Aug. 8, 1961 S. MILLS 2,995,104

BOAT

Filed Dec. 7, 1959 2 Sheets-Sheet 1

FIG. 1

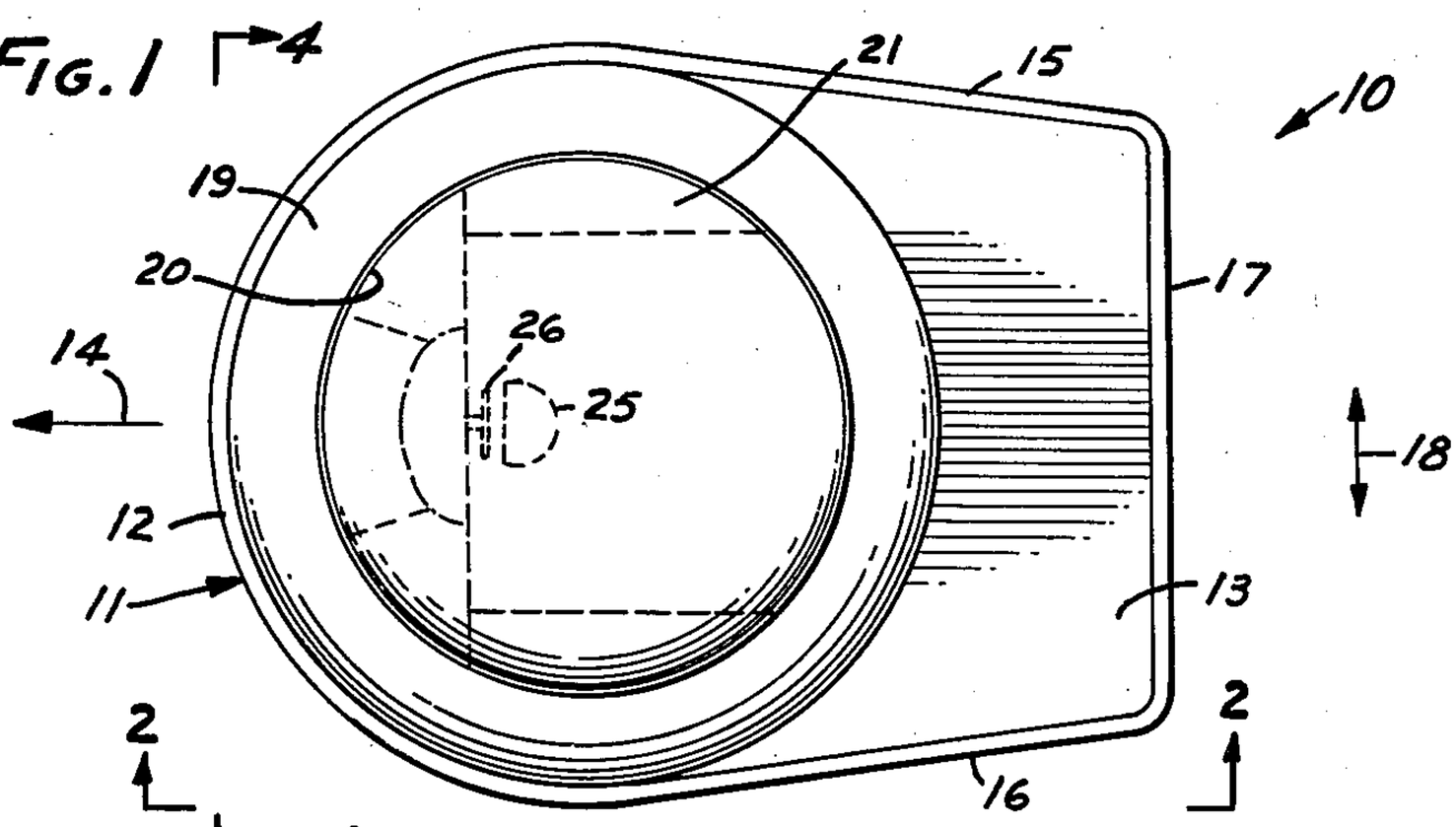

FIG. 3

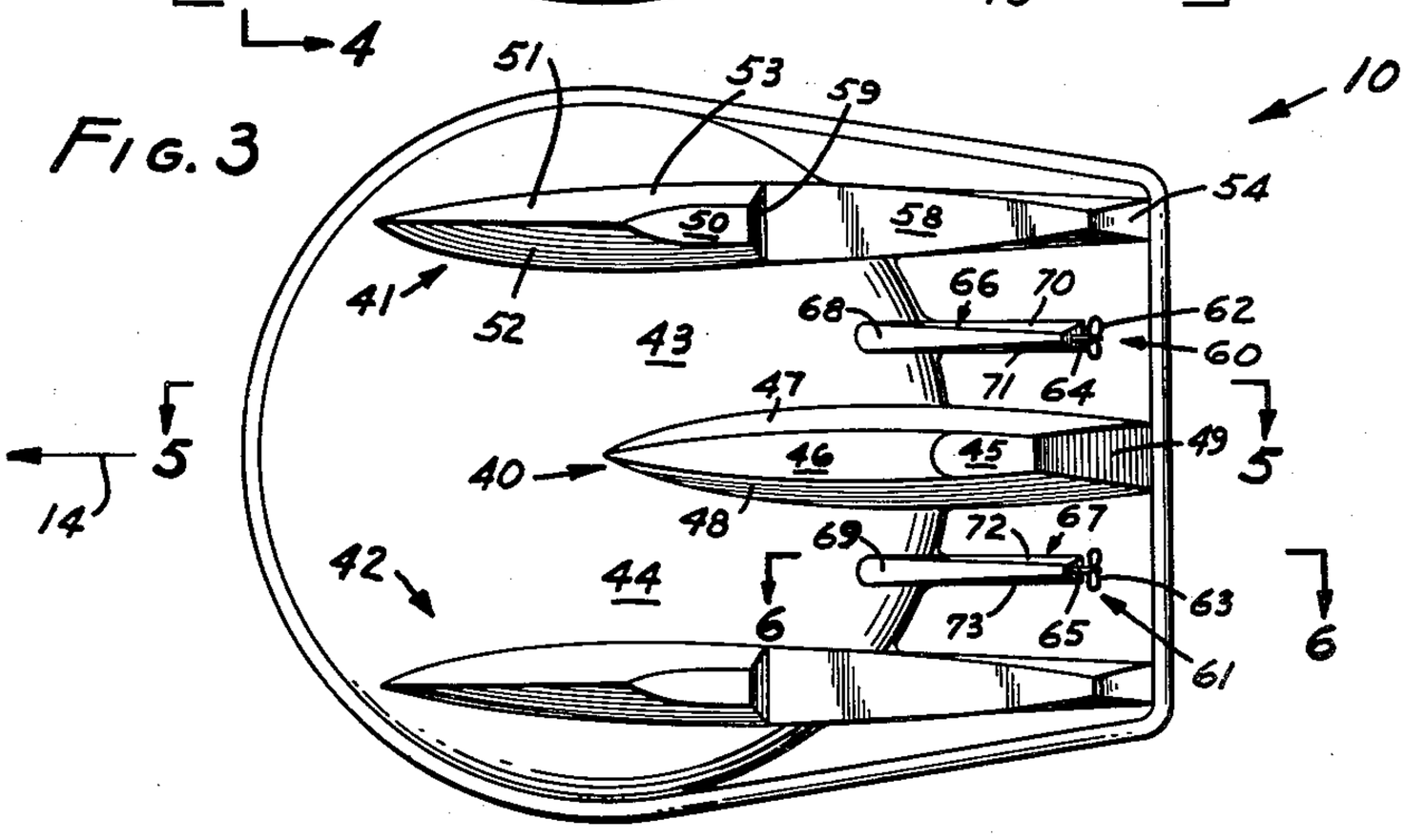

FIG. 2

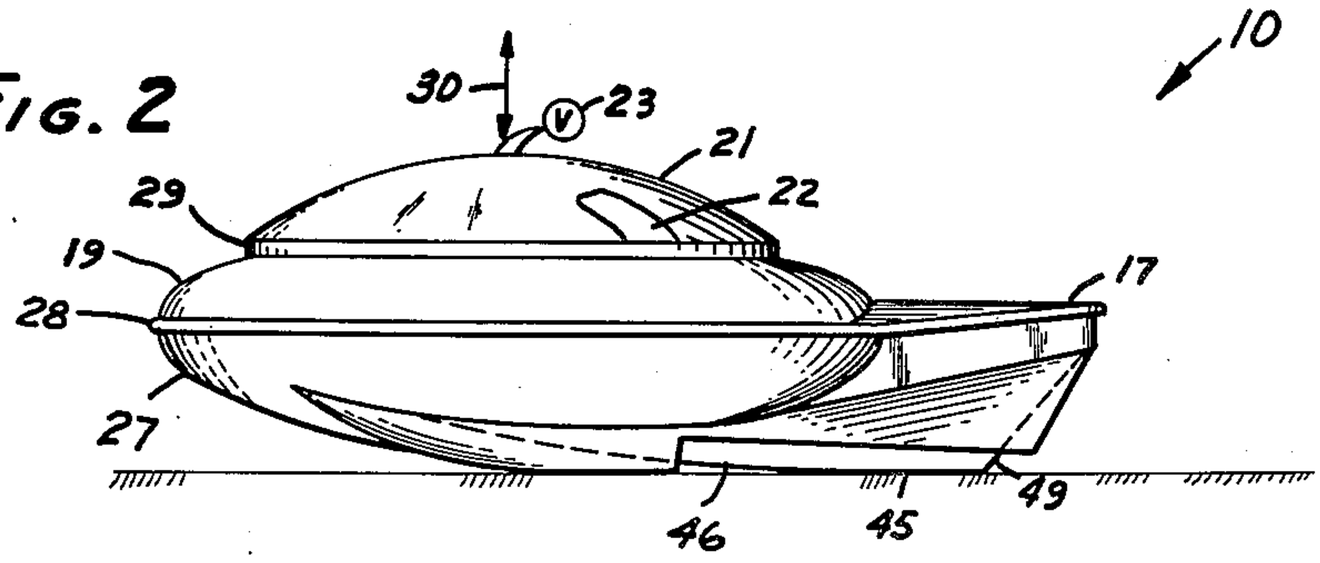

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FIG. 4

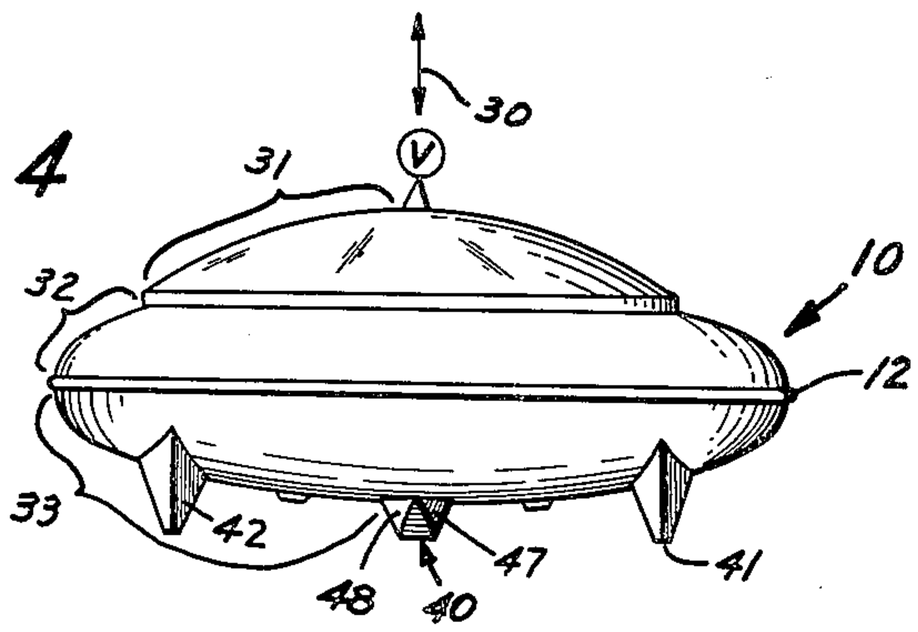


FIG. 6

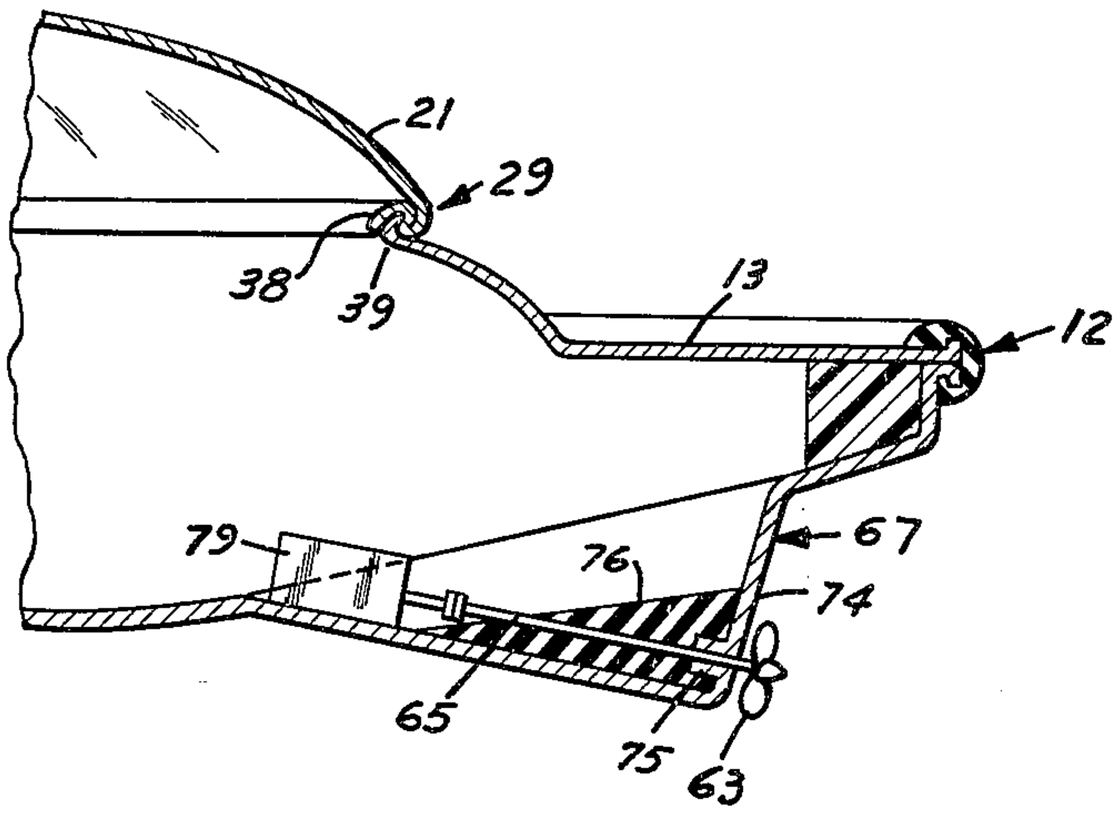


FIG. 5

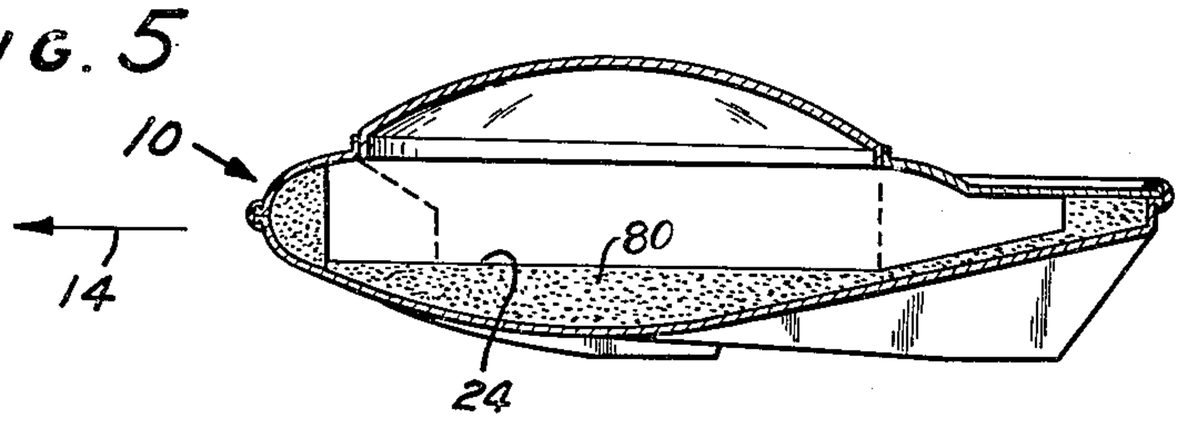
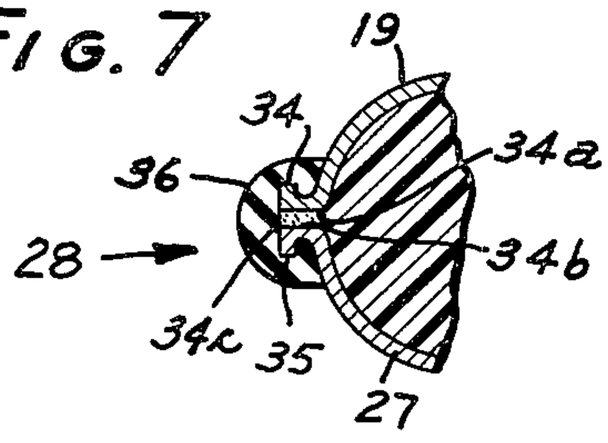


FIG. 7



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United States Patent Office

2,995,104

Patented Aug. 8, 1961

2,995,104

BOAT

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Filed Dec. 7, 1959, Ser. No. 857,646
14 Claims. (Cl. 114—56)

This invention relates to a boat.

An object of this invention is to provide a boat construction which passes through its surrounding fluids with a minimum of drag, and thereby can make its way at various speeds with less power than other boats of similar weight at the same speeds. A related object is to provide such a boat which is stable and will give a smooth ride.

Still another object is to provide a boat structure in which the passengers may be completely enclosed if desired, and which provides a substantially maximum area of deck space per unit of width.

Still a further object of the invention is to provide a rudderless boat wherein directional control may be exerted by propulsion means, which means may be so disposed as to operate at their optimum conditions.

A feature of the invention resides in providing a hull having a bottom and an upper decking, both of which are formed as surfaces of revolution generated by an elliptical arc revolved around the vertical central axis of the boat. The resulting hull structure is substantially circular in plan view, and is substantially eliptical along any elevation. It has been found that this shape results in a construction wherein the resistance to surrounding fluids, both the water in which it floats, and the air above the water, is held to a substantial minimum.

An additional feature of the invention resides in the provision of a plurality of sponsons projecting beneath the boat, there preferably (although not necessarily) being three of said sponsons: a central keel sponson, and a port and starboard sponson, one on each side of the keel sponson. These sponsons provide two channels between which preferably, but not necessarily, are so shaped as to form a venturi structure that tends to lift the boat out of the water when it is under way. Propulsion means are placed in at least two of said channels, whereby the boat may be steered by differential operation thereof.

According to still another preferred but optional feature of the invention, a canopy may be placed atop the decking which itself is preferably a surface of revolution generated by an elliptical arc revolved around the vertical central axis, said canopy being solid and imperforate, if desired, and ventilating means such as a snorkel ventilator or the like, ventilating the canopy, thereby keeping the interior of the boat dry, even in rough weather.

The above and other features of this invention will be fully understood from the following detailed description and the accompanying drawings, in which:

FIG. 1 is a plan view of a boat according to the invention;

FIG. 2 is a side elevation taken at line 2—2 of FIG. 1;

FIG. 3 is a bottom view of the boat shown in FIG. 1;

FIG. 4 is a head-on view taken at line 4—4 of FIG. 1;

FIG. 5 is a cross-section taken at line 5—5 of FIG. 3;

FIG. 6 is a fragmentary cross-section taken at line 6—6 of FIG. 3; and

FIG. 7 is a cross-section of a detail of the boat shown in FIG. 1.

FIG. 1 shows a boat 10 according to the invention. The boat is substantially circular in plan view as shown, the hull 11 having its outermost limits defined by a joint 12. A fantail 13 is integral with the hull and modifies its circuar shape at the rear thereof. Forward axis 14 indicates the forward direction of the boat for purposes of reference.

The fantail has sides 15, 16 which are preferably straight lines tangent to joint 12, and which form an acute angle between them. The acute angle opens toward the boat. The stern end 17 of the fantail is preferably a straight edge extending parallel to the transverse axis 18 of the boat. The transverse axis is normal to the vertical axis 30 and forward axis 14.

The hull includes a decking 19 having an opening 20 therein. This opening may be left open if no protection from the elements is desired for the passengers, but usually a canopy 21 is provided. The canopy is a complete enclosure. It is provided with a door 22 for entry. A snorkel tube 23 is placed atop the canopy for ventilation purposes. It serves to ventilate the region beneath the canopy.

The interior of the hull is provided with a flooring 24 on which rest seats 25. Controls 26 are provided for maneuvering the craft.

Reference should now be made to FIGS. 2 and 4 for a full disclosure of the geometrical configuration of the outer surfaces of the boat.

As can best be seen in FIG. 2, the hull includes a bottom 27 which is joined by attach means 28 to decking 19. The decking 19 has the canopy attached to it by attach means 29. The outer surfaces of the bottom, the decking and the canopy are surfaces of revolution formed by arcs of ellipses rotated around the vertical axis 30 of the boat. The vertical axis of the boat is substantially normal to the water when the boat rests in the water, and is shown in FIG. 4. Arcs 31, 32, and 33 which generate the canopy surface, decking surface, and bottom surface are indicated by brackets in FIG. 4.

Preferably, but not necessarily, arcs 32 and 33 which generate the bottom and the decking surfaces, are from the same ellipse, although they may be from different ellipses if desired. The canopy may have a slightly greater minor axis in order to give greater head room for the occupants of the boat than if arc 32 were continued to make a complete ellipse. It is to be understood that it is within the scope of this invention, however, to make the cross-section through the central axis a complete ellipse by completing the ellipse which would be generated by arcs 32 and 33. The major axes of all the elliptical arcs lie in planes parallel to the plane in which joint 12 lies.

In FIG. 7, there are shown attach means 28 which are utilized to join decking 19 and bottom 27. A hook-shaped flange 34 is formed around the lower edge of decking 19, and a similar hook-shaped flange 35 is formed around the edge of bottom 27. The hooks are oppositely directed. There are flat surfaces 34*a* and 34*b* just inside the hooks. A layer of cement 34*c* joins the bottom and decking by cementing them together. An epoxy resin formulation is a suitable cement. A collision bumper 36 of some resilient material such as silicone rubber, may be snapped over the hooks around the edge of the boat.

The construction of this hull renders its susceptible to being made more buoyant by the inclusion therein of a foam-in-place plastic material. The craft may thereby be made substantially unsinkable. As is shown in FIGS. 5–7, a buoyant, non-porous material 80 such as urethane foam may be cast or otherwise inserted inside the hull at the outer joint of the decking and bottom, around the complete periphery thereof. It serves not only to increase buoyancy, but also acts as an additional means for attaching the two hull portions together. Furthermore, this material may be cast into the unused bottom sections beneath the flooring for additional buoyancy.

FIG. 6 illustrates a means for attaching the canopy to the decking. A U-shaped bead 38 is pressed over an upright flange 39 on the decking, and the canopy is pressed

over the outside of the U-shaped bead, where the resilience of the bead presses back against the canopy to hold it on. The canopy can be removed when desired by snapping it off of the bead. Screws, hold-down lugs, or the like, may also be provided to hold down the canopy to the decking, either permanently or semi-permanently.

While the hull is described herein as being formed of continuous arcs of the shapes defined, it will be understood that the fantail and certain elements yet to be described are appended thereto, and while they interrupt the continuity of the arcs, it may be imagined that the hull is a continuous surface beneath them. The protuberances are merely local modifications of a generally and substantially continuously curved structure.

The hull has attached to its bottom and protruding downward therefrom a central keel sponson **40** (FIG. 4) and a port and a starboard sponson **41**, **42**. The keel sponson is on the center line of the boat and extends in a forward direction. Sponsons **41** and **42** are generally aligned with the keel sponson. They are spaced from it, one on each side, and form channels **43**, **44** therebetween.

The keel sponson has a heel **45** which is a flat area spaced to the rear of the central axis of the boat. A curved surface **46**, generated by a straight-line generator maintained parallel to transverse axis **18** extends forwardly from the keel and merges with the bottom about at the central axis of the boat. On each side of surface **46** there are curved sides **47**, **48** which converge toward the front end of the keel sponson, diverge toward its middle, and again converge toward the rear face **49** thereof. The rear face of the sponson is a sloping planar rear surface which intersects the heel, the two sides **47**, **48**, and the bottom surface of the fantail. Surfaces **47** and **48** intersect surface **46**, the bottom of the boat, and the bottom of the fantail.

The port and starboard sponsons are mirror images of each other, so that only port sponson **41** will be described in detail. The starboard sponson has similar structure. The port sponson has a heel **50** which is forward of heel **45**. Therefore, there are three sponson heels on the boat. They all lie in the same plane. The boat can be taken out of the water and set on the heels. The avoids dry-docking problems, because the boat has a stable footing, the three heels defining a single plane of rest for the boat, and supporting the boat.

The forward end of heel **50** meets a sharp-pointed edge **51** which extends forwardly, and curves gently outward. Edge **51** is formed by the intersection of two curved sides **52**, **53**. Side **52** is inboard, and side **53** is outboard. Side **52** has a more pronounced curvature than side **53**, and therefore a greater area, both in plan and in elevation than the outboard side. Both of the sides diverge from the forward edge of the sponson to a point about midway on the respective sponsons, at which point they begin to converge again toward the rear thereof. The rear face **54** of the sponson is a sloping plane which joins the rear end of the fantail, the two curved sides, and also a lower rear surface **58** on the bottom of the sponson.

The heel and surface **58** are joined by a step **59**, this step causing the heel to be at a lower elevation than rear surface **58**. This creates a hydroplane-type step on the sponson, which aids the boat in rising out of the water when in operation.

The pronounced curvature of the inboard sides of the port and starboard sponsons, together with the curvature of the sides of the keel sponson, form two venturi channels **43**, **44**. The greater curvature of the inboard surfaces of the port and starboard sponsons as compared to the curvature of the outer surfaces, tends to create an increased pressure effect for lifting the boat as it moves in the water.

Propulsion means **60**, **61** are respectively disposed in channels **43** and **44**. The propulsion means are shown as propellers **62**, **63** mounted to shafts **64**, **65**, respectively.

These shafts are supported in journals **66**, **67**, these journals being formed as fins which project into said channels. The journals have a hydrofoil construction so their impedance to water flow is minimized. The propellers are preferably disposed near the rear of the channels, but they are ahead of the rear faces of the sponson and are overhung by the fantail. The boat can then be backed into a dock without damaging the propellers. The journals have sloping surfaces **68**, **69** on their bottom surfaces, and they are bounded by side surfaces **70**, **71**, and **72**, **73**, respectively.

FIG. 6 shows journal **67**, which is identical to journal **66**, and which provides means whereby the propulsion means are mounted in the channels, and by which they are connected to driving means. To the rear surface **74** of journal **67** there is fixed a bearing **75**. A rubber fill **76** may conveniently be placed in the bottom of the journal to reduce vibration. The propeller is mounted to a propeller shaft **65** that is journaled in bearing **75**. The shaft passes through the rubber fill to a motor **79** mounted to the hull. Because this boat has so little drag as compared with conventional boats, it has been found practical to drive it by the use of high-current capacity batteries, and this is one of the advantages attainable from the paticular boat construction. Dangers of explosion resulting from the use of inflammable fuels and the like can thereby be eliminated.

It will be noted that this boat is rudderless. It is controlled by operation of the two propellers at selected speeds in selected directions. Other propulsion means, if used, could also be operated differentially.

The entire boat, with the exception of the canopy, may be made of conventional fiberglass-reinforced plastic construction. As one result of its general smooth curvature, this boat is able to withstand severe buffetting which would loosen the joints of conventional boat manufacture, without damage. Accordingly, the boat may also be made lighter in weight than conventional boats, inasmuch as it does not require such substantial bracing. The shape is self-bracing and sufficiently flexible to withstand heavy peak force loads.

The canopy is preferably made of a transparent material, and may be cast or otherwise formed perhaps from plexiglass. In operation, the propulsion means are started up, and the boat in moving forward tends to rise up on its sponsons. The curved surface **46** on the keel sponson is the source of the principal reaction for raising the boat initially out of the water, the port and starboard sponsons serving as stabilizers. The port and starboard sponsons soon rise on their keels as does the keel sponson, and the step arrangement of the port and starboard sponsons tend to reduce friction by lifting a considerable proportion of the sponson areas out of the water in accordance with well-known hydrodynamic concepts. It is, of course, advantageous to remove the boat as far as possible from the water during forward motion, because this eliminates the tremendous waste of energy which is ordinarily expended in forming a bow wave to part the water to move a boat therethrough. It is the ability of this boat to "climb up" on the water, as opposed to forming a bow wave which so greatly reduces the energy requirements for propulsion, which energy ordinarily goes into creating a bow wave.

In addition, considering other fluids through which the boat moves, that is, the air which surrounds it as well as the water below it, an elliptical surface appears to have hydrodynamic and aerodynamic properties which result in least waste of energy.

At any rate, whatever the theoretical reason for its ability to move at considerable velocities with low power requirements, this boat has been found to attain velocities hitherto unattainable by boats of this general class, while still requiring relatively very low horsepower for the purpose. The boat is conveniently maneuverable by differential operation of the propellers, and may conven-

iently be docked by simply backing the fantail against a dock. The propellers are protected by the rear ends of the sponsons from damage when backing into the dock.

Any desired rearrangement may be made with the canopy. It may be eliminated entirely, if desired, but one of the advantages of the particular construction shown is the ability to make a flat, stable boat with considerable headroom, which may be entirely enclosed if desired. Of course, any desired portion of the canopy may be removed, or the canopy may be removed entirely. The snorkel valve, however, will provide suitable ventilation for the boat under all operating conditions.

This invention is not to be limited by the embodiment shown in the drawings and described in the description which is given by way of example and not of limitation, but only in accordance with the scope of the appended claims.

I claim:

1. A boat comprising a hull having an upright central axis, a bottom having an outer surface, a decking having an outer surface, both of said outer surfaces being surfaces of revolution generated by a respective elliptical arc revolved around said upright central axis, thereby forming a structure which is circular in plan view, a fantail integral with said hull and projecting therefrom at the rear thereof, said fantail being bounded in plan by a pair of tangents to the hull, which tangents include an acute angle between them which opens toward the hull, a keel sponson integral with the bottom surface and extending in the direction of forward motion of the boat, a port and starboard sponson integral with the bottom and projecting therefrom, one on each side of the keel sponson, said sponsons being spaced apart so as to leave channels therebetween, propulsion means mounted in each channel for propelling the boat, and means carried by the boat for operating the propulsion means.

2. A boat according to claim 1 in which the port and starboard sponsons are mirror images of each other, each having a substantially flat heel normal to the central axis and spaced from the outer surface of the bottom, a prow edge slanting toward and intersecting said bottom surface in a direction away from said fantail, a step adjacent said heel immediately behind and contiguous thereto.

3. A boat according to claim 2 in which the keel sponson has a heel normal to the central axis, a forwardly and upwardly sloping surface contiguous to and ahead of the heel, and a pair of curved side surfaces intersecting the sloping surface and heel.

4. A boat according to claim 3 in which the sloping surface on the keel sponson is generated by a straight line generator maintained parallel to the transverse axis of the boat.

5. A boat according to claim 2 in which the inboard surfaces of the port and starboard sponsons are curved to form a pair of venturi sections with the keel section.

6. A boat according to claim 5 in which the curvature of the inboard surfaces of the port and starboard sponsons is more pronounced than the curvature of the outboard surfaces.

7. A boat comprising a hull having an upright central axis, a bottom having an outer surface, a decking having an outer surface, both said outer surfaces being surfaces of revolution generated by a respective elliptical arc revolved around said central axis, a fantail integral with said hull and projecting therefrom at the rear thereof, said fantail being bounded in plan by a pair of tangents to the hull, which tangents include an acute angle between them which opens toward the hull, a keel sponson integral with the bottom surface and extending in the direction of forward motion of the boat, a port and starboard sponson integral with the bottom and projecting therefrom, one on each side of the keel sponson, said sponsons being spaced apart so as to leave channels therebetween, the bounding surfaces of said channels being curved so as to form venturi sections therebetween, propulsion means mounted in each channel astern of the narrowest section of said venturi channels for propelling the boat, means carried by the boat for operating the propulsion means, means for joining the bottom and decking, a continuous hooked edge on each of said bottom and decking, said hooks being oppositely directed where the bottom and decking are brought together, and a continuous collision bumper over said two hooks, and buoyant means inside the boat adjacent said joint for adding buoyancy to the boat.

8. A boat according to claim 7 in which said propulsion means comprise shaft-driven propellers, and in which supports are provided for holding the propellers in their respective venturi channels.

9. A boat according to claim 8 in which the propulsion means are separately controllable from each other.

10. A boat according to claim 8 in which the upper decking has an opening therein, and in which a canopy is provided which fits said opening for forming an enclosure.

11. A boat according to claim 10 in which the canopy is adapted to be entirely closed, and in which a snorkel valve is provided therethrough for venting the same.

12. A boat according to claim 10 in which means are provided for joining the canopy to the upper decking comprising a circumferential flange on the upper decking, a U-shaped bead fitted over said flange, the canopy being adapted to be pressed over said bead to be retained thereby.

13. A boat according to claim 6 in which said propulsion means comprise shaft-driven propellers, and in which supports are provided for holding the propellers in their respective venturi channels.

14. A boat according to claim 13 in which the propulsion means are separately controllable from each other.

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