Feb. 13, 1945. A. J. HIGGINS 2,369,633

BOAT HULL CONSTRUCTION

Filed Nov. 3, 1941 2 Sheets-Sheet 1

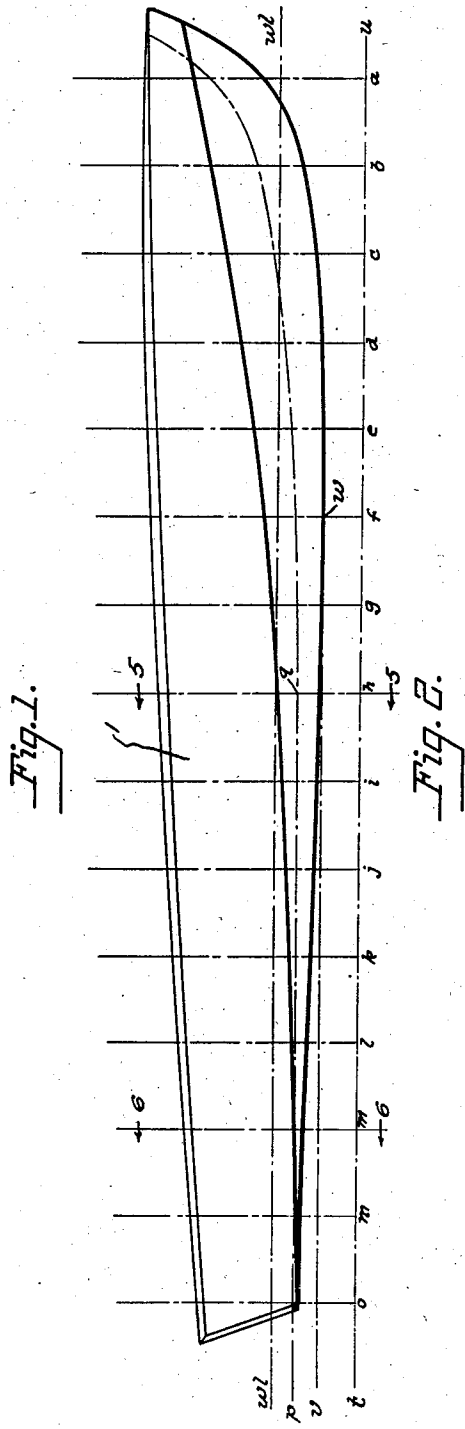

Fig. 1.

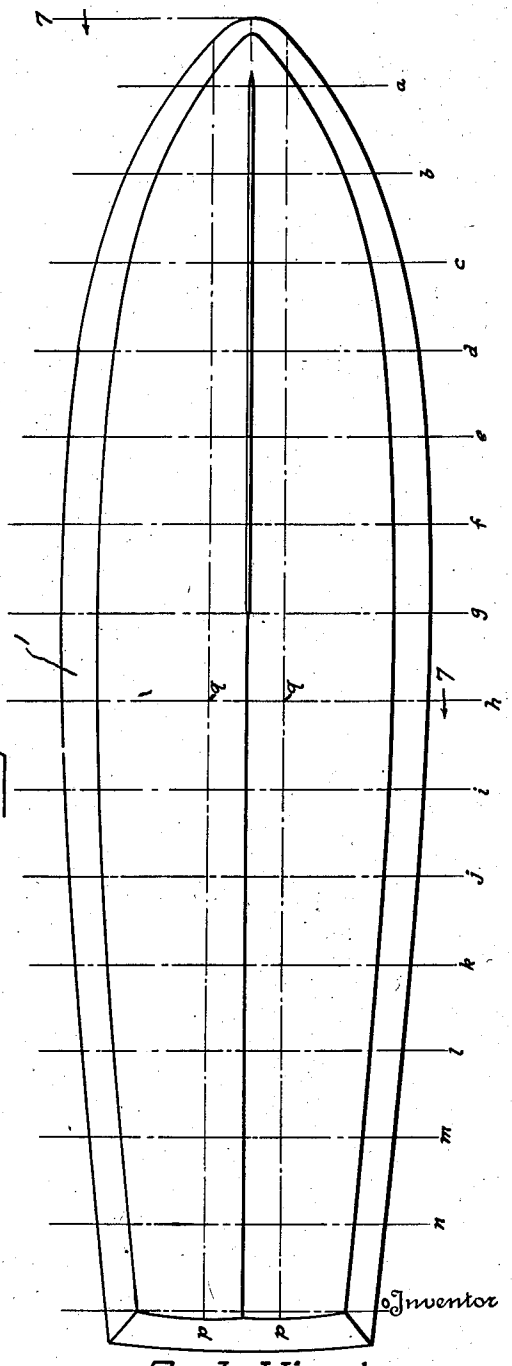

Fig. 2.

Inventor

A. J. Higgins

By Mason Fenwick & Lawrence Attorneys

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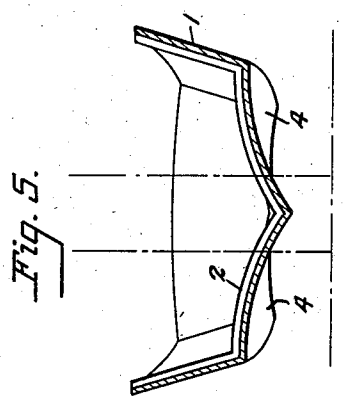

Fig. 5.

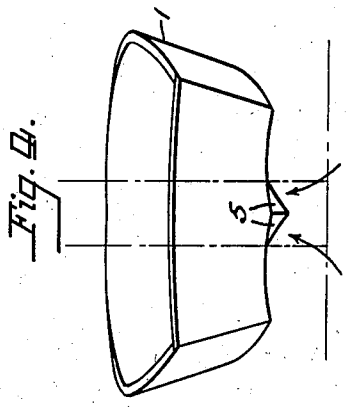

Fig. 4.

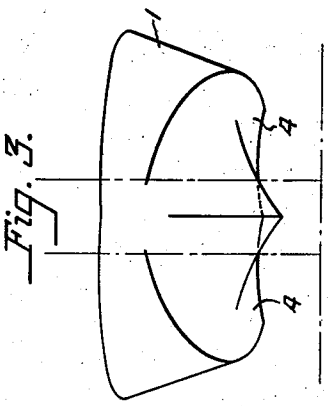

Fig. 3.

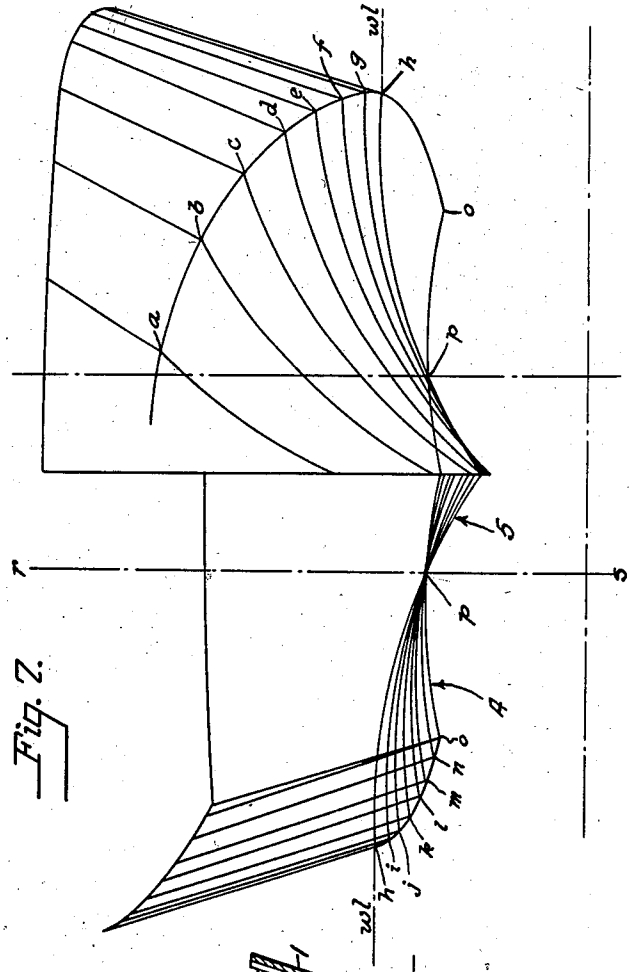

Fig. 7.

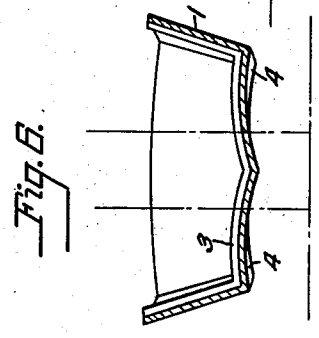

Fig. 6.

Inventor
A. J. Higgins

By Mason, Fenwick & Lawrence
Attorneys

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BOAT HULL CONSTRUCTION

Andrew J. Higgins, New Orleans, La.

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6 Claims. (Cl. 114—66.5)

This invention relates to boat hull construction particularly designed for a type of boat such as a motor torpedo boat which travels at high speed with a large part of the forward section of the boat out of water. Such a boat necessarily entrains a great deal of air beneath the forward section, which in ordinary hull shapes is either thrown out uselessly at the sides, or if it continues beneath the boat, is discharged sternward in the path of the propeller, causing cavitation.

One of the objects of the invention is to conserve the entrained air, retaining as much as is practicable beneath the boat from the point of its entrainment to the stern, so that the boat travels largely upon an aerated film of water which greatly reduces the skin friction and enhances the speed of the boat. At the same time the invention provides that the entrained air shall be diverted from the propeller path.

In carrying out this general object, the invention contemplates as one of its more specific objects a boat hull in which the cross-sectional contour lines of the bottom on each side between chine and keel from amidships to stern are concave arcs of the same curvature, all intersecting a straight line lying in a plane parallel to the plane of symmetry of the hull which embraces the keel, and progressively tilted about said line, the outer end of the midship contour being highest and the outer ends of the other contours successively descending in the direction of the stern, while the inner end of the midship contour is lowest at the keel, the inner ends of the other contours successively ascending towards the stern. This gives the bottom of the boat hull on each side of the keel a twist about said line, so that the portion outside of said line forms a forwardly directed scoop for engulfing the aerated water entrained by the forward section of the hull, while the reverse inclination of that portion of the bottom between said line and the keel produces vacuum which draws solid water up from the depths against the bottom of the hull forwardly of the propeller, displacing the aerated water and keeping it out of the region between said line and the keel.

Other objects of the invention will appear as the following description of a preferred and practical embodiment thereof proceeds.

In the drawings which accompany and form a part of the following specification, and throughout the several figures of which the same characters of reference have been employed to designate identical parts:

Figure 1 is a side elevation of a boat hull embodying the principles of the present invention;

Figure 2 is a plan view;

Figure 3 is a front end elevation;

Figure 4 is a rear end elevation;

Figure 5 is a transverse vertical section taken along the line 5—5 of Figure 1;

Figure 6 is a transverse vertical section taken along the line 6—6 of Figure 1;

Figure 7 is a diagrammatical view in end elevation, the right half showing the stations from bow to amidships, the left hand portion representing the stations from amidships to stern.

Referring now in detail to the several figures, the numeral 1 represents in general the boat hull, the views of which are intersected in Figures 1 and 2 by parallel lines representing the positions of vertical transverse planes or stations, which beginning with the bow end of the hull, have been designated by the reference characters *a* to *o*, inclusive. The contours at said stations are shown in elevation in Figure 7 and have been designated by the same characters of reference.

In the hull shape, as shown, all the contours of the boat, from bow to stern and between chine and keel, are arcs of the same curvature and the ribs, two of which are shown at 2 and 3 in Figures 5 and 6, are cut with the same curvature. This incidentally makes for economy in the construction of the hull for the rib pieces are interchangeable, it being necessary only to cut them to the proper length. The contours with which the present invention is primarily concerned, however, are only those from near the midship section to the stern.

Figures 1, 2 and 7 show that all of the bottom contours from the midship section to stern, on each side of the keel, intersect in a line *p*, *q*, the end only of which is viewed in Figure 7 and is designated as *p*. This line lies in a longitudinal vertical plane represented by the line *r*, *s* in Figure 7, which plane is parallel to the longitudinal plane of symmetry of the hull which embraces the keel. In the normal running position of the boat which is shown in Figure 1, the lines *p*, *q* on each side of the boat are parallel to the base line *t*, *u*.

The bottom contours on each side from amidships to stern, are tilted about this base line *p*, *q*, as shown in Figure 7, in such a manner that the outer end of the midship contour at *h* is higher than the outer ends of any of the other contours aft of amidships and that they progressively descend, the outer end of the stern contour at station *o* being the lowermost. The reverse is true

with regard to the inner ends of the contours at the keel. The inner end of the midship contour at station *h* is lowermost and the inner ends of the other contours progressively rise toward the stern, the inner end of the stern contour at station *o* being the highest.

This arrangement of contours produces a twist on each side of the bottom of the hull aft of the midship station about the line *p, q*, that portion of the bottom outside of said line constituting a forwardly directed curved scoop which as a whole is designated by the reference character **4**, while the reversely twisted portion of the bottom between the line *p, q* and the keel tapers upwardly toward the stern, constituting a water displacing vacuum producing member, which as a whole is designated by the reference character **5**.

As the vessel moves forwardly at a rapid rate, aerated water will be entrained under the forward sections of the hull, a large portion of which is out of water, as shown in Figure 1. This aerated water is engulfed beneath the contours adjacent the midship section, and traverses the bottom of the boat to the stern, the hull riding upon an aerated film which greatly reduces skin friction and increases the speed of the boat.

It will be noted in Figure 7 that the outer end portion of the midship contour at station *h* is substantially horizontal, while the outer ends of the successive contours in a sternward direction dip at progressively greater angles, so that while there is no particular tendency of the midship contour to retain the aerated water beneath the boat, this tendency increases with each of the succeeding contours, which by virtue of the dip of their outer ends hold the aerated water beneath the hull.

Referring to Figure 1, it will be observed that the plane of the water line *w. l.* cuts the keel adjacent the station *a*. Figure 7 shows that the bottom contours at station *a* meet at a rather sharp acute angle, so that aerated water is entrained beneath the forward section throughout the whole width of the boat. If this aerated water were permitted to travel longitudinally beneath the hull to the stern throughout the entire width of the boat, it would carry air into the propeller path and cause cavitation. The vacuum producing portion **5** prevents this by drawing solid water from the depths between the lines *p, q* on opposite sides of the keel, as indicated by the arrows in Figure 4, which solid water displaces the aerated water from that part of the bottom which is between the lines *p, q*, diverting the aerated water outwardly of said lines. It will be observed from Figure 1 that while the lowest part of the keel is not at the midship section, but probably at the station *f*, the vacuum producing effect of the portion **5** is inconsequential until the midship section is reached. Figure 1 shows a line *v, w* parallel to the water line and drawn to a point *w* at the station *f*, which point represents the lowest part of the keel. The space between the angle which the line *v, w* makes with the keel line aft of station *f*, represents the volume of vacuum producing displacement of the portion **5**, and the vacuum increases as the width of this angle increases. It will be understood, of course, that there is no void beneath the portion **5**, but that the vacuum is satisfied by the maintenance of solid water drawn up from the depths through a width distance equal to the transverse distance between the lines *p, q*. As has been stated, this vacuum is feeble just aft of the point *w* on station *f* and very gradually increases, so that there is very little displacement or aerated water from beneath the middle part of the hull until aft of the midship section, and then the displacement increases, the aerated water in excess of what the dipping contours aft of the midship contour are able to hold being thrown outwardly at the quarters. Long before the propeller is reached, all of the aerated water adjacent the keel has been displaced by the solid water drawn up from the depths by the sternward-tapering portion **5** of the hull bottom.

The result is that at the stern of the boat the water between the planes represented by the lines *r, s* which embrace the lines *p, q* is altogether free from the entrained air so that the propeller operates in solid water, free from cavitation, while aerated water is discharged from under the stern contours at station *o* between the vertical planes passing through the lines *p, q* and the outer ends of said contours, the result being that throughout its entire area of contact with the water, the hull travels upon an aerated film with the exception of that region beginning some distance in advance of the propeller and extending sternward into the path of rotation of the propeller, in which region the water is solid, that is to say, unaerated.

The fact that the bottom contours of the boat are arcs of the same curvature throughout the region of twist about the lines *p, q*, that is, between the midship station and stern, assures that the curvature of the interface between the water and hull bottom will be streamlined throughout and not subject to abrupt changes which would cause the development of localized pressure between the hull and the supporting aerated film which would tend to drive air bubbles out of the regions of excess pressure and thus make the aerated film nonuniform in its antifrictional capacity.

While I have in the above description disclosed what I believe to be a preferred and practical embodiment of my invention, it will be understood to those skilled in the art that the specific details of construction are by way of example and not to be construed as limiting the scope of the invention which is defined in the appended claims.

What I claim as my invention is:

1. Boat hull construction in which the bottom portion on each side from chine to keel and from the stern to a point a substantial distance forwardly of the stern has the shape of a twist about a line running parallel to the vertical longitudinal plane of symmetry of the hull and intermediate the keel and chine, the part between said line and chine sloping upwardly in a forward direction and the part between said line and keel sloping upwardly toward the stern, all transverse bottom contours in said portion being arcs of the same curvature.

2. Boat hull construction in which the bottom portion on each side from chine to keel and from the stern to a point adjacent amidships has the shape of a twist about a line running parallel to the vertical longitudinal plane of symmetry of the hull and intermediate the keel and chine, the part between said line and chine sloping upwardly in a forward direction and the part between said line and keel sloping upwardly toward the stern, all transverse bottom contours in said portion being arcs of the same curvature.

3. Boat hull construction in which the bottom portion on each side from chine to keel and from the stern forwardly to a point adjacent the mid-

ship section has a shape the transverse contours of which intersect a line running parallel to the vertical longitudinal plane of symmetry of the hull and intermediate the keel and chine, said contours being concavely arcuate and progressively tilted about said line, the outer end of the foremost contour being closest to the plane of water level and the outer ends of the other contours being at progressively deeper levels, while the inner end of the foremost contour is at lowest level, the inner ends of the other contours being at progressively higher levels in the direction of the stern, whereby the part of said portion of the hull outside of said line forms a forwardly directed scoop for engulfing the aerated water entrained by the forward section of the hull, while the reverse slope of that part between said line and the keel produces vacuum which draws solid water up from the depths against the bottom of the hull forwardly of the propeller, displacing the aerated water and keeping it out of the propeller path between said line and the keel.

4. Boat hull construction in which the bottom portion on each side from chine to keel and from the stern forwardly to a point adjacent the midship section has a shape the transverse contours of which intersect a line in a plane parallel to the longitudinal median plane of symmetry of the hull and intermediate the keel and chine, said contours being concavely arcuate with the same curvature, and progressively tilted about said line as an axis, the outer end of the foremost contour being closest to the plane of water level and the outer ends of the other contours being at progressively deeper levels, while the inner end of the foremost contour is at lowest level, the inner ends of the other contours being at progressively higher levels in the direction of the stern, whereby that part of said portion outside of said line forms a forwardly directed scoop for engulfing the aerated water entrained by the forward section of the hull, while the reverse slope of that portion of the bottom between said line and the keel produces vacuum which draws solid water up from the depths against the bottom of the hull forwardly of the propeller and between said line and keel, displacing the aerated water and keeping it out of the path of the propeller, said axes of tilt lying closer to said keel than to said chine.

5. Boat hull construction in which the bottom portion on each side from chine to keel and from the stern forwardly to a point adjacent the midship section has a shape the transverse contours of which intersect a line in a plane parallel to the longitudinal median plane of symmetry of the hull and intermediate the keel and chine, said contours being concavely arcuate with the same curvature, and progressively tilted about said line, the outer end of the foremost contour being closest to the plane of water level and the outer ends of the other contours being at progressively deeper levels, while the inner end of the foremost contour is at lowest level, the inner ends of the other contours being at progressively higher levels in the direction of the stern, whereby that part of said portion outside of said line forms a forwardly directed scoop for engulfing the aerated water entrained by the forward section of the hull, while the reverse slope of that portion of the bottom between said line and the keel produces vacuum which draws solid water up from the depths against the bottom of the hull forwardly of the propeller and between said line and keel, displacing the aerated water and keeping it out of the path of the propeller, the outer ends of transverse contours from the stern to a substantial distance forward of said stern dipping below the crowns of said contours defining an aerated water retaining channel.

6. Boat hull construction in which the bottom portion on each side from chine to keel and from the stern forwardly to a point adjacent the midship section has a shape the transverse contours of which intersect a line in a plane parallel to the longitudinal median plane of symmetry of the hull and intermediate the keel and chine, said contours being concavely arcuate and progressively tilted about said line, the outer end of the foremost contour being closest to the plane of water level and the outer ends of the other contours being at progressively deeper levels, while the inner end of the foremost contour is at lowest level, the inner ends of the other contours being at progressively higher levels in the direction of the stern, whereby that part of said portion outside of said line forms a forwardly directed scoop for engulfing the aerated water entrained by the forward section of the hull, while the reverse slope of that portion of the bottom between said line and the keel produces vacuum which draws solid water up from the depths against the bottom of the hull forwardly of the propeller and between said line and keel, displacing the aerated water and keeping it out of the path of the propeller, the outer ends of transverse contours from the stern to a substantial distance forward of said stern dipping below the crowns of said contours defining an aerated water retaining channel.

ANDREW J. HIGGINS.