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(54) IMPROVEMENTS IN OR RELATING TO THE DESIGN AND CONSTRUCTION OF HULLS FOR MARINE CRAFT

(71) We, ROTORK MARINE LIMITED, a British Company, of 30 Queen Charlotte Street, Bristol BS1 4HS, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the design and construction of hulls for power-propelled marine craft. In particular, the invention is concerned with improvements in the design and construction of hulls of the kind in which the hull is in the form of a rectangular body in plan having a substantially flat undersurface provided with a pair of spaced keel members which depend therefrom and extend substantially parallel from the bow of the hull to the stern. The spaced keel members are positioned each closely adjacent a side of the hull and the undersurface of the body is curved at the stern of the hull to provide a cutaway or turnup so that air passing under the hull is trapped below the hull between the spaced keel members.

At the planing speed the efficiency of the hull is greatly increased in that a considerable improvement is obtained in the forward speed for a given output of the power unit due to the cushioning effect of the air which reduces the hydrodynamic drag caused by skin friction. In addition, due to the flat construction of the hull its load carrying capacity is very greatly increased, while the ride is more comfortable due particularly to a reduction in slamming, pitching and rolling.

A hull construction of this kind however, has certain disadvantages when applied to marine craft namely, a reduction in stability while cornering at speed.

The present invention therefore sets out to provide an improved and modified hull construction which avoids this difficulty, particularly for larger craft and which may also provide for the more efficient mounting of

the power units, especially power units of the jet type.

According to the invention there is provided a power propelled marine craft comprising a hull in the form of a rectangular body in plan having a substantially flat undersurface provided with a pair of spaced members depending therefrom, said members extending substantially parallel from the bow of the hull towards the stern thereof, wherein the spaced members are positioned closely adjacent the sides of the hull and the said undersurface is provided also with one or more projections extending longitudinally of the hull between said spaced members so as to form with said spaced members a plurality of independent channels, said projection or projections each having a width which is substantially greater than its depth and having a depth which is less than the maximum depth of said spaced members, and said undersurface of the body being curved at the stern of the hull to provide a cutaway or turnup whereby during forward movement of the craft air passing thereunder is trapped below the hull between the spaced members in said independent channels. The projection or projections together with the spaced side members form part of the outer skin of the hull which is moulded as an integral unit with sides supporting a deck structure. The deck structure is preferably modular and comprises a series of torsional boxes constructed over the inner surfaces of the projections of the outer skin.

In order that the invention may be clearly understood a preferred embodiment will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a plan view of the hull,

Figure 2 is a front view of the hull looking from the right in Figure 1,

Figure 3 is a section on the line 3—3 of Figure 1,

Figure 3A is a detail view on an enlarged

scale of a portion of the deck structure, and Figure 4 is a section on the line 4—4 of Figure 1.

The hull construction shown in the drawings comprises a substantially flat, rectangular body 10 of the undersurface 11 of which forms part of the shell or skin of the vessel and which is moulded as an integral unit in a plastics material, such as resin reinforced with fibreglass. The skin includes also vertical side surfaces 12 and 13 together with inclined surfaces 14 and 15 between the side surfaces and the undersurface of the hull. The lower surface 11 of the body 10 is shaped longitudinally from the stem to present an upwardly curved front portion 16 (Figure 2) so as to reduce hydrodynamic resistance during forward movement of the craft in the water. The front portion 16 includes a ramp board 17 hingably connected to the front edge 18 of the undersurface 11.

The outer skin of the hull is formed with a longitudinal stiffening section 19 in each of the vertical side surfaces 12 and 13 and the usual strake 20 extends horizontally at the junction between the vertical side surfaces 12 and 13 and the inclined surfaces 14 and 15. The strake is provided with a longitudinal rubbing strip 21.

As previously explained the efficiency, i.e. the forward speed of the hull, is greatly increased for a given output of the power unit by providing a cushion of air beneath the flat or substantially flat undersurface 11 of the hull. This cushion of air is trapped beneath the hull by providing firstly a pair of spaced members like keel boards 22 and 23 as an integral part of the undersurface 11 of the outer skin of the hull. The keel boards extend downwardly from the undersurface 11 of the hull at positions closely adjacent the start of the upwardly inclined side members 14 and 15 of the hull. The spaced keel boards 22, 23 are parallel and they vary in shape and size along the length of the hull so as to have their maximum depth at the position at or closely adjacent the bow of the hull (Figure 2) and they gradually reduce in depth (see Figures 3 and 4) to merge with the undersurface of the hull at a point near the transom 24 of the craft. The function of the spaced keel members 22 and 23 is to trap air passing beneath the turnup or cutaway of the hull formed by the front curved portion 16 of the hull and to funnel this air beneath the hull to provide a cushion of air or aerated water beneath the stern of the hull. In this way the drag or hydrodynamic resistance due to skin friction is considerably reduced and a greater forward speed is obtained for a given output of the power unit mounted on the hull.

According to the invention the undersur-

face 11 is provided also with one or more downwardly extending projections depending on the size of the hull i.e. the distance between the space parallel keel boards 22 and 23. In the embodiment shown two projections 25 and 26 are provided between the keel boards 22 and 23 and each projection extends longitudinally of the hull in the manner of the keel boards being substantially parallel with them and also forming an integral part of the undersurface 11 of the skin of the hull. Each projection 25 and 26 has a substantial width along the length of the hull compared with its depth and the size and shape of the projections remain substantially constant. The projections 25 and 26 thus provide a channel 27 between the downwardly extending projections 25 and 26 and channels 28 and 29 between the projections 25 and 26 and the adjacent keel boards 22 and 23. The projections 25 and 26 are shown as having a substantial flat undersurface which merges into the adjacent channels by an inclined surface which is angled at about 45° to assist water flow on cornering. The keel boards and projections are provided at their front ends with inset rubbing strips 30 (Figure 2).

The construction thereby provides a number of parallel channels 27, 28 and 29 extending longitudinally along the undersurface 11 of the hull structure and the effect is to entrain a cushion of air in each channel as the craft is propelled forward. The provision of a number of independent channels provides for greater efficiency and stability in cornering, more particularly for larger craft, in that entrainment of air is improved and sideways flow is reduced.

The deck structure of the hull is modular and comprises a series of transverse torsional boxes built up on the inner surfaces of the longitudinal projections 25 and 26 of the outer skin. The arrangement is shown in Figure 3 and particularly in the enlarged detail view of Figure 3A.

An inner side member 31 is attached to the upper edge of the outer side members 12 and 13 of the skin and the usual longitudinal capping members 32 are affixed with side fenders 33. The side members 31 are spaced from the side surfaces 12 and 13 and are formed with a flat surface 34, an inclined section 35 and an inwardly bent section 36 which abuts and is bonded to the upwardly bent section 36 which abuts and is bonded to the upwardly inclined inner wall of the corresponding keel board 22, 23. As shown more clearly in Figure 3A, a U-shaped member is mounted on the inner surface of the skin above each projection 25, 26 and each U-shaped member has a flat top surface 37 and inclined side walls 38, the side walls 38 having their lower

ends 39 bent outwardly to abut the inner sides of the skin above the adjacent channels. The ends 39 are bonded to the skin and the joint is strengthened by a bent longitudinal strip 40 which abuts and is bonded to the wall 38 of the U-shaped member and the inner wall of the projections 25 or 26. The flat surfaces 34 and 37 provide support for decking 41. The construction enables loads which might peel the skin to be transferred to frame joints without rivet or bolt heads piercing the outer envelope of the structure.

Referring now to Figure 4, power units 42 of the jet type are shown beneath the engine housing 43. As shown the power units are mounted on supports 44 which are located on the turned-over edges 45 of inlet apertures 46 formed in the rear portions of the longitudinally extending projections 25 and 26, the side members 31 being modified to extend over channels 28 and 29 with a central U-shaped member mounted over the central channel 27. The space between the skin and the side members 31 and the U-shaped members is filled with plastics foam 47.

The location of the power units 42 with their inlets in the projections 25, 26 ensures that an adequate pick-up of water free of entrained air is fed to the jet intake. The arrangement avoids the necessity of added inlet ducts and the consequent increase in appendage drag.

If desired each of the channels provided on the undersurface of the hull may be formed with an enlarged entrance area so as to ensure adequate supply of air during the forward movement of the hull.

The hull construction of the invention provides improved handling in that the correct proportioning of the projections (i.e. the width should be large by comparison with their depth) results in a reduced efficiency of sideways flow and hence reduced momentum transfer. If the angle of the side of the projections is kept low and lateral drag is controlled, an increased angle of lateral attack is achieved whilst turning and high centrepetal forces are generated, minimising the tendency to trip associated with low deadrise planing hulls.

The depth of the projections at the forward part of the hull reduces slamming in head seas while maintaining adequate buoyancy forward to prevent broaching in following seas.

The hull can be made of materials other than plastics, such as aluminium.

WHAT WE CLAIM IS:—

1. A power propelled marine craft comprising a hull in the form of a rectangular body in plan having a substantially flat undersurface provided with a pair of spaced

members depending therefrom, said members extending substantially parallel from the bow of the hull towards the stern thereof, wherein the spaced members are positioned closely adjacent the sides of the hull and the said undersurface is provided also with one or more projections extending longitudinally of the hull between said spaced members so as to form with said spaced members a plurality of independent channels, said projection or projections each having a width which is substantially greater than its depth and having a depth which is less than the maximum depth of said spaced members, and said undersurface of the body being curved at the stern of the hull to provide a cutaway or turnup whereby during forward movement of the craft air passing thereunder is trapped below the hull between the spaced members in said independent channels.

2. A marine craft as claimed in Claim 1, wherein said spaced members have a depth which is a maximum at the bow of the hull and which reduces gradually rearwardly of the hull to merge therewith.

3. A marine craft as claimed in Claim 2, wherein said projection or projections each has a cross-sectional shape remaining substantially constant throughout the length of the projection.

4. A marine craft as claimed in any preceding claim, wherein said projection or projections each has a flat surface and sloped edges between it and the adjoining portions of the undersurface of the body.

5. A marine craft as claimed in any preceding claim, wherein the or each projection is moulded in the outer skin of the hull and the deck structure is mounted thereon comprising a modular structure of torsional boxes built up on said projections.

6. A marine craft as claimed in Claim 5, wherein inverted U-shaped members are mounted over the inner surfaces of the said projections and the edges of said U-shaped members are abutted against and bonded to the adjacent surface of the outer skin forming the undersurface of the hull.

7. A marine craft as claimed in Claim 5 or 6, wherein the space between the decking and the skin forming said undersurface is filled with plastics foam.

8. A marine craft as claimed in any one of the preceding claims, wherein power units of the jet type are mounted above the projections and water inlet ducts for said power units are provided in said projections so as to ensure a supply of water free of entrained air.

9. A marine craft as claimed in any one of the preceding claims, wherein the hull is a flat rectangular body having a depth which is relatively small compared with the length and width thereof, and the stern

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ends 39 bent outwardly to abut the inner sides of the skin above the adjacent channels. The ends 39 are bonded to the skin and the joint is strengthened by a bent longitudinal strip 40 which abuts and is bonded to the wall 38 of the U-shaped member and the inner wall of the projections 25 or 26. The flat surfaces 34 and 37 provide support for decking 41. The construction enables loads which might peel the skin to be transferred to frame joints without rivet or bolt heads piercing the outer envelope of the structure.

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8. A marine craft as claimed in any one of the preceding claims, wherein power units of the jet type are mounted above the projections and water inlet ducts for said power units are provided in said projections so as to ensure a supply of water free of entrained air.

9. A marine craft as claimed in any one of the preceding claims, wherein the hull is a flat rectangular body having a depth which is relatively small compared with the length and width thereof, and the stem

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thereof is provided with a ramp board for loading at the waters edge.

10. A power-propelled marine craft substantially as hereinbefore described and
5. as shown in the accompanying drawings.

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