetted surface, as the deflecting force is decreased in the more deeply submerged areas toward the stern. This causes the stern to "squat" and produces an excess trim angle and a resultant unfavorable drag-lift ratio. The greatest negative lifting force occurs in the central aft portion of the hull.

It has been proposed to provide a rearwardly downwardly inclined hull surface at the central aft portion of a planing hull to increase the lift at that area to overcome the foregoing disadvantages and provide an improved drag-lift ratio. However, this design works only over a very narrow speed range as any material increase in speed develops excessive lift in the aft region and depresses the bow to prevent planing. Moreover, the hull still has the defects of poor stability and skidding on the turns.

Certain prior constructions have disclosed hulls with longitudinal tunnels in their bottom surfaces. For example, U. S. Pat. No. 2,367,323 shows a hull having a longitudinal tunnel with straight vertical sides and a concave bottom surface which merges into a flat surface at the stern where the sides of the tunnel terminate. The purpose of this patent is to provide a racing boat in which at high speed the air in front of the bow is forced into the tunnel and provides a substantial air lift while the hull is substantially supported on the two parallel runner or stabilizing surfaces formed along the sides of the tunnel and the central flat surface at the stern. At moderate to low speeds this hull would not be effective as a planing hull.

SUMMARY OF THE INVENTION

It is a general object of the present invention to provide an improved planing hull construction which will give optimum performance at lower speed ranges of the order of 15 to 30 knots per hour.

Another object is to provide an improved planing hull construction which will maintain a desired trim angle and drag-lift ratio over a substantial range of moderate speeds.

A further object is to provide an improved tunnel hull construction which has increased pitch stability relative to changing center of gravity, due to swept or tapered tunnel sidewalls.

Another object is to provide an improved tunnel hull having an inclined central lifting skeg acting to balance the fore and aft lift effect during the entire displacement to planing speed range.

A still further object is to provide an improved planing tunnel hull of increased stability in making sharp turns at planing speeds.

I have discovered that the foregoing objects can be accomplished and the defects of prior constructions overcome by providing a hull having a central longitudinal tunnel with swept or tapered sides and with a central inclined flat-bottomed lifting skeg forming a groove in the fore part and a projection in the aft part of the tunnel, the ratio between the tunnel and skeg bottom surfaces being predetermined, whereby the stern lifting forces generated are inversely proportioned to the change in forward speed.

I am aware of the Canazzi U. S. Pat. No. 3,148,652 showing a tunnel hull with a central longitudinal "wedge-shaped, combined displaced water dividing and planing member 24" (col. 2, line 28). This construction does not and can not accomplish the purposes of the present invention.

The Canazzi central dividing and planing member 24 is designed and adapted primarily as a stabilizing and turn-improving component as well as a means for diverting water away from the propeller (col. 2, line 50, to col. 3, line 2). Canazzi cautions against changing his dimensions (col. 3, lines 51-61), and the ratio of the surface area of the member 24 to the surface area of his tunnel is insufficient to provide increased lifting forces at the stern, as in the present invention, particularly since the member 24 extends well into the fore section, whereas in my design the rear lifting skeg merges into a recess in the fore section. Moreover, Canazzi requires a narrowing tunnel entry merging into straight sides as distinguished from my gradually widening tunnel having tapered pitch-stabilizing sides.

Canazzi suggests no conception of using an inclined flat-bottomed lifting surface in the aft portion of a tunnel hull of proportionate size to counteract the suction forces developing on the other rear planing surfaces, thereby balancing the fore and aft lift forces to maintain a desired trim angle with optimum drag-lift ratio.

Referring to the drawings:

FIG. 1 is a bottom perspective view of a preferred embodiment of a boat having the improved planing boat hull of the present invention.

FIG. 2 is a top plan view thereof, partly broken away.

FIG. 3 is a side elevation thereof, showing the trim angle of the boat at planing speed in relation to the water line.

FIG. 4 is a front elevation thereof.

FIG. 5 is a rear elevation thereof.

FIG. 6 is a longitudinal section on line 6-6 of FIG. 2.

FIG. 7 is a cross section on line 7-7 of FIG. 2.

FIG. 8 is a cross section on line 8-8 of FIG. 2.

FIG. 9 is a cross section on line 9-9 of FIG. 2.

FIG. 10 is a bottom plan view of the improved boat hull.

FIG. 11 is a detached plan view of the seat and supporting bracket.

FIG. 12 is a partial sectional view on line 12-12 of FIG. 11.

DESCRIPTION OF A PREFERRED EMBODIMENT

The improved boat hull is preferably a hollow shell formed preferably by molding from reinforced plastic material such as fiberglass. The hull may be formed from a variety of plastic materials which may be suitably reinforced, as by embodying fibers before or during molding or by spraying on fibers after molding.

The particular design shown and described herein is especially adapted for small boats about 7 feet to 14 feet in length, although the same principles can be applied to somewhat longer boats by making changes in the relative angles and dimensions of the component parts of the hull. The overall dimensions of the hull shown herein are 7 feet 4 inches long by 4 feet 4 inches wide for storage inside a standard station wagon to transport the boat from place to place.

The improved hull has a substantially straight, squared-off stern 12 with a near vertical transom wall 13 having a reinforcing motor mounting board 14 secured thereto. The bow 15 curves upwardly from the generally flat bottom 16 and terminates in a substantially straight, transverse upper portion 17 preferably having a slight convex curve. The sides 18 extend upwardly at steep angles and are generally straight although slightly convex longitudinally and merge into the bow and stern walls through curvilinear surfaces. The upward inclination of the sides has been determined as best for all speeds. This includes low speed for rowing, intermediate speed for sailing, and higher speeds up to about 30 knots for planing with outboard motor propulsion. The upper edges of all the walls are reversely curved downwardly terminating in out-

turned peripheral flanges 19 on which a U-shaped rubbing strip 20 is fitted. The flanges 19 along the sides or gunwales serve to deflect downwardly any spray encountered in agitated waters.

The generally flat bottom 16 is preferably slightly convexly curved longitudinally from stern to bow, as best seen in FIGS. 1 and 3, and has a central longitudinal tunnel 21 extending from stern to bow and becoming gradually shallower as it curves upwardly to die out and terminate in the transverse upper bow portion 17. The side walls 22 defining the tunnel are angled inwardly upward at angles becoming progressively shallower from stern to bow, being of the order of $75^\circ \pm 10^\circ$ at the stern and $65^\circ \pm 10^\circ$ adjacent the upwardly curved portion of the bow. The depth of the tunnel may vary from about 3 inches at the stern to about $1\frac{1}{2}$ inches adjacent the upwardly curved portion of the bow.

The tunnel side walls 22 taper laterally outwardly from bow to stern so that the tunnel 21 becomes gradually wider. Although the sidewalls are slightly inwardly convex with respect to each other, the angle α between the longitudinal centerline of the tunnel and the chord 24 of each sidewall is of the order of $2^\circ - 6^\circ$ (see FIG. 10).

The side walls 22 are connected by longitudinally extending, laterally upwardly inclined sponson walls 26 to the sidewalls 18 to form the chines 27. The lateral angle of the walls 26 with the horizontal is greatest at the stern and becomes progressively shallower toward the bow, preferably varying from about 24° to 13° . The bottom wall 28 of the tunnel extending laterally inward from the side walls 22 is preferably flat, and at the longitudinally medial portion of the hull the bottom wall extends laterally horizontally from one wall 22 to the other (see FIG. 8).

An inclined lifting surface extends longitudinally centrally in the tunnel 21 and is so disposed that from the medial portion of the hull rearwardly it is a rearwardly downwardly inclined projection or skeg 29 and from the medial portion forwardly it is a forwardly upwardly inclined channel 30 which curves upwardly in the bow to die out and terminate in the upper bow portion 17 generally opposite the terminations of side walls 22 of the tunnel 21. The inclination of the longitudinal chord of the lifting surface 29, 30 with respect to the longitudinal chord of the hull bottom 28 is preferably of the order of $2^\circ - 5^\circ$ (FIG. 6). The side walls 32 of the projecting skeg 29 slope upwardly outward at angles of about $63^\circ \pm 10^\circ$ to the horizontal (FIG. 9), and the side walls 33 of the channel 30 slope upwardly inward at about the same angles (FIG. 7).

The inclination of the entire lifting surface with respect to the flat tunnel surface 28 is the same throughout the projecting skeg 29 and the recessed channel 30, and the ratio of the flat tunnel surface area to the lifting surface area is from 30/70 to 50/50 (43 percent - 100 percent) to give effective pitch stabilization. The width of the lifting surface gradually increases from bow to stern and the taper of each of the surfaces relative to the longitudinal centerline is preferably of the order of $1^\circ - 3^\circ$, although the taper may be reduced to approaching 0° and still give satisfactory results.

The double stepped entry surfaces formed in the bow by the tunnel 21 and the inclined channel 30 provide for effective breakup of small waves encountered in low speed operation, as distinguished from a flat single surface in the bow which would tend to deflect a major portion of the water upwards into the boat. This is because the stepped surfaces produce offset timed smaller deflection spray areas which are further nullified by the front peripheral flange 19 and rubbing strip 20.

As indicated, the sidewalls 18 may have outwardly offset upper portions 18' which provide inner shoulders 34 on which to support a seat construction 35 extending across the central portion of the hull. As indicated in FIGS. 2 and 11, the seat is T-shaped, having a longitudinal portion 36 extending rearwardly to an upwardly angled rear end 37 riveted or otherwise secured to the transom 13 of the hull. The seat preferably is supported on the bottom wall of the hull by a U-shaped

bracket 38 and the hull bottom 30 may be thickened for reinforcement in the area supporting the bracket. The seat and bracket may be of suitable molded plastic material and the seat portions 35 and 36 preferably have a nonslip texture on top and downturned marginal flanges 39, 40 and 41 confining a layer of plastic foam material 42 to give the boat sufficient buoyancy to stay afloat in upright position, when the hull is filled with water.

When the seat is bonded or welded to the hull it acts to reinforce and rigidize the bottom, sides and transom into an effective structural unit. The T-shaped design of the seat has the further advantages of fixing the exact seating location of a single person rowing the boat, as well as the location of a second person at the area of maximum displacement and least shift in center of gravity. Further, when the boat is operated with a motor, the seat provides the helmsman with a range of seating locations to properly balance the boat with his own weight against the location and weight of all accessories and thus obtain the most favorable drag-lift ratio.

By extensive testing of scale models, I have determined that the taper from $2^\circ - 6^\circ$ of each of the tunnel sidewalls 22 produces optimum pitch stability, i.e., a substantially constant trim angle of the hull without bobbing from displacement through the desired planing speeds of 15 - 30 knots, while the central lifting skeg 29 produces the optimum trim angle because the rear end lifting forces are inversely proportional to forward speed. Thus, the combined effect of the tapered tunnel walls and the lifting skeg is to produce and maintain the optimum trim angle.

The transverse inclinations of the longitudinal side walls 22, 32 and 33 of the tunnel and the lifting surface 29, 30 have also been carefully determined to give the hull maximum turning stability while enhancing the pitch stability at the optimum trim angle. These sloped sidewalls act in conjunction with the lateral slope or rise of the sponsons 26 to produce a transverse water flow during turning which tends to develop lift on the outer hull portions and negative lift on the inner hull portions. The tunnel sidewall of the inner sponson has a near vertical disposition in a banked turn, exerting a keel-like resistance to side slippage.

Accordingly, the improved hull has been found to be superior in turning stability and side slip resistance not only to conventional flat bottom hulls, but also to conventional Vee and deep Vee type hulls.

Referring to FIGS. 8 - 10, the configuration of the chines 27 is designed to deflect spray and achieve a smooth frictionless flow of water past the stern section throughout the desired speed range. The chines taper slightly from their longitudinal medial points to become substantially straight longitudinally at the stern. Thus, at low speed with the center of gravity substantially at the medial section, a smooth flow of water past the stern section is obtained, and as the speed is increased and the stern depressed, a water flow away from the hull sides at the stern is induced, decreasing the boundary layer friction along the hull side walls.

It will be apparent that the improved hull provides a relatively small boat which gives optimum performance at low rowing speeds, as well as moderate planing speeds of 15 to 30 knots per hour, in maintaining a desired trim angle and drag lift ratio, as well as in producing increased stability and side slip resistance in turning.

Since the values of the various angles and inclinations of the hull surfaces were determined by actual tests for a small boat for optimum planing performance at speeds of 15 - 30 knots, these values for larger boats and higher speeds would change somewhat in accordance with further tests.

I claim:

1. A planing boat hull for maintaining optimum trim angle throughout a slow to moderate speed range, said hull having a central longitudinal tunnel of gradually increasing width from bow to stern, and a central inclined lifting surface extending longitudinally of said tunnel, said lifting surface forming an inclined projection terminating flush with the bottom of said

tunnel at the longitudinally medial portion of the hull and inclining downwardly therefrom to the stern.

2. A planing boat hull as in claim 1, in which each sidewall of the tunnel tapers on an angle of about 2° – 6° with respect to the center line.

3. A planing boat hull as in claim 2, in which the lifting surface gradually increases in width toward the stern, and each sidewall of the inclined projection tapers on an angle of the order of 1° – 3° with respect to the center line.

4. A planing boat hull as in claim 3 in which each sidewall of the inclined projection is laterally inclined upwardly outward.

5. A planing boat hull as in claim 2, in which each tunnel sidewall is laterally inclined upwardly inward.

6. A planing boat hull as in claim 1, in which the lifting surface gradually increases in width toward the stern.

7. A planing boat hull as in claim 1, in which the central inclined lifting surface extends forwardly at the same inclination to the bow forming a channel recess in the bottom of the tunnel of gradually increasing depth.

8. A planing boat hull as in claim 7, in which the lifting surface gradually increases in width from bow to stern.

9. A planing boat hull as in claim 8, in which each sidewall

of the tunnel tapers on an angle of about 2° – 6° and each side wall of the lifting surface tapers on an angle of the order of 1° – 3° with respect to the centerline.

10. A planing boat hull as in claim 9, in which the area of the bottom surface of the tunnel is from about 43 percent to 100 percent times the area of the lifting surface.

11. A planing boat hull as in claim 10, in which each tunnel sidewall and each sidewall of the channel recess is laterally inclined upwardly inward and each sidewall of the inclined projection is laterally inclined upwardly outward.

12. A planing boat hull as in claim 7, in which the area of the bottom surface of the tunnel is from about 43 percent to 100 percent times the area of the lifting surface.

13. A planing boat hull as in claim 7, in which each tunnel sidewall and each sidewall of the channel recess is laterally inclined upwardly inward and each side wall of the inclined projection is laterally inclined upwardly outward.

14. A planing boat hull as in claim 9, in which each tunnel sidewall and each sidewall of the channel recess is laterally inclined upwardly inward and each side wall of the inclined projection is laterally inclined upwardly outward.

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