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(54) IMPROVED AIR CUSHIONED PLANING HULL

(71) I, LEONARD DIRK ^{Stolk} STOLT, of 52, Hilltop Road, Clareville, in the State of New South Wales, 2107 Australia, formerly of Corroboree Park, Wilberforce, in the State of New South Wales in the Commonwealth of Australia, a Dutch subject and an Australian citizen, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a boat having a planing hull, of the type known as a marine G.E.M. or "ground effect machine".

A G.E.M. type of craft usually has a tunnel type hull comprising two narrow outer hulls or sponsoons, joined together by a central wing or deck and the backward flip of this craft is commonplace and accepted.

The invention provides a boat having a planing tunnel hull comprising a transverse step positioned between the ends of the hull, the transverse step being provided with an air outlet vent or vents, the hull bottom forward of the step having a port and a starboard side keel and the two side keels respectively extending aft from the step on either side of the hull to the transom, the hull underside forming a forward tunnel forward of the transverse step and a rear tunnel aft of the transverse step, the depth of the forward tunnel reducing from the forward part of the hull to the step, and the depth of the rear tunnel decreasing in depth as it extends towards the transom, the rear tunnel hull underside being stepped-up from the forward tunnel hull underside relative to the waterline, the rear tunnel forming with the transverse step and with the extensions aft of the step of the 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 the air-pressure retaining cavity whereby the hull can plane on the port and starboard side keels supported by an air

cushion under the front and rear parts of the hull.

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:

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

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

Figure 3 is a rear end view of the same hull;

Figure 4 is a perspective view of the hull from below;

Figure 5 is a plan view of the hull;

Figure 6 shows hull section lines A, B and C corresponding to those in Figure 2;

Figure 7 shows transverse section views 7a; 7b; 7c and 7d corresponding to those marked in Figure 1, and

Figure 8 shows a front end view similar to Figure 2 of a modified arrangement.

Referring now to the drawings, a tunnel hull 10 has port and starboard bilge V's 11 with a centre section 12, chines 13 and a foredeck 14 with an aircowl 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 centre section 12 fairs into a straked forward bilge keel 18, a garboard strake being shown at 19 and a stepped-up rear tunnel underside 20 extending to the rear of the boat. Outwardly inclined bottom straking 32 is provided at the bottom of the stepped-up rear tunnel underside 20. An after centre keel 45 is also provided. A two part transverse step 21 is provided with one part extending from each side of the centre section 12. The transverse step 21 divides the hull underside into a forward tunnel forward of the transverse step and a rear tunnel aft of the transverse step. 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 centre section 12 as shown in the transverse section 7b of

Figure 7. Both parts are provided with air outlet vents 23.

Port and starboard side keels 24 of substantially rectangular cross-section 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 depth of the forward tunnel and the wedge so formed between the water surface 41 and the hull section shown in 7a of Figure 7 to the trailing edge position shown in 7b of Figure 7 of the transverse step 21 and the restriction caused by the reduction in depth of the stepped-up rear tunnel underside 20 shown in 7c of Figure 7 to the trailing edge position at the transom 25 shown in 7d of Figure 7, 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-up rear tunnel underside 20. This increase in pressure or "ground effect" produces lifting forces acting on the boat and, at maximum load, reduce draft by as much as 85%.

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. An aircoawl 15 is supported by cowl struts 31.

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 forward bilge keel 18 as shown in Figure 8 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 longitudinals (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 45a in the drawing) form only eight per cent (8%) of mean wetted area of the boat at rest. 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 centre of gravity is approximately in the centre of the boat (because the combined aerodynamic and hydrodynamic forces act approximately on the centre of the boat, backward flip will be minimised or eliminated and a constant trim angle will be assured.

At low speed air passing through vents 23 provided on the transverse step serves 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 W-bottom, preferably with 20 degrees 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 transome. The forward bilge keel 18 is provided forward of the step to give sufficient longitudinal and lateral strength. The keel 18 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 centre 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 centre 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 W-hull and the stepped-up 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 7b of Figure 7) 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 portion 45a of the after centre keel 45. These points are shown as dotted areas in Figure 4 and provide the directional stability of the hull.

The air holes or air vents 23 are located on the rib or frame where the step is formed

on each side of the centre section 12 as shown in Figure 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 suitably refined nose section and longer wave breaker centre piece than 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.

The invention is not intended to be limited to the specific embodiments referred to above but includes in its scope modifications and equivalent constructions falling within the scope of the appended claims.

WHAT I CLAIM IS:—

1. A boat having a planing tunnel hull comprising a transverse step positioned between the ends of the hull, the transverse step being provided with an air outlet vent or vents, the hull bottom forward of the step having a port and a starboard side keel and the two side keels respectively extending aft from the step on either side of the hull to the transom, the hull underside forming a forward tunnel forward of the transverse step and a rear tunnel aft of the transverse step, the depth of the forward tunnel reducing from the forward part of the hull to the step, and the depth of the rear tunnel decreasing in depth as it extends towards the transom, the rear tunnel hull underside being stepped-up from the forward tunnel hull underside relative to the waterline, the rear tunnel forming with the transverse step and with the extensions aft of the step of the 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 the air-pressure retaining cavity

whereby the hull can plane on the port and starboard side keels supported by an air cushion under the front and rear parts of the hull.

2. A boat as claimed in claim 1 wherein the means to enable air to be forced through the transverse step comprises an air tunnel extending from an air intake at a forward part of the boat to the or each air outlet vent in the transverse step so that air can be forced into the pressure retaining cavity by forward movement of the boat.

3. A boat as claimed in any of the preceding claims wherein a forward centre keel and a rear centre keel is provided, the hull underside having the profile of a substantially inverted W-shape, the transverse step extending transversely to either side of the forward centre keel and being located substantially half-way between the ends of the hull.

4. A boat as claimed in any of claims 1 to 3 wherein the transverse step comprises two parts each part being provided with at least one air outlet vent.

5. A boat as claimed in claim 4 wherein the means to enable air to be forced through the transverse step comprises an aperture provided in the forward part of the hull on each side of the longitudinal axis of the hull and a tunnel extending from each aperture to the air vent or vents in each part of the transverse step.

6. A boat as claimed in any of the preceding claims wherein the extensions of the side keels are substantially rectangular in cross-section.

7. A boat substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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on each side of the centre section 12 as shown in Figure 4.

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whereby the hull can plane on the port and starboard side keels supported by an air cushion under the front and rear parts of the hull.

2. A boat as claimed in claim 1 wherein the means to enable air to be forced through the transverse step comprises an air tunnel extending from an air intake at a forward part of the boat to the or each air outlet vent in the transverse step so that air can be forced into the pressure retaining cavity by forward movement of the boat.

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