An air-cushioned planing hull for a boat having an air-vented transverse step extending across the width of the underside of the hull, with the port and starboard keels extending backward on each side of the hull from the transverse step to the transom, such that, when planing, the keel rides on three points provided by the two outermost of the steps and the rearmost point of the hull.

7 Claims, 11 Drawing Figures
AIR-CUSHIONED PLANNING HULL

This application is a continuation-in-part of my co-pending application, Ser. No. 270,615, filed July 11, 1972, on an Improved Air-Cushioned Planing Hull, now abandoned.

SUMMARY OF THE INVENTION

The invention provides a boat having a planing hull of the type known as a marine G.E.M. or "ground effect machine," the hull comprising an air-vented transverse step extending in a plane substantially at right angles to the longitudinal axis of the boat across substantially the width of the underside and intermediate the ends of the hull, the hull having a keel forward of the step and having a substantially inverted V-shaped cross section forward of the step, the depth of the cross section reducing in area in the direction of said step, port and starboard keels continuing from the step on either side of said hull, a stepped-down center keel extending aft of said transverse step to the transom of the boat and increasing in depth in the direction of its length, forming with said port and starboard side keels an air pressure retaining cavity extending beneath that portion of the hull between the step and the transom, and means to enable air to be forced through the transverse step and into said air pressure retaining cavity whereby the hull can plane on a portion of the port and starboard side keels and said stepped down center keel when the boat is in motion.

DESCRIPTION OF THE INVENTION

A boat embodying the invention will now be described with reference, by way of example, to a preferred embodiment for smooth water operations as illustrated in the accompanying drawings wherein:

FIG. 1 is a side view of a planing hull according to the invention;

FIG. 2 is a front end view of the same hull showing hull section lines A, B and C corresponding to those in FIG. 6;

FIG. 3 is a rear end view of the same hull;

FIG. 4 is a perspective view of the hull from below;

FIG. 5 is a plan view of the hull;

FIG. 6 is a view showing the hull section on lines A, B and C of FIG. 2;

FIG. 7 shows a transverse sectional view on line 7—7 of FIG. 1;

FIG. 8 shows a transverse sectional view on line 8—8 of FIG. 1;

FIG. 9 shows a transverse sectional view on line 9—9 of FIG. 1;

FIG. 10 shows a transverse sectional view on line 10—10 of FIG. 1;

FIG. 11 shows a front end view, similar to FIG. 2, of a modified arrangement.

Referring to the drawings, a tunnel hull 10 has port and starboard bilge V's 11 with a center section 12, chines 13, and a foredeck 14 with an airowl 15. Beneath the foredeck 14 are sheer strakes 16 on each side of the hull 10, and beneath the sheer strakes 16 is provided side straking 17. The center section 12 fairs into a straked forward bilge keel 18, a garboard strake being shown at 19 and a stepped-down after keel 20 extending to the rear of the boat. Outwardly inclined bottom straking 22 is provided at the bottom of the stepped-down after keel 20. A two-part transverse step 21 is provided with one part extending from each side of the center section 12. Each part of the transverse step 21 is triangular in section and is four times deeper at the port and starboard bilge V's 11 than it is at the center section 12 as shown in the transverse section illustrated in FIG. 8. Both parts are provided with air outlet vents 23. Air intake vents 26 are connected to the air outlet vents 23 provided in each part of the transverse step 21 by an air tunnel 27. The airowl 15 is supported by cowl struts 31.

Port and starboard side keels 24 extend one on each side of the boat from the transverse step to the transom 25 to maintain air pressure. The air pressure is formed by air entering intake vent 26 and passing out through the air vents 23, and by sufficient planing speed together with air which is forced through the opening 22 provided between the bilge V's 11 and the waterline 41 when the boat is in motion.

The restriction caused by the reduction in cross sectional area and the wedge so formed by the water surface 41 at the hull section shown in FIG. 7 to the trailing edge position shown in FIG. 8 at the transverse step 21 and the stepped-down keel 20 shown in FIG. 9 to the trailing edge position at the transom 25 shown in FIG. 10, reduces the incoming air velocity with a consequent increase in pressure on the underside of the hull section bilge V's 11 and the stepped-down after-keel section 20. This increase in pressure or "ground effect" produces lifting forces acting on the boat and, at maximum load, may reduce draft by as much as 85%.

It will be appreciated that any suitable location for the air intake vents 26 may be adopted. For example, it has been found advantageous to form the intake vents below the foredeck 14 of the boat in the upper part of the port and starboard bilge V's 11, one vent aperture 50 being provided on each side of the center section 12 as shown in FIG. 11 of the drawings. If this arrangement is adopted, then each aperture 50 is connected by a tunnel to an air outlet vent 23 in the part of the transverse step 21 which is on the same side of the hull as that aperture.

Inside the hull the usual fittings may be provided as required. For example, transverse ribs or frames and longitudinal (not shown) may be provided to give additional hull strength. A box keel (also not shown) may also be included.

In the present boat seventy per cent (70%) of the lift is by air. When in flight the combined wetted areas of the present craft (36, 37 and 20a) in the drawing (see FIG. 4) form only eight per cent (8%) of the water plane area. If the boat speed is increased so that port and starboard bilge V's 36 and 37 lift clear from the water surface as far as the transverse step, the ground effect of lifting forces in front of the transverse step will decrease rapidly. The rear lifting forces will increase as more air passes through the tunnel under the hull and because of these forces, combined with the fact that the center of gravity is approximately in the center of the boat (because the combined aerodynamic and hydrodynamic forces act approximately on the center of the boat), rearward flip will be minimized or eliminated and a constant trim angle will be assured.

At low speed, air passing through vents 23 provided on the transverse step serve to minimize any extra drag caused by the closed-in section of the hull behind the step. The front section of the hull forward of the transverse step has an inverted deep V-bottom, preferably
with 20° dead rise angle at the step. The back section of the hull aft of the step has an air pressure retaining cavity extending between that portion of the hull between the step and the transom. A center section is provided forward of the step to give sufficient longitudinal and lateral strength. The center section may be shaped so as to roll water under the hull to give the boat its initial lift before the air lift takes over. The center section does not function as a sub-hull and has no effect on the performance of the boat because, when the boat attains sufficient speed, the center section is raised out of the water.

When driven forward the hull of the present invention is lifted and supported by the upward force exerted by the air on the inclined surface of the front inverted V-hull and the stepped-down rear tunnel section, and this double or two-fold ground effect or aerodynamic lift acting under the hull, is the main lifting force to lift the boat.

In operation, an outboard motor unit 42 may be provided which drives a propeller 43 initially to move the boat forward. Water resting in the air tunnel 27 up to the load water line 41a as shown in FIG. 8 when the boat is at rest, is drawn out as air is forced in through the air inlets 26 and through the air tunnels 27 during forward motion of the boat. If the air pressure under the hull exceeds the pressure in the air tunnels 27, then air will flow in a reverse direction through the tunnels 27. If desired, a reverse flow may also be obtained mechanically by obstructing the airflow into the intake vents 26.

When in flight, the hull planes on the two rear areas of the port and starboard bilge V's as shown at 36 and 37 and the rear center point as shown at 20a. These points are shown as dotted areas in FIG. 4, and provide the directional stability of the hull.

Because of the stepped construction, the combined aerohydrodynamic pressure is approximately in the middle of the boat and consequently so also is the center of gravity of the boat.

The air holes or air vents 23 are located on the rib or frame where the step is formed on each side of the center section 12 as shown in FIG. 4.

The invention when incorporated into a boat is highly successful in maintaining planing speed and constant trim angle combined with stability and, when built as a seagoing craft with a suitably refined nose section and longer waver breaker centerpiece has been shown in the illustrated example, is able to sustain substantial amounts of pounding from waves and rough seas. If used for seagoing duty, desirably strengthening ribs, longitudinals, and a box keel for added hull strength are provided.

While I have illustrated and described the preferred form of construction for carrying my invention into effect, this is capable of variation and modification without departing from the spirit of the invention. I, therefore, do not wish to be limited to the precise details of construction set forth, but desire to avail myself of such variations and modifications as come within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to protect by Letters Patent is:

1. A boat having a planing tunnel hull comprising:
   a. a hull having a forward tunnel and a rearward tunnel,
   b. a transverse step extending across the full width of and between said forward tunnel and said rearward tunnel of the hull,
   c. said forward tunnel reducing in depth and transverse cross-sectional area as it approaches said transverse step,
   d. said rearward tunnel reducing in depth and transverse cross-sectional area as it extends from said step toward the transom of the hull so that the forward cross-sectional area of said rearward tunnel has a greater depth than the rearward cross-sectional area of said forward tunnel so as to provide a stepped-up rear tunnel hull at said transverse step,
   e. air ramming means comprising air vents formed in the hull forward of said transverse step and having outlet vents in said step opening into said rearward tunnel,
   f. port and starboard side keels extending rearwardly of said transverse step on either side of said rearward tunnel,
   g. said port and starboard side keels cooperating with said stepped-up rearward tunnel to form an air pressure retaining cavity extending rearwardly of said air vents whereby the hull planes on said port and starboard side keels on an air cushion under the entire length of the hull.

2. A boat as claimed in claim 1 wherein the means ramming air through the transverse step comprises an air tunnel extending from an air intake at a forward part of the boat to air vents in the transverse step, which vents communicate with the cavity formed beneath said portion of the hull, air being forced into the air tunnel by forward movement of the boat.

3. A boat as claimed in claim 1 wherein the transverse step comprises two parts each part extending from the keel forward of the step to the port and starboard side keels respectively.

4. A boat as claimed in claim 2 wherein the transverse step comprises two parts each part extending from the keel forward of the step to the port and starboard side keels respectively.

5. A boat as claimed in claim 3 wherein each part of the transverse step is provided with an air vent.

6. A boat as claimed in claim 4 wherein each part of the transverse step is provided with an air vent.

7. A boat as claimed in claim 5 wherein the air intake comprises an aperture formed in the hull on each side of the keel forward of the step and a tunnel extending from each aperture to the air vent in each part of the transverse step.

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