Dec. 10, 1963 H. L. BROWNBACK 3,113,543

INVERTED VEE-BOTTOM BOATS

Filed Dec. 6, 1961 3 Sheets-Sheet 1

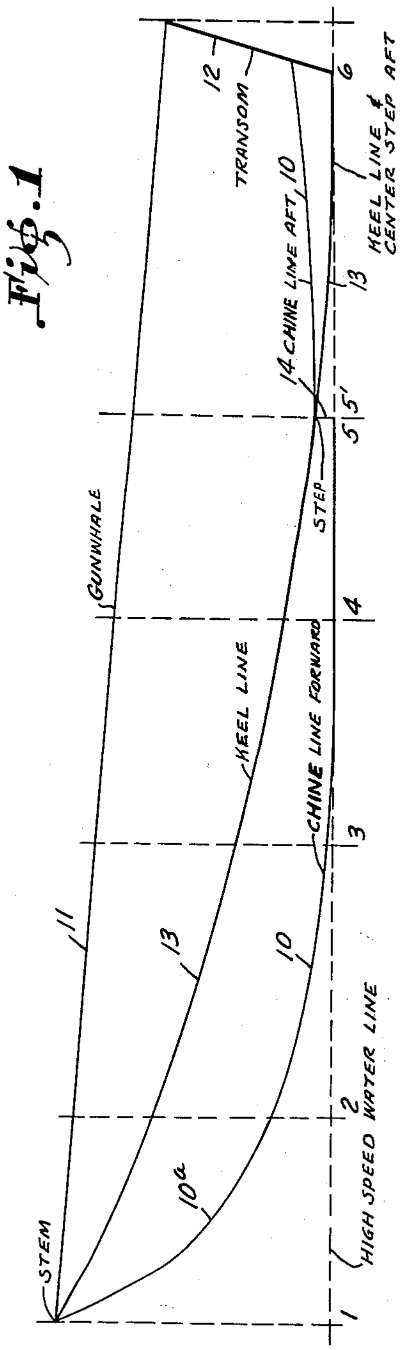

Fig. 1

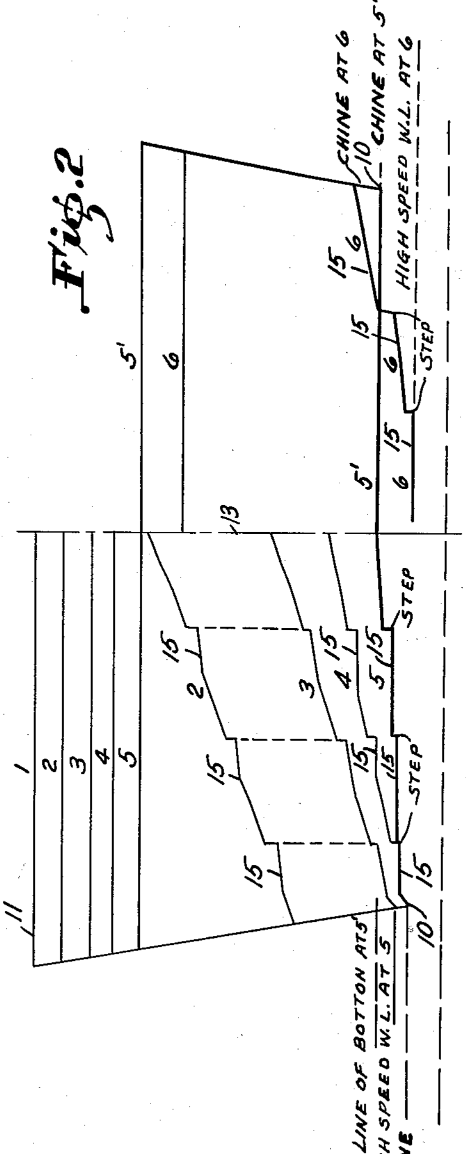

Fig. 2

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INVERTED VEE-BOTTOM BOATS

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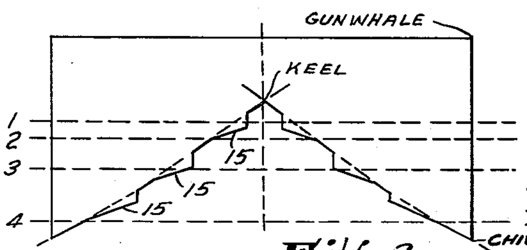


Fig. 3

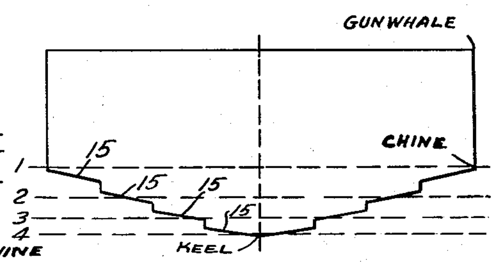


Fig. 4

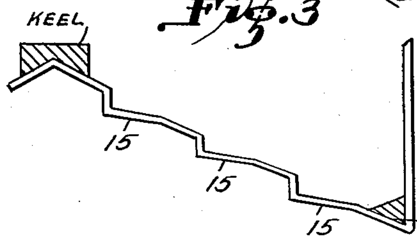


Fig. 5

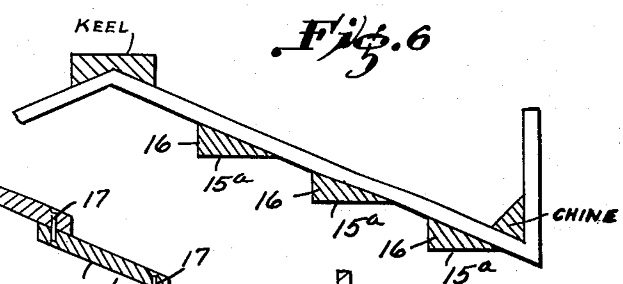


Fig. 6

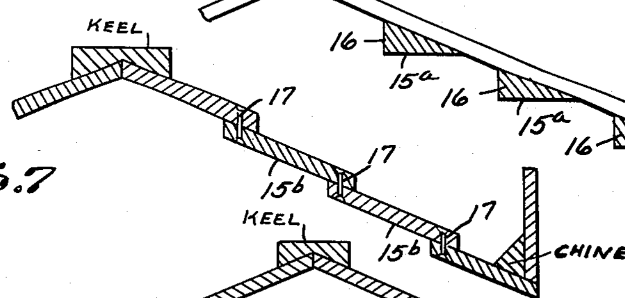


Fig. 7

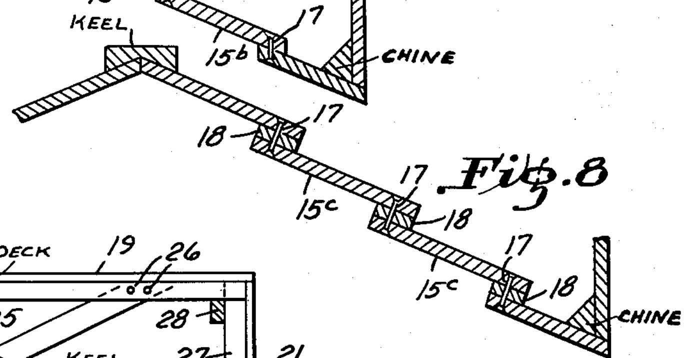
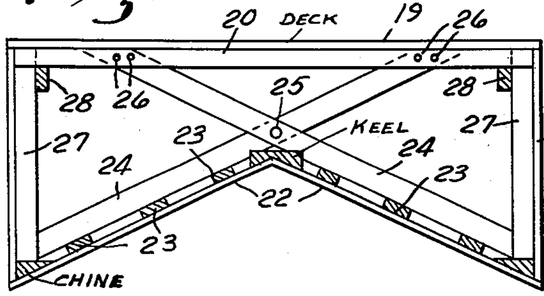


Fig. 8

Fig. 9



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INVERTED VEE-BOTTOM BOATS

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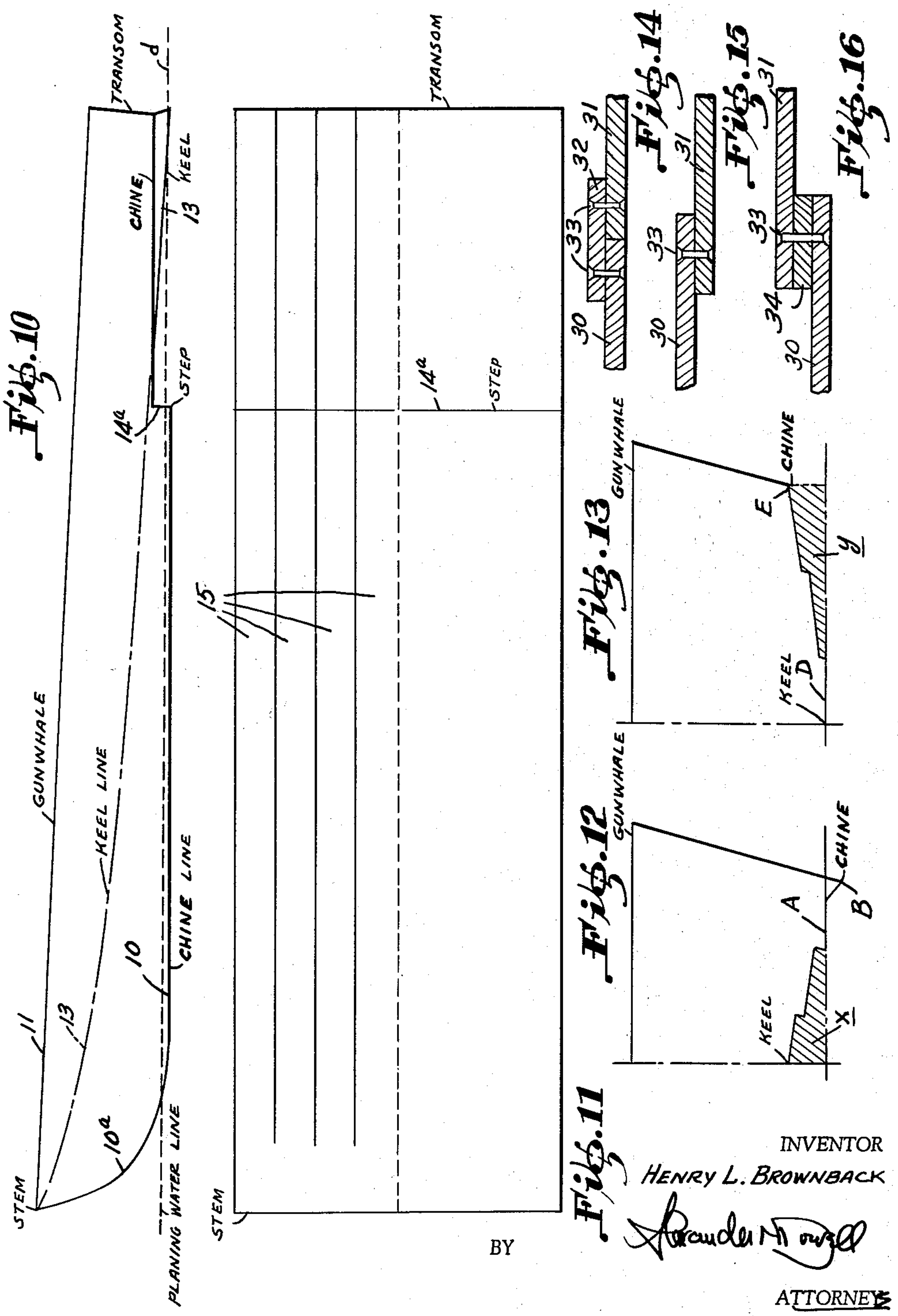

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3,113,543

INVERTED V-BOTTOM BOATS

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Filed Dec. 6, 1961, Ser. No. 157,339
16 Claims. (Cl. 114—66.5)

This invention is a novel improvement in inverted V-bottom boats, and the principal object of the invention is to provide a boat of the above type containing certain novel features of construction hereinafter more fully set forth, said boat having a transverse step in its bottom disposed adjacent the stern, and having longitudinal steps in its bottom disposed fore and aft of the transverse step, whereby when the boat is propelled at speeds wherein the forces tending to distort the hull are the greatest, and wherein the greatest quantity of air is being forced under the hull, the forward part of the hull at each side will ride on the outer longitudinal steps and on the chines plus the cushion of trapped air being forced under the hull and moving toward the back of the boat, making for a widely separated support laterally in advance of the transverse step, while the after part of the hull is supported on the center longitudinal step in rear of the transverse step, thus giving a three point suspension relieving the hull from undue torsional loading, while at the same time the imprisoned air passing rearwardly from the hollow V portion of the hull will be expelled laterally in rear of the transverse step giving air-clear water for proper operation of the propeller or propeller and rudder; and said laterally expelled air clearing away to a large extent any water which might tend to run along the bottom of the boat creating friction.

The well-known inverted V-bottom boat or sea sled, as first proposed by Albert Hickman, was designed to roll the bow wave under the forward part of the bottom of the boat giving it, as lift, much of the energy ordinarily wasted in throwing spray or forming a high bow wave in the ordinary form of hull. In the original Hickman boat this inverted V section continued toward the stern decreasing in depth until it was very shallow or entirely absent at the transom. The object of this design was, of course, to force the displaced water into this tunnel lifting the hull and accelerating the water mixed with a large volume of air toward the stern of the vessel. When everything was right, some of these hulls proved themselves capable of carrying heavy loadings per horsepower at high speeds as compared to certain other types, and, further, the Hickman boats rode better and resisted "digging in" at the bow in a following sea.

On the debit side, Hickman's long sharp chine which ran like a sled runner in the water for the full length of the boat, made it difficult to turn the boat and made it subject to nasty catching of the chine under many different circumstances, which often resulted in overturned boats. Later models had flattened chines which improved handling somewhat but lowered the efficiency of the hull and made it throw spray and furthermore weakened the boat structure.

Another handicap of the Hickman design was due to the fact that the long shallow box form of hull was very weak in torsion when built under the ordinary keel and frame construction, since while it bore on both sides of the hull full length it could in some seas bear on diagonal corners. This deformation of the hull was very severe on power plant and drive installations and wracked the whole hull structure.

A third handicap of the Hickman design was the fact that the bow wave water mixed with large volumes of air could not escape at any point in the hull laterally and was carried back to the transom and discharged directly into the path of the propeller and rudder causing such excessive cavitation that Hickman was compelled to use

side plate rudders and propellers of a very large diameter in which only the blades below the hub bore in the water. This not only created a great disturbance and a "rooster tail" of spray but the boats were unmanageable at low speeds unless two wheels were used and the torsional vibration set up in the propeller shafts was transmitted to the entire power plant, causing many failures. These weaknesses made the use of excessively heavy construction obligatory, reducing the payload, and any attempt to lighten the power installation or hull to gain payload or speed increased the risk of power plant and hull failure. The forces at the forward end of the boat created by forcing the hull through the water were upwards and outwards, and as the hull was almost divided in two for at least 25% of its length, this outward force sometimes caused hull failures.

The first radical improvement in the hollow V-type of hull, as shown in my U.S. Letters Patent No. 2,366,590, comprised a hull in which the hollow V extended back from the bow toward the stern for about 75–80% the length of the hull at which point it changed to a positive V or convex bottom or "deadrise," providing a boat which could be easily maneuvered as the stern turning could not trip, and the force of the water on the bottom made it bank inwardly while making turns, with the front the chines acting as fins to keep the front of the boat from skidding. Further, the flat portion of the hull at the point where the hollow V became deadrise, flattened out the water and air coming back from the hollow forward section, and much of the air escaped laterally permitting the usual submerged propeller and rudder to be used.

Further tests and studies have shown how a series of improvements using, at times, devices which had been used separately with other types of hulls but, never to the best of my knowledge, together or in a hollow V hull, could not only radically increase the efficiency and safety of the hollow V bottom, but could relieve some of the destructive loading on the hull, and that improved bracing would give the required strength without undue weight. These discoveries and studies form the basis of my present invention.

I will explain the invention with reference to the accompanying drawings which illustrate several practical embodiments thereof to enable others familiar with the art to adopt and use the same, and will summarize in the claims, the novel features of construction, and novel combinations of parts, for which protection is desired.

In said drawings:

FIG. 1 is a diagrammatic longitudinal or side elevational view of one form of hull according to my invention, having a transverse step and longitudinal steps fore and aft of the transverse step, the chine line at the transverse step rising to meet the keel line, and the chine line aft of the step continuing above the keel line to the transom.

FIG. 2 is a diagrammatic transverse sectional view indicating the typical transverse sections of the hull at the various stations numbered 1 to 6 in FIG. 1 showing the arrangement of the longitudinal steps fore and aft of the transverse step.

FIGS. 3 and 4 are diagrammatic views in slightly exaggerated form showing in FIG. 3 an elevation of the forward section of the hull, and in FIG. 4 an elevation of the after section of the hull.

FIGS. 5, 6, 7 and 8 are cross-sectional views showing different methods of forming the longitudinal steps in the hull, respectively; FIG. 5 showing the steps formed by pressing the metal or plastic of the hull body; FIG. 6 showing the steps as applied to the hull body; FIG. 7 showing the steps as formed by lapstrake planking; and FIG. 8 showing the steps as formed by longitudinal battens.

FIG. 9 is a cross-section through the forward portion of the hull showing my novel bracing arrangement.

FIG. 10 is a view similar to FIG. 1 showing a modified hull having a transverse step in which the chine line does not rise at the transverse step to fully meet the keel line at the transverse step, but crosses the keel line abaft of the transverse step.

FIG. 11 is a diagrammatic bottom plan view of the hull shown in FIG. 10, showing an arrangement in which the longitudinal steps both fore and aft of the transverse step are in substantial alignment.

FIG. 12 is a diagrammatic cross-section through the forward portion of the hull indicating the entrapment of air and water in the hollow V at the forward portion of the hull permitting the air and water to escape backwards toward the stern at relatively high speeds of the hull.

FIG. 13 is a view similar to FIG. 12 but showing how the entrapped air and water in FIG. 12 may escape laterally of the hull aft of the transverse section so that the hull is supported at the aft section on substantially solid water.

FIGS. 14, 15 and 16 are sectional views showing various types of planking which may be used in connection with my hull, particularly when the planking is light and made of wood or plywood; FIG. 14 showing the use of standard battened planking; FIG. 15 lapstrake planking; and FIG. 16 my improved battened planking arranged to stiffen the joint between the planks.

As shown in FIGS. 1 and 2, the chine line **10** of the side plates of the hull are preferably disposed slightly farther apart adjacent the bow than at the stern, giving the gunwale or sheer line **11** a slight deadrise above the chine line **10** at the bow of the boat, the chine line being rounded as at **10***a* at a point approaching the stern and extending upwardly and forwardly to meet the gunwale line **11** at the stern. The rear ends of the side members of the hull are connected by a transom **12** whereby substantially the same width of hull is maintained throughout the length of the hull, as indicated in FIG. 11. The keel line **13** extends from a point at the stern below the gunwale line **11** and passes rearwardly and downwardly in a curve of large radius to the transverse step **14** disposed approximately ⅔ of the length of the hull from the bow to the stern at which step **14** the keel line **13** touches the chine line **10** and continues below the chine line **10** abaft of the transverse step **14**, as clearly indicated in FIG. 1.

The bottom of the hull from the bow to the transverse step **14** is of the type known as a hollow V or concave, the hull line **13** being disposed above the chine line **10**. The bottom of the hull abaft of the transverse step **14** is of normal V or round bottom extending aft approximately ⅓ the length of the boat, the shape of the bottom fore and aft of the transverse step **14** being clearly indicated in FIGS. 2–8 of the drawings.

The bottom of the hull both fore and aft of the transverse step **14** is provided with longitudinal steps **15** as shown in FIGS. 2–8, which may be formed in various manners, FIGS. 3 and 4 showing at the line marked **1** the normal water line of the hull when at rest; line **2** indicating the water line with relation to the hull at low speed planing of the hull; line **3** indicating the water line as the planing speed increases; and line **4** indicating the water line at high hull speeds.

I have thus provided a hull of the above mentioned type in which the extreme front or bow of the boat is that of the ordinary type of hollow V bow boat which at low speeds will roll up a bow wave and create lift, and when any attempt is made to submerge, the bow creates a tremendous dynamic lift plus great reserve buoyancy. The chine **10** rises to meet the keel **13** at the horizontal stem which meets the gunwale **11** as well. The chines **10** curve down and back for about 20% of the length of the hull and then run roughly parallel to the waterline toward the stern. The keel **13** sweeps down and back on a much larger curvature, which if continued would cross the chines **10** about 80% the length of the boat from bow to stern. It will be seen, therefore, that the basic bottom of the hull is typical of the hollow V bottom boat which at low speeds will roll the bow wave under to produce lift and prevent any diving in following or cross seas.

In my present invention following along the bottom beginning at a point roughly half of the distance from the stem to where the chine **10** roughly parallels the water line, a series of longitudinal steps **15** are formed in the bottom of the boat. These steps **15** may be applied, or formed in the bottom or forced by "lapstrake" construction as desired and their width will vary with the service for which the boat is intended. These steps begin by being very shallow and increase in depth at the point where they parallel, roughly, the waterline or planing line of the hull. The faces of these steps **15** will begin by having a transverse angle like that of the bottom but less in degree and by the time they reach the point where the chine **10** roughly parallels the water line they will be horizontal or nearly so cross-ship. The lowest point of these steps **15** is always above that of the chines **10** so that when the hull is planing on the lowest of these longitudinal steps the chines **10** will be in the water back to the point where the after section of the bottom becomes a positive V or "deadrise" or convex. Thus at speed the chines **10** in the forward section of the hull touch the water to prevent it being thrown out from the hull laterally and to imprison all water displaced as well as air taken in by the bow and to accelerate both air and water toward the stern of the boat.

Thus, if we take the action of the forward part of the hull starting at the lowest speeds and going to the maximum we will see that the boat will first roll up on the imprisoned bow wave and then begin to plane on the inclined inverted V bottom and the longitudinal steps **15**, which will vary in number with the beam and the weight of the hull, power plant and payload. As the speed increases the boat will rise on this combination until the keel is clear of the water and the imprisoned air forms a cushion. It will continue to rise as the speed rises until one step after another is raised from the water and at full boat speeds the boat will be running on the longitudinal steps **15** nearest the chines **10** with the keel and the steps nearest the keel clear of the water, and with high velocity air feeding through the inverted V thus formed and sealed by the chines **10**.

At a distance roughly 70–80% of the distance from the bow to the stern of the hull, the inverted V section of the hull and its longitudinal steps terminates either by making a cross-ship step **14** in the hull at this point by cutting the chines to the height of the keel and making the bottom roughly horizontal cross-ship at this point, thus forming two shallow triangular steps which do not cut the keel (FIGS. 10–11) or by a flat cross-line in the bottom below which will project the ends of the longitudinal steps **15** of the forward part of the hull

In both cases, back of this point the bottom becomes convex or "deadrise" with the angle increasing toward the transom or stern, and this part of the bottom also is provided with longitudinal steps **15** arranged so as to start with zero depth at this line **14** and increase in depth for some distance toward the transom. The step **14** at the keel **13** is flat across, or nearly so, and the angle of each step **15** going aft toward the transom will increase so as to form "deadrise" in the steps. At low speeds the hull will ride on the bottom and all of the steps, but as the speed rises the chines in the after portion of the hull will lift clear of the water so that at full speed the after portion of the hull is riding on the longitudinal step **15** at the keel, and the other steps and chines will be riding clear of the water.

In FIGS. 5–8, various methods or means are indicated for forming the steps. For instance, in FIG. 5, the steps

15 are formed directly in the metal or fibre glass plastic bottom of the hull by pressing the same during the process of forming the hull bottom. In FIG. 6 the steps **15***a* are applied to the bottom of the hull by means of strips **16** of substantially triangular cross-section, as shown. In FIG. 7 the steps **15***b* are formed by lapstrake planking, the overlapping side edges of the lapstrake being secured together by suitable fasteners **17**, while in FIG. 8 the steps **15***c* are similar to those shown in FIG. 7 with the exception that longitudinal battens **18** are interposed between the overlapping edges of the lapstrakes, the battens **18** being also secured by the fasteners **17** as shown in FIG. 7.

In addition to the reduction of torsional stress resulting from the actual three point suspension of the hull at speed, I further provide for torsional stiffness by having the skin of the hull run on longitudinal stringers and by providing an X frame across the bottom of sufficient depth to stiffen the structure of the hull particularly when combined with cross-ship bulkheads.

FIG. 9 shows my novel means for bracing the hull at the forward section thereof in which figure the deck is indicated by the numeral **19**, the same being supported by deck beam **20**. The side planks are indicated by numeral **21**, and the bottom planks by numeral **22**. At spaced intervals on the bottom planking are placed battens **23** between the bottom planking **22** and the crossed or X frames **24**, respectively, which frames cross above the keel and are secured together by a fastener **25**, the bottom frames **24** continuing upwardly to meet the deck beams **20** to which the same are secured by fasteners **26**. Side frames **27** are provided at the side planking **21** extending from the chine to the deck beam **20**, the upper ends of the frames **27** being secured to the deck beam **20** by means of clamps **28**.

This construction materially strengthens the forward part of the hollow V by running the bottom frames **24** up to the deck beam **29**, pivoting the bottom beams **24** together above the keel, i.e., where the beams cross, and by fastening the upper ends of the bottom frames **24** to the deck beam **20**. This construction forms in effect two triangles linked to each other but with their apices so fastened to the deck beam **20** that an attempt by the separating forces to distort the hull or to rupture same is resisted by compression in that part of the deck beam lying between them. This series of triangles firmly braces the hull and may be very light in weight.

FIGS. 10 and 11 show a modified form of hull similar to FIGS. 1 and 2 and similar parts are similarly lettered. In this modification, however, the transverse step **14***a* terminates below the keel line **13** at that station and the chine line **10** extends rearwardly in a more or less horizontal direction crossing the keel line **13** at a substantial distance aft of the step **14***a*.

In any boat having a hollow V bow section forward and a deadrise section aft, there is some point where the chine line **10** must cross the keel line **13** as at one point the keel is above the chine line and at the other it is below the chine line. In the step hull this will occur at the step **14***a* if the keel is cut to give a step clear across the hull, but if the keel is not so cut (a method which I prefer) it will occur aft of the step **14***a*. With the step hull shown in FIG. 10, the boat will plane on its lowermost steps fore and aft in the hull. These being near and above the chine to the step, and near the keel and below the chine aft, at some point the chine **10** will have to cross and rise above the keel line **13**. Actually the boat will plane on the outer longitudinal steps **15** forward and the middle longitudinal steps **15** aft. The transverse step **14***a* is so arranged that the planing angles will be about 1¼–2° at high speed and about 4° at lower speeds. In FIG. 10 the line *d* indicates the planing waterline and it will be noted that at step **14***a* the above waterline zone at the step will begin to discharge air which has come back and into from the hollow V.

In FIG. 11 the longitudinal steps **15** in the forward and aft portions of the hull are indicated as being in alignment, although it is not necessary that the same number of steps fore and aft be maintained throughout the hull, or that the same number of steps fore and aft be identical. In FIG. 11 the step **14***a* does not cross the keel line.

In FIG. 12 it is noted that the water under the forward portion of the hull denoted by letter X will be forced inwardly laterally toward the keel, the chine sealing the air and water trapped or forced into the sectioned portion *x*, while in FIG. 13 we have noted that the water under the after portion of the hull is forced laterally away from the keel and that the chines are above the keel allowing the trapped air from the forward section to escape laterally after reaching the lateral step **14***a*, the air being indicated by the sectioned portion *y* in FIG. 13.

With respect to FIG. 12 which shows the forward portion of the boat at the step **14***a* looking forward, note that the boat is planing forward on longitudinal step A, while chine B is immersed in water while the opening *x* allows trapped air and water to escape rearwardly at high velocity towards the stern when reaching the step.

FIG. 13 shows the after portion of the boat. Note that the boat is planing on longitudinal step D with chine E well above the waterline, while space *y* is a void allowing the trapped air and water which was discharged from the forward section through the opening of the transverse step **14***a* to escape laterally so that the rear portion of the boat is running on solid water supported by the step D.

FIGS. 14, 15 and 16 show various types of planking, FIG. 14 showing the standard battened planking in which the plank **30** is connected to plank **31** by means of a batten **32** overlying the abutting edges of planks **30** and **31** and secured thereto by rows of fasteners **33**, such as rivets or the like. FIG. 15 shows a modification for lapstrake planing in which the plank **30** overlaps the plank **31** and is secured thereto by a single row of fasteners **33** fastened through the overlapping portions of the plank, which planks are usually lightweight and made of wood or plywood. In FIG. 16 the preferred form of plank is shown in which the planks **30** and **31** overlap as in FIG. 15. However, a batten **34** is inserted therebetween and the fastener **33** extends through the overlapping sides or edges of the planks **30**, **31**, and also through the batten **34**, the method shown in FIG. 16 materially stiffening the joint.

Summarizing, in my present invention following along the bottom beginning at a point roughly half of the distance from the stem to where the chine roughly parallels the waterline, a series of longitudinal steps are formed in the bottom of the boat. These steps may be applied, or formed in the bottom or forced by "lapstrake" construction as desired and their width will vary with the service for which the boat is intended. These steps will begin by being very shallow and will increase in depth at the point where they parallel, roughly, the waterline or planing line of the hull. The faces of these steps will begin by having a transverse angle like that of the bottom but less in degree and by the time they reach the point where the chine roughly parallels the waterline they will be horizontal or nearly so cross ship. The lowest point of these steps is always above that of the chines so that when the hull is planing on the lowest of these longitudinal steps the chines will be in the water back to the point where the after section of the bottom becomes a positive V or "deadrise" or convex. Thus at speed the chines in the forward section of the hull touch the water to prevent it being thrown out from the hull laterally and to imprison all water displaced as well as air taken in by the bow and to accelerate both toward the stern of the vessel.

Thus, if we take the action of the forward part of the hull starting at the lowest speeds and going to the maximum we will see that the boat will first roll up on the imprisoned bow wave and then begin to plane on the inclined inverted V bottom and the longitudinal steps, which will vary in number with the beam and the weight of the hull, power plant and payload, and as the speed increases the boat will rise on this combination until the keel is clear of the water and the imprisoned air forms a cushion. It will continue to rise as the speed rises until one step after another is raised from the water and at full speed will be running on the longitudinal steps nearest the chines with the keel and the steps nearest the keel clear of the water, and with high velocity air feeding through the inverted V thus formed and sealed by the chines.

At a distance roughly 70–80% of the distance from the bow to the stern of the hull, the inverted V section of the hull and its longitudinal steps will be terminated either by making a cross-ship step in the hull at this point by cutting the chines to the height of the keel and making the bottom roughly horizontal cross-ship at this point, thus forming two shallow triangular steps which do not cut the keel or by flat cross-line in the bottom below which will project the ends of the longitudinal steps of the forward part of the hull.

In both cases, back of this point the bottom will become convex or deadrise with the angle increasing toward the transom of stern and this part of the bottom will also have longitudinal steps arranged so as to start with zero depth at this line and increase in depth for some distance toward the transom. The step at the keel will be flat across or nearly so and the angle of each step going toward the transom will increase so as to form deadrise in the steps. At low speeds the hull will ride on the bottom and all of the steps but as the speed rises the chines in the after portion of the hull will lift clear of the water so that at full speed the after portion of the hull is riding on the longitudinal steps at the keel and the other steps and chines will be riding clear of the water.

It will be seen, therefore, that at speeds when the forces tending to distort the hull are the greatest, and the greatest quantity of air is being forced under the hull, the forward part will ride on the outer steps and the chines plus a cushion of trapped air being forced toward the back of the boat making for a widely separated support laterally and the after part of the hull on the center longitudinal step thus giving a three point suspension relieving the hull of torsional loading, and at the same time the imprisoned air combing back from the hollow V portion of the hull will be expelled laterally giving clear water for the propellers or propellers and rudder. Further, this laterally expelled air will clear away any water which might tend to run along the bottom of the boat creating friction.

I have shown different numbers of steps 15 in the several views referred to, purposely, as the longitudinal steps may be continuous or break off as would be the case with four steps forward and three steps aft. Actually, while the inverted V hull can and usually does have great efficiency, it can also be retarded by water friction caused by the displaced water running close to the bottom with no break until it gets aft where the displaced air breaks it up. The longitudinal steps break this sheet of displaced water after of the hull's bottom and when it is thus detached the displaced air will get under it and further break it away.

With the step type of boat as shown in FIGS. 10 and 11, this breakaway is further accomplished by the step which may also be vented to insure a clean break. This makes the hull, as far as water contact is concerned, a true three point hull as it will bear on the chines and outer longitudinal steps forward and on the inner longitudinal step aft.

If the hull has no step, the number of forward longitudinal steps can be different from those aft, and break off where the normal bottom (the bottom if no steps were used) would change from the inverted V to the deadrise form; and the break in the forward longitudinal steps would, in fact, form a series of transverse steps insuring the detachment of the water from the bottom of the hull.

For some reason, continual water flow at high speeds appears to do two things—the first being to create friction, and the second to draw the hull down, out, to and into the water, but the least sharp break stops this just as the sharp chine on a V bottom or deadrise hull breaks the water flow at the chine line and the boat will plane better and more clearly than a similar round bottom hull where the breakaway is not used, and, as a consequence the hull tends to spiral down in the water.

These longitudinal steps do, therefore, serve a double purpose, the first being to provide planing surfaces to lift the hull through hydrodynamic action and also break the water away from the normal bottom of the hull and/or the steps themselves in a clear break, preventing or minimizing the drag of water on the hull.

I do not limit my invention to the exact form shown in the drawings, for obviously changes may be made therein within the scope of the claims.

I claim:

1. A hull for speed boats, comprising substantially parallel sides, a transom, a bottom; the lower edges of the sides defining chine lines and the upper edges of the sides defining the gunwales; an axially disposed keel disposed upon the bottom, the lower edge of the keel defining the keel line; said keel extending from a point adjacent the gunwales at the bow and passing below the chine line at a point approximately two-thirds the length of the hull from the bow and continuing below the chine line from said passing point to the transom, whereby the hull will have a hollow V-bottom from the bow gradually diminishing in depth to the passing point where the bottom is substantially flat, and will have a convex V-bottom from said passing point gradually increasing in depth to the transom; and a transverse step in the hull adjacent said passing point; whereby at high speeds the hull will have a substantially three-point suspension bearing on the chines forward and on the keel aft of the transverse step.

2. In a hull as set forth in claim 1, said transverse step being disposed at said passing point.

3. In a hull as set forth in claim 1, said transverse step being disposed forwardly of said passing point.

4. In a hull as set forth in claim 1, said transverse step being disposed forwardly of said passing point, and said transverse step terminating laterally of the keel forming parallel shallow triangular steps at each side of the hull into which projects the forward part of the hull bottom.

5. In a hull as set forth in claim 1, the lowest points of the hull bottom forward of the transverse step being always disposed above the chine lines to imprison displaced water and air taken in by the bow and to accelerate both air and water toward the stern of the boat; said imprisoned water and air discharging laterally of the hull at the aft portion of the hull in rear of the transverse step.

6. In a hull as set forth in claim 1, deck beams connecting the gunwales forward by the passing point; means for providing torsional stiffness in the hull in the forward portion thereof, comprising an X-frame disposed transversely of the hull connected to the bottom of the boat and to a deck beam, said members of the X-frame being pivoted to each other above the keel, whereby any attempt to distort the hull will be resisted by compression in that part of the deck beam lying between the upper ends of the X-frame.

7. A hull for speed boats, comprising substantially parallel sides, a transom, a bottom; the lower edges of the sides defining chine lines and the upper edges of the sides defining the gunwales; said gunwales and chine line being for the major portions of their lengths substantially parallel; an axially disposed keel disposed upon

the bottom, the lower edge of the keel defining the keel line; said keel extending from a point adjacent the gunwhales at the bow and passing below the chine line at a point approximately two-thirds the length of the hull from the bow and continuing below the chine line from said passing point to the transom, whereby the hull will have a hollow V-bottom from the bow gradually diminishing in depth to the passing point where the bottom is substantially flat, and will have a convex V-bottom from said passing point gradually increasing in depth to the transom; a transverse step in the hull adjacent said passing point; and longitudinal steps in its bottom disposed fore and aft of the transverse step, whereby at high speeds the hull will have a substantially three-point suspension bearing on the chines and outer longitudinal steps forward and on the inner longitudinal step aft of the transverse step.

8. In a hull as set forth in claim 7, said transverse step being disposed at said passing point.

9. In a hull as set forth in claim 7, said transverse step being disposed forwardly of said passing point.

10. In a hull as set forth in claim 7, said transverse step being disposed forwardly of said passing point, and said transverse step terminating laterally of the keel forming parallel shallow triangular steps at each side of the hull into which projects the ends of the longitudinal steps of the forward part of the hull bottom.

11. In a hull as set forth in claim 7, the lowest points of the longitudinal steps forward of the transverse step being always disposed above the chine lines to imprison disposed water and air taken in by the bow and to accelerate both air and water toward the stern of the boat; said imprisoned water and air discharging laterally of the hull at the aft portion of the hull in rear of the transverse step.

12. In a hull as set forth in claim 7, deck beams connecting the gunwhales forward of the passing point; means for providing torsional stiffness in the hull in the forward portion thereof, comprising an X-frame disposed transversely of the hull connected to the bottom of the boat and to a deck beam, said members of the X-frame being pivoted to each other above the keel whereby any attempt to distort the hull will be resisted by compression in that part of the deck beam lying between the upper ends of the X-frame.

13. A hull for speed boats, comprising substantially parallel sides, a transom, a bottom; the lower edges of the sides defining chine lines and the upper edges of the sides defining the gunwales; an axially disposed keel disposed upon the bottom, the lower edge of the keel defining the keel line; said keel extending from a point adjacent the gunwales at the bow and passing below the chine line at a point approximately two-thirds the length of the hull from the bow and continuing below the chine line from said passing point to the transom, whereby the hull will have a hollow V-bottom from the bow gradually diminishing in depth to the passing point where the bottom is substantially flat, and will have a convex V-bottom from said passing point gradually increasing in depth to the transom; a transverse step in the hull disposed adjacent to said passing point, said transverse step terminating laterally of the keel forming parallel shallow triangular steps at each side of the hull into which projects the forward part of the hull bottom; and longitudinal steps in its bottom disposed fore and aft of the transverse step, the lowest points of the longitudinal steps forward of the transverse step being always disposed above the chine lines to imprison displaced water and air taken in by the bow and to acclerate both air and water toward the stern of the boat; said imprisoned water and air discharging laterally of the hull at the aft portion of the hull in rear of the transverse step, whereby at high speeds the hull will have a substantially three-point suspension bearing on the chines and outer longitudinal steps forward and on the inner longitudinal step aft of the transverse step.

14. In a hull as set forth in claim 13, said transverse step being disposed at said passing point.

15. In a hull as set forth in claim 13, deck beams connecting the gunwales forward of the passing point; means for providing torsional stiffness in the hull in the forward portion thereof, comprising an X-frame disposed transversely of the hull connected to the bottom of the boat and to a deck beam, said members of the X-frame being pivoted to each other above the keel whereby any attempt to distort the hull will be resisted by compression in that part of the deck beam lying between the upper ends of the X-frame.

16. A hull for speed boats, comprising substantially parallel sides, a transom, a bottom; the lower edges of the sides defining chine lines and the upper edges of the sides defining the gunwales; an axially disposed keel disposed upon the bottom, the lower edge of the keel defining the keel line; and said keel extending from a point adjacent the gunwales at the bow and passing below the chine line and continuing below the chine line from said passing point to the transom, whereby at high speeds the hull will have a substantially three-point suspension bearing on the chines forward and on the keel aft of the passing point; deck beams connecting the gunwhales forward of the passing point; means for providing torsional stiffness in the hull in the forward portion thereof, comprising an X-frame disposed transversely of the hull connected to the bottom of the boat and to a deck beam, said members of the X-frame being pivoted to each other above the keel whereby any attempt to distort the hull will be resisted by compression in that part of the deck beam lying between the upper ends of the X-frame.

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