July 11, 1967 H. J. DORNAK 3,330,239

BOAT HULL WITH TUNNELED V-BOTTOM

Filed Sept. 3, 1964 4 Sheets-Sheet 1

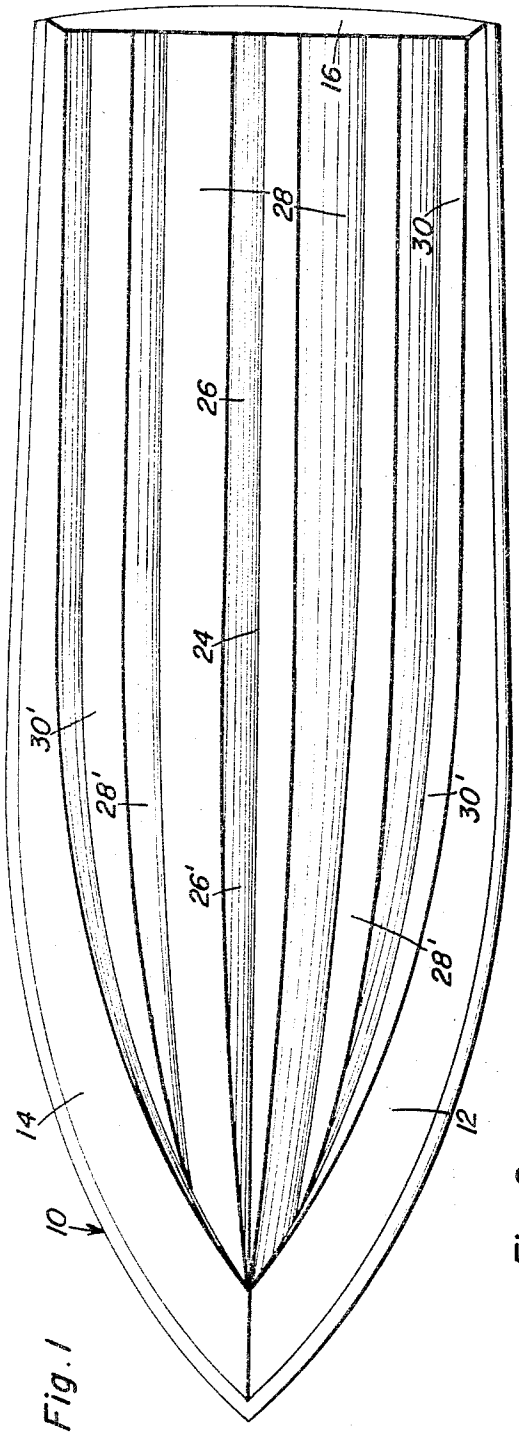


Fig. 1

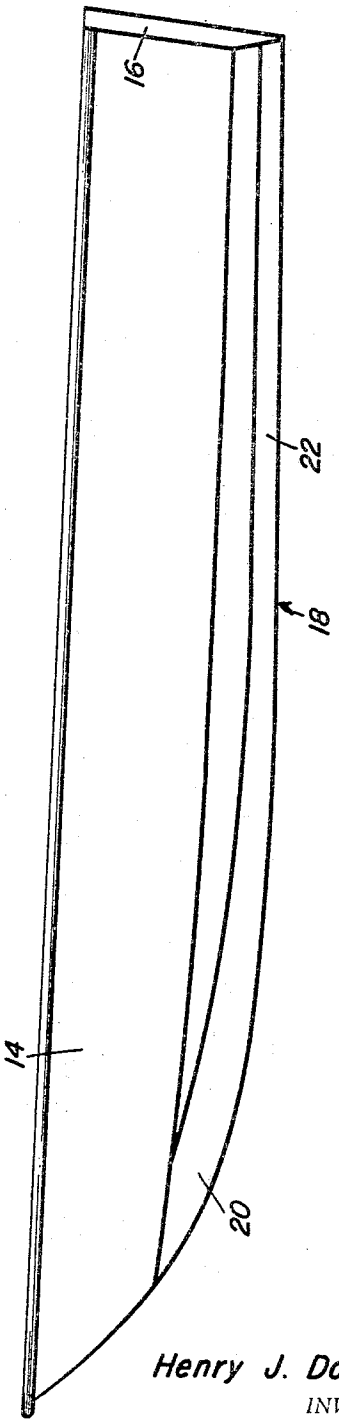


Fig. 2

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BOAT HULL WITH TUNNELED V-BOTTOM

Filed Sept. 3, 1964 4 Sheets-Sheet 2

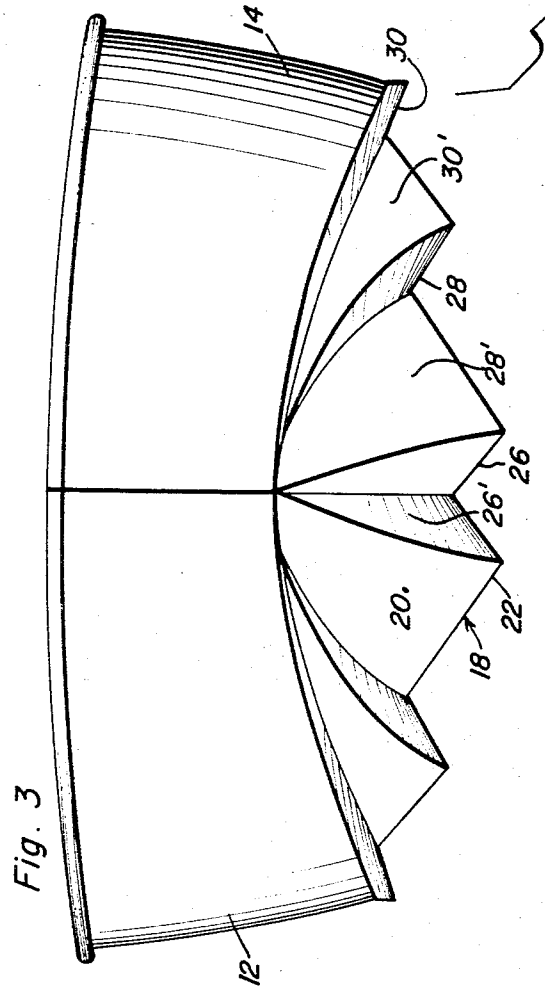


Fig. 3

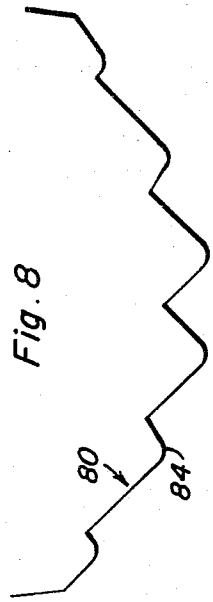


Fig. 8

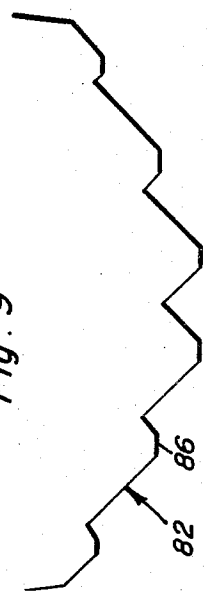


Fig. 9

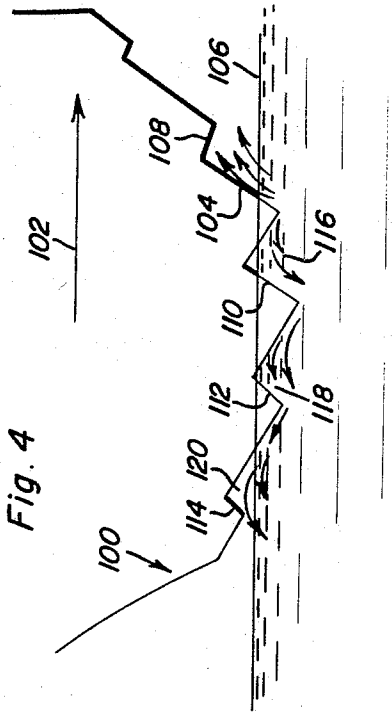


Fig. 4

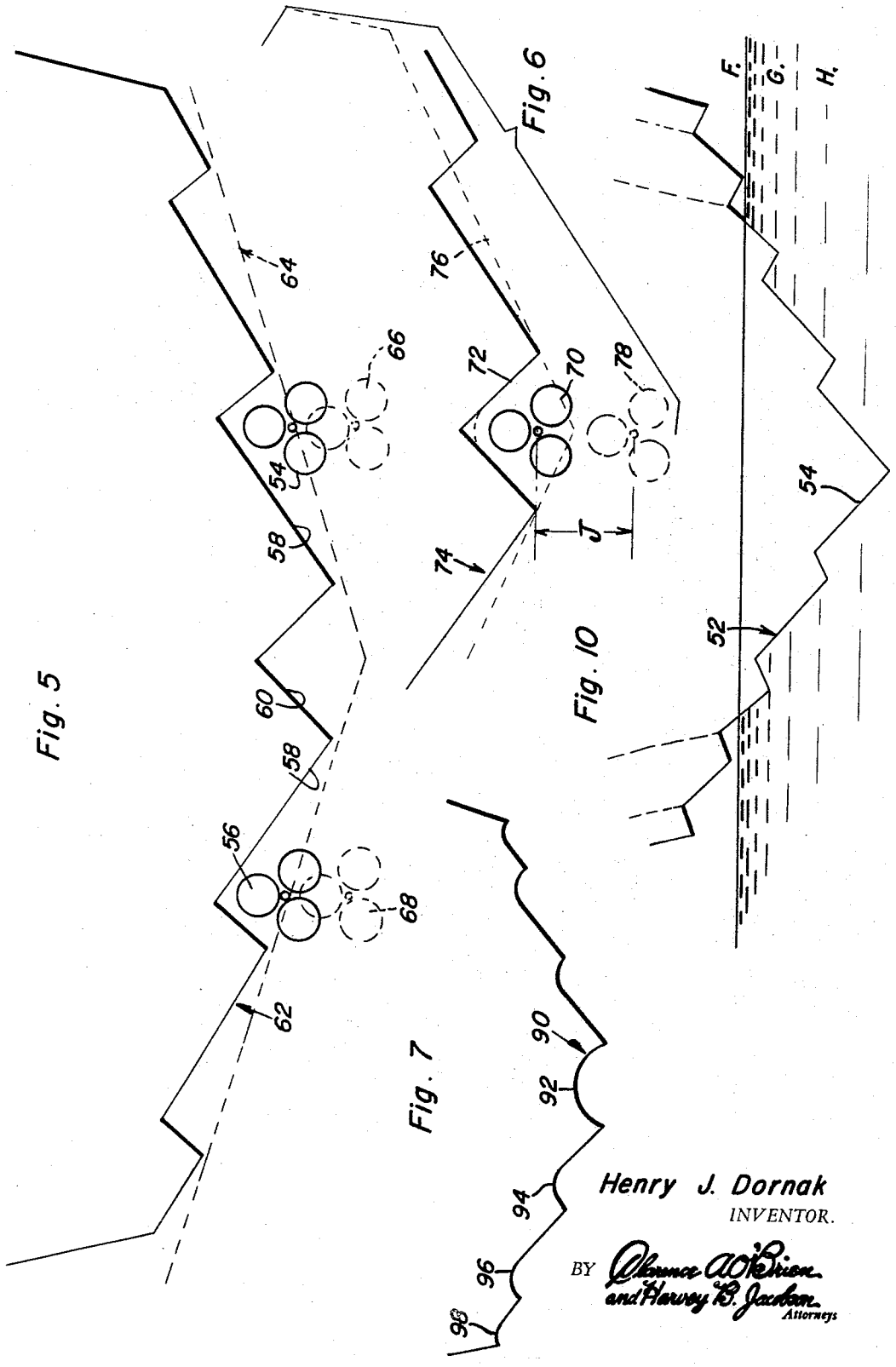
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July 11, 1967 H. J. DORNAK 3,330,239

BOAT HULL WITH TUNNELED V-BOTTOM

Filed Sept. 3, 1964 4 Sheets-Sheet 3



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July 11, 1967 H. J. DORNAK 3,330,239

BOAT HULL WITH TUNNELED V-BOTTOM

Filed Sept. 3, 1964 4 Sheets-Sheet 4

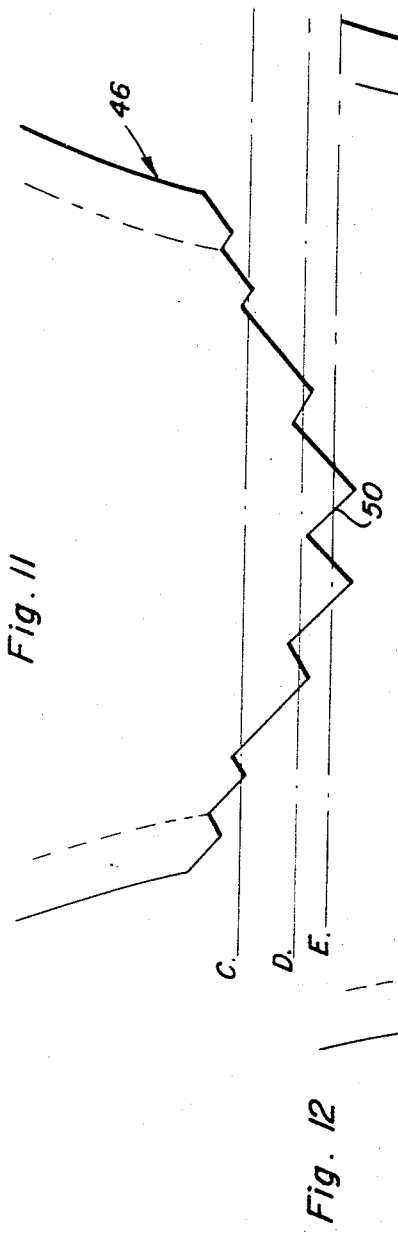


Fig. 11

Fig. 12

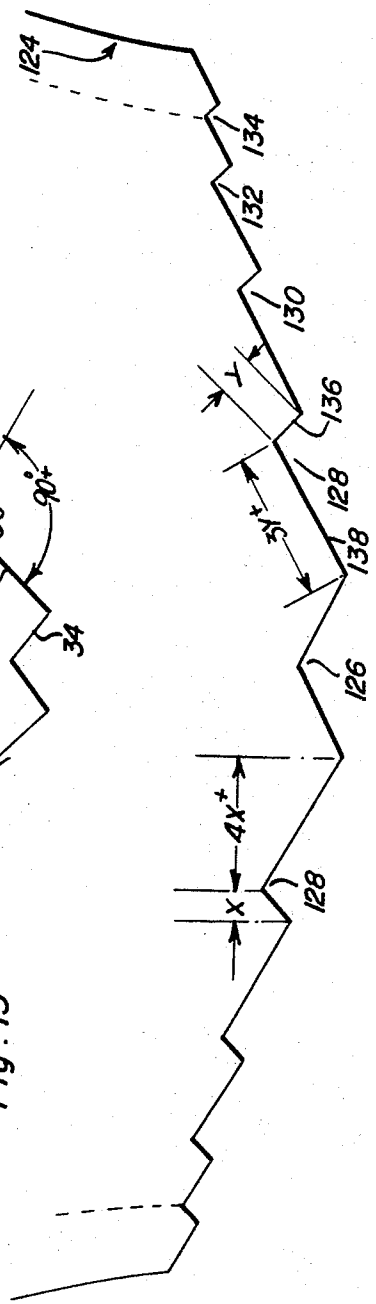


Fig. 13

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BOAT HULL WITH TUNNELED V-BOTTOM

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21 Claims. (Cl. 114—56)

This invention relates to a novel and useful boat hull of the type including a forward upwardly and forwardly curving bow portion and a substantially longitudinally straight planing portion. The planing portion of the bottom of the boat hull of the instant invention defines a longitudinal centerline and at least one pair of downwardly opening generally inverted V-shaped and longitudinally straight lift tunnels which extend along opposite sides of the longitudinal centerline of the bottom. Each of the tunnels includes inner and outer downwardly divergent surfaces including major portions that are substantially planar and corresponding longitudinal edge portions of the inner surfaces of the tunnels are disposed in a first plane spaced below a second plane containing the lower longitudinal marginal edge portions of the corresponding outer surfaces. In this manner a basically V-shaped hull is formed and yet a hull including longitudinally extending and downwardly opening tunnels which, in addition to trapping air in the forward portion thereof and providing a means for cushioning the ride afforded by the boat hull, give rise to many advantages of operation as a result of their particular configuration as will hereinafter be more fully set forth.

The main object of this invention is to provide a boat hull which is basically V-shaped in transverse vertical section and which includes longitudinally straight and downwardly opening generally inverted V-shaped tunnels disposed on opposite sides of the longitudinal centerline of the hull.

Another object of this invention, in accordance with the immediately preceding object, is to provide each of the tunnels with a smoothly and forwardly and upwardly curving forward portion disposed in the bow portion of the hull and which, when the boat hull is moving at high speed, will increase the lift of the hull in a manner such that only a narrow center strip of the planing surfaces of the hull are disposed in contact with the water when the hull is moving at high speed thereby appreciably reducing the wetted area of the hull and thus the hull to water friction, therefore increasing speed as compared to conventional designs.

Still another object of this invention is to provide the downwardly opening tunnels of the boat hull of the instant invention with downwardly divergent opposite side surfaces which are substantially planar and form an included angle exceeding 90 degrees. With this type of construction forward movement of the hull through the water and the downward thrust of the hull on the water will cause the upwardly and outwardly inclined inner surfaces of the tunnels to cause water to be rapidly displaced upwardly and outwardly along the inner surfaces of the tunnels and toward the downwardly and outwardly inclined outer surfaces of the tunnels thereby enabling the momentum or kinetic energy of the water displaced to apply a lifting thrust on the outer surfaces of the tunnels, thereby allowing the hull to carry greater load per horse power than conventional designs. In most instances, because of the desired overall V-shaped configuration of the hull, the upwardly and outwardly inclined inner surfaces of the tunnels will be of considerably greater width than the downwardly and outwardly inclined outer surfaces of the tunnels and in addition the upwardly and outwardly inclined inner surfaces of the tunnels will be disposed at a greater angle relative to a vertical plane than

the downwardly and outwardly inclined outer surface of the tunnels.

Yet another object of this invention is to provide a tunneled boat hull construction which is basically V-shaped in transverse cross-section and which includes structural features which adapt the hull for use in calm water as well as rough water.

Another object of this invention, in accordance with the immediately preceding object, is to provide a boat hull construction including longitudinally extending and downwardly opening generally V-shaped tunnels disposed relative to each other and including inclined surfaces which adapt themselves for slight variations in construction and design in a manner enabling a basic design of boat hull to be followed with only slight modifications thereto being required to specifically adapt the boat hull for use in smooth or rough water and to be utilized to carry heavy or light loads.

Still another object of this invention is to provide a boat hull construction that is well suited for inboard as well as outboard motor installations and which is further well suited for use in construction of inboard hulls and outboards hulls as well as sea plane hulls and other planing apparatus.

Still another object of this invention is to provide a boat hull construction including structural features which specifically adapt the boat hull to afford an air cushioned ride while simultaneously reducing the wetted area of the hull.

A further object of this invention is to provide a boat hull including structural features that enable any and all water displaced transversely outwardly away from the longitudinal centerline of the hull in response to rapid forward movement of the hull over a body of water to be deflected downwardly as opposed to upwardly and outwardly thereby providing a boat hull which is extremely "dry."

Yet another object of this invention is to provide a boat hull constructon including structural features adapting the hull for use with single propeller installations as well as dual propeller installations while simultaneously providing the desired V-shaped hull and also reducing the draft of the boat hull relative to the draft of a conventional V-shaped hull.

Another object of this invention is to provide a boat hull construction that due to the tunnels and tunnel surfaces maintains positive control and maneuverability in any type of seat at any speed range.

Another object of this invention is to provide a boat hull construction including structural features that provide superior stability to the craft at rest and in motion.

Another object of this invention is to provide a boat hull construction including structural features which due to their configuration lends additional inherent strength to the bottom material, therefrom providing a stronger bottom structurally than conventional hull designs.

Another object of this invention is to provide a boat hull construction including structural features that allow ram air to enter beneath the hull and become trapped and compressed and as it passes aft along the hull to cushion the ride and break up skin friction on the tunnel surfaces.

A final object of this invention to be specifically enumerated herein is to provide a tunneled V-bottom boat hull in accordance with the preceding objects which will conform to conventional forms of manufacture, be readily adaptable to minor configuration variations and highly efficient in operation so as to provide a hull that will be economically feasible, readily adaptable for use on rough and smooth water and for maximum speed and stability.

These together with other objects and advantages which will become subsequently apparent reside in the details of

construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a bottom plan view of the boat hull of the instant invention;

FIGURE 2 is a side elevational view of the boat hull of the instant invention;

FIGURE 3 is a front elevational view of the boat hull of the instant invention shown on somewhat of an enlarged scale;

FIGURE 4 is a diagrammatical view of the cross-sectional shape of the boat hull of the instant invention illustrating the manner in which the boat hull affords exceptional stability while executing a turn;

FIGURE 5 is a diagrammatical view of the cross-sectional shape of the boat hull of the instant invention showing the manner in which it is particularly well adapted for dual motor installation and also the manner in which the overall draft of the boat hull is substantially reduced by its particular configuration and its adaptability for dual motor installation;

FIGURE 6 is a further diagrammatical view of the cross-sectional shape of the center portion of the boat hull of the instant invention illustrating the manner in which it is particularly well adapted for single motor installation and also the manner in which the draft of the boat hull of the instant invention is reduced relative to the draft of a conventional V-bottom hull including a single propeller;

FIGURE 7 is still another diagrammatical view of the cross-sectional shape of the boat hull of the instant invention but showing a slightly modified cross-sectional contour;

FIGURES 8 and 9 are two additional diagrammatical views of two further modified cross-sectional shapes of the boat hull of the instant invention;

FIGURE 10 is yet another diagrammatical view of the cross-sectional shape of a hull constructed in accordance with the present invention and illustrating a further modification thereof including a center generally V-shaped wedge and also illustrating the manner in which the wetted area of the boat hull is progressively reduced as the speed of the hull over the surface of a body of water is increased and also with still another modification of the cross-sectional shape of the hull illustrated in phantom lines;

FIGURE 11 is a diagrammatical view of the cross-sectional shape of the boat hull of the instant invention similar to that of FIGURE 10 but showing another modified form of boat hull;

FIGURE 12 is a diagrammatical view of the cross-sectional shape of yet another form of boat hull constructed in accordance with the present invention which defines a deeper V-shaped hull; and

FIGURE 13 is a diagrammatical view of the cross-sectional shape of the boat hull constructed in accordance with the present invention and with a further modified form of boat hull shown in phantom lines.

Referring now more specifically to the drawings the numeral **10** generally designates the boat hull of the instant invention which may be seen to include opposite sides **12** and **14** interconnected by means of a transom **16** and a bottom generally referred to by the reference numeral **18** including a forwardly and upwardly curving bow portion **20** and a substantially longitudinally straight planing portion **22**. The bottom **18** defines a longitudinal centerline **24** and a plurality of downwardly opening and longitudinally extending generally inverted V-shaped tunnels **26, 28** and **30**. The tunnels **26, 28,** and **30** are substantially straight in the planing portion **22** and include forward extensions **26', 28'** and **30'** which smoothly curve forwardly and upwardly in the bow portion **20**, the extensions **28'** and **30'** also curving inwardly toward the center tunnel **26'**. Tunnels **28** and **30** plus any additional lift and stability tunnels which smoothly curve forwardly and upwardly may also be run substantially parallel to the longitudinal centerline in bow portion **20** without changing the performance characteristics to any extent.

With attention now invited to FIGURE 12 of the drawings there may be seen a modified form of boat hull generally referred to by the reference numeral **32** and which includes a center tunnel **34** corresponding to the tunnel **26** and a first pair of opposite side tunnels **36** corresponding to the opposite side tunnels **28**. The tunnels **36** and **28** define lift tunnels and it may be seen that the hull **32** additionally includes a second pair of lift tunnels **38**. Then, disposed outwardly of the second pair of lift tunnels **38** the hull includes a pair of inner stabilizing tunnels **40** corresponding to the stabilizing tunnels **30** and a second pair of outer stabilizing tunnels **42**.

Each of the tunnels **36, 38, 40** and **42** includes a pair of downwardly divergent opposite side inner and outer surfaces A and B. The included angles formed between corresponding inner and outer surfaces A and B is greater than 90° and it may be seen by the arrows disposed in the tunnels **36, 38, 40** and **42** at the left side of FIGURE 12 that any downward force of the boat hull **32** on a body of water while the boat hull **32** is traveling at good speeds will cause quantities of water to be rapidly displaced upwardly and outwardly along the inclined inner surfaces A and to be directed against the downwardly and outwardly inclined surfaces B thereby enabling the hull construction **32** to harness the kinetic energy of the laterally and upwardly displaced water impinging upon the downwardly and outwardly inclined outer surfaces A to apply an upward lifting force on the hull construction **32**.

With attention now invited to FIGURE 11 of the drawings there may be seen a modified form of boat hull construction generally referred to by the reference numeral **46** and which is similar to the hull construction **32**. Horizontal broken lines C, D and E designate the water lines of the hull construction **46** while traveling at slow speeds, intermediate speeds and high speeds, respectively. It is believed that it may be readily appreciated that the greater the speed of the hull construction **46** the greater will be the upward lifting force of the water applied to the hull construction **46** as explained above in connection with the harnessing of the kinetic energy of the water displaced upwardly and outwardly along the inner surfaces A and impinging upon the outer surfaces B plus the air lift and kinetic water lift imparted on the center tunnel, the air being compressed and acting as a shock absorber cushioning the ride and breaking up skin friction on its surfaces.

Although extreme cases may prove exception to the rule, the downwardly and outwardly inclined outer surfaces B are to be disposed at an angle falling between 40 and 80 degrees from a vertical plane and therefore the surfaces A, the inner surfaces of the tunnels, are disposed at an angle inclined at least 10 degrees from a horizontal plane.

It may be noted that the boat hull construction **46** illustrated in FIGURE 11 of the drawings includes a center tunnel **50** but that a similar hull construction illustrated in FIGURE 10 of the drawings and generally designated by the reference numeral **52** includes a center generally V-shaped wedge **54** in lieu of the center tunnel **50**. The center V-shaped wedge **54** may be utilized in lieu of the center inverted V-shaped tunnel when a boat hull is designed with at least one pair of lift tunnels and one or more pairs of stability tunnels. The terms lift and stability as referred to the tunnels is used for clarity and are interchangeable. Each tunnel acts as a lift and/or stability tunnel.

The water levels or lines F, G and H shown in FIGURE 10 of the drawings further illustrate the manner in which the kinetic energy of the laterally and outwardly displaced water caused by forward movement of the hull constructed in accordance with the present invention may be harnessed by the outer downwardly and outwardly in-

clined surfaces of the tunnels and utilized to effect an upward lifting force on the hull which increases as the forward speed of the hull increases.

With attention now directed to FIGURES 5 and 6 of the drawings there may be seen diagrammatically illustrated a pair of marine propellers **54** and **56** shown in their positions partially embraced in the lifting tunnels **58** disposed on opposite sides of the center tunnel **60** of the hull construction generally referred to by the reference numeral **62**. The outline of a conventional V-shaped hull is generally designated by the reference numeral **64** and it may be seen that a dual propeller installation diagrammatically illustrated by the phantom line showings of the propellers **66** and **68** requires considerably more draft. In addition, a single propeller installation may be seen to be illustrated in FIGURE 6 of the drawings by the diagrammatical showing of the propeller **70** partially embraced by the center tunnel **72** of a hull construction generally referred to by the reference numeral **74**. The outline of a conventional V-shaped hull is also illustrated in FIGURE 6 of the drawings by phantom lines **76** and an accompanying single marine propeller is designated by the reference numeral **78**. The increase in draft of the conventional V-shaped hull construction provided with a single propeller installation over the draft of the hull construction **74** provided with a single propeller installation is designated by the distance J. Therefore, it may be seen from a comparison of FIGURES 5 and 6 of the drawings that a hull construction in accordance with the present invention and including a center tunnel is particularly well adapted for shallow draft operation with dual propellers and that the same type of hull construction is also particularly well adapted for use with single propeller installation and also provides a reduced draft as compared to the draft of a conventional boat hull construction utilizing a single propeller installation.

With attention now directed to the modified hull construction illustrated in FIGURES 8 and 9 of the drawings and generally referred to by the reference numerals **80** and **82**, it may be seen that the lower longitudinal edge portions of the cut waters **84** defined between adjacent tunnels of the hull construction **80** are generally semi-cylindrical in configuration. Additionally it may be seen from the showing in FIGURE 9 of the drawings that the tunnels of the hull construction **82** are separated by means of generally horizontal longitudinally extending narrow planing surfaces **86**.

Although the lower portions of the cut waters defined between adjacent tunnels of the hull constructions **80** and **82** are somewhat modified, the operation of these hull constructions remains substantially the same as the hull constructions disclosed herein which are substantially V-shaped in transverse outline.

With attention now directed to FIGURE 7 of the drawings there may be seen a still further modified form of hull construction generally referred to by the reference numeral **90** and which includes a plurality of longitudinally extending tunnels which are generally inverted V-shaped in cross-section but which include generally semi-cylindrical apices **92**, **94**, **96** and **98**. Again, while the cross-sectional outline of the tunnels of the hull construction **90** has been modified to some degree, the operation of the hull construction **90** remains substantially the same as the other hull constructions disclosed herein.

In FIGURE 4 of the drawings a hull construction generally referred to by the reference numeral **100** and generally corresponding to the hull construction **10** is illustrated and is shown executing a turn at high speed with the centrifugal forces caused by the high speed turn being indicated by the arrow **102**. The inner tunnel surface **104** is being advanced against the water **106** and acts to upwardly deflect the side of the boat hull construction **100** on the outside of the turn by its planing action with the water **106** and by deflecting the water upwardly and into impingement with the corresponding

outer side tunnel surface **108**. This upwardly deflected water is strapped by the outer side tunnel surface **108** causing the tunnel to be filled with water and, therefore, supplying a constant volume of water to the outboard propeller while turning. In this manner cavitation and thus loss of power is sequenced. Additionally, it will be noted that the outer tunnel side surface **108** is still downwardly and outwardly inclined and therefore that the spray effected by the boat hull construction **100** executing a turn at high speed is deflected downwardly toward the surface of the water **106**. Additionally, it will be noted that the outer surfaces **110**, **112** and **114** of the tunnels **116**, **118** and **120** act as keels to minimize side slipping of the hull construction **100** while the latter is executing the turn at high speed.

With attention now invited to FIGURE 13 of the drawings there may be seen yet another modified form of hull construction generally referred to by the reference numeral **124**. The hull construction **124** includes a center tunnel **126**, two pairs of opposite side lift tunnels **128** and **130** and two pairs of opposite side stabilizing tunnels **132** and **134**. The transverse width of the outer surface **136** of the tunnel **128** on the righthand side of FIGURE 13 is designated as an unknown distance Y. The corresponding inner surface **138** has a transverse width greater than three times the width Y. Although variations in the ratio of the width of the surfaces **138** and **136** may vary, it is to be noted that this ratio will be at least 2 to 1. In addition, it may be seen that the transverse width of the outer side of the tunnel **128** disposed on the lefthand side of the figure is designated as X and that the transverse width of the inner side of the tunnel **128** on the lefthand side of FIGURE 13 is designated as greater than four times X and not less than 2 to 1. Again, although the ratio between the transverse width of the inner and outer sides of the tunnels of the hull construction **124** may vary, it is to be understood that this ratio will not exceed 5 to 1.

All of the various tunnels of the various hull constructions disclosed herein fall within these ratio limits and these ratio limits have been found to offer the most desired operational advantages of hull constructions constructed in accordance with the present invention. Additionally, it is to be noted that the included angles formed by corresponding inner and outer surfaces of all of the tunnels disclosed herein are greater than 90 degrees as previously set forth in connection with the hull construction **32** illustrated in FIGURE 12 of the drawings. Still further, the phantom line illustration in FIGURES 6, 7 and 10–13 illustrate further modified forms of hull constructions which include on less pair of tunnels than the corresponding form of the invention illustrated in solid lines.

In actual controlled tests as a result of the construction and testing of numerous hull constructions such as those illustrated in the present invention and other modifications operating on the same principles of lift as described herein, it has been found that the hull construction that is provided with a deeper overall V in transverse section as is illustrated in FIGURE 12 as compared to a shallower overall V in transverse section as in FIGURE 13 operates in a superior manner in rough water at sea. The converse of these situations would then obviously also apply with a shallower V-shaped hull. The shallower overall V-shaped hull operates in a superior manner when used in shallower waters such as bays, lakes, and sounds due to higher load capabilities and shallower draft plus a corresponding speed increase with equal horsepower. Thus, both minor modifications work under the same tunnel principles at the present invention with only a change in the degree of effectiveness.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention

to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be restored to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A boat hull including a bottom substantially V-shaped in transverse cross-section, said bottom defining a forward upwardly and forwardly curving bow portion and a substantially longitudinally straight aft planing portion, said planing portion of said bottom defining a longitudinal center line and at least one pair of downwardly opening generally inverted V-shaped and longitudinally staright lift tunnels extending along opposite sides of said center line, each of said tunnels including inner and outer downwardly divergent surfaces including major portions that are substantially planar, said inner surfaces being downwardly and inwardly inclined and said outer surfaces being downwardly and outwardly inclined, the angle of said inner surfaces relative to the dead rise of said hull being less than 30 degrees and said outer surfaces being inclined at least 10 degrees relative to a horizontal plane.

2. The combination of claim 1 wherein said center line is defined by the apex of a center generally inverted V-shaped center tunnel disposed between said lift tunnels.

3. The combination of claim 1 wherein said center line is defined by a depending generally V-shaped center wedge defined by the lowermost inner surfaces.

4. The combination of claim 1 wherein said planing portion of said bottom includes at least a first pair of opposite side generally inverted V-shaped stabilizing tunnels disposed immediately outwardly of the corresponding lift tunnels and also including inner and outer downwardly divergent surfaces including major portions that are substantially planar, corresponding lower longitudinal edge portions of the last-mentioned inner surfaces being generally disposed in said second plane and below a third plane containing the lower longitudinal edge portions of the last-mentioned outer surfaces.

5. The combination of claim 4 wherein said planing portion of said bottom includes a second pair of opposite side inverted V-shaped stabilizing tunnels, the second pair of stabilizing tunnels being disposed immediately outwardly of said first pair of stabilizing tunnels and including inner and outer downwardly divergent surfaces also including major portions that are substantially planar, the corresponding lower longitudinal edge portions of the last-mentioned inner surfaces being generally disposed in said third plane and below a fourth plane containing the lower longitudinal edge portions of the last-mentioned outer surfaces.

6. The combination of claim 1 wherein said planing portion of said bottom includes at least a first pair of opposite side generally inverted V-shaped stabilizing tunnels disposed immediately outwardly of the corresponding lift tunnels and also including inner and outer downwardly divergent surfaces including major portions that are substantially planar, corresponding lower longitudinal edge portions of the last-mentioned inner surfaces being generally disposed in said second plane and below a third plane containing the lower longitudinal edge portions of the last-mentioned outer surfaces, the included angles formed by corresponding inner and outer surfaces of said tunnels is greater than 90 degrees.

7. The combination of claim 1 wherein the ratio of the transverse width of said inner and outer surfaces of each of said lift tunnels measured in a horizontal plane is at least two to one.

8. The combination of claim 1 wherein the ratio of the transverse width of said inner and outer surfaces of each of said lift tunnels measured along said inner and outer surfaces is less than five to one.

9. The combination of claim 8 wherein the included angles formed by corresponding inner and outer surfaces of said lift tunnels is greater than 90 degrees.

10. The combination of claim 9 wherein the ratio of the transverse width of said inner and outer surfaces of each of said lift tunnels measured in a horizontal plane is at least two to one.

11. The combination of claim 1 wherein said tunnels on opposite sides of said centerline include forward extensions thereof smoothly curving forwardly and upwardly at their forward ends into said bow portion.

12. The combination of claim 11 wherein said forward extensions also curve forwardly and inwardly toward said centerline.

13. The combination of claim 1 wherein said tunnels immediately adjacent said centerline are of a width adapted to span the diameter of a marine propeller.

14. The combination of claim 1 wherein said centerline is defined by the apex of a center generally inverted V-shaped center tunnel disposed between said lift tunnels, said center tunnel being of a width adapted to span the diameter of a marine propeller.

15. The combination of claim 1 wherein said outer surfaces are inclined downwardly and outwardly at an angle between forty and eighty degrees from a vertical plane.

16. The combination of claim 1 wherein the included angles formed by corresponding inner and outer surfaces of said lift tunnels is greater than 90 degrees.

17. The combination of claim 1 wherein the ratio of the transverse width of said inner and outer surfaces of each of said lift tunnels measured along said surfaces is between 2 to 1 and 4 to 1.

18. The combination of claim 1 wherein the ratio of the transverse width of said inner and outer surfaces of each of said lift tunnels measured along a horizontal plane is between 5 to 1 and 2 to 1.

19. The combination of claim 1 wherein the ratio of the transverse width of said inner and outer surfaces of each of said tunnels measured along said surfaces is at least 2 to 1.

20. A boat hull including a bottom substantially V-shaped in transverse cross-section, said bottom defining a forward upwardly and forwardly curving bow portion and a substantially longitudinally straight aft planing portion, said planing portion of said bottom defining a longitudinal center line and at least one pair of downwardly opening generally inverted V-shaped and longitudinally straight lift tunnels extending along opposite sides of said center line, each of said tunnels including inner and outer downwardly divergent surfaces including major portions that are substantially planar, said inner surfaces being downwardly and inwardly inclined and said outer surfaces being downwardly and outwardly inclined, the included angles formed by the corresponding inner and outer surfaces of said tunnels being generally 90 degrees and the ratio of the transverse width of said inner and outer surfaces of each of said tunnels measured along said surfaces being at least 2 to 1.

21. The combination of claim 20 wherein the outer surfaces of said tunnels are inclined at least 10 degrees relative to a horizontal plane.

References Cited

UNITED STATES PATENTS

1,933,598	11/1933	Parker	114—67 X
2,875,720	3/1959	Hupp	114—62 X
3,040,687	6/1962	Huet	114—56
3,077,172	2/1963	Dornak	114—62
3,113,543	12/1963	Brownback	9—6 X
3,117,544	1/1964	Schoell	114—56
3,216,389	11/1965	Thorsen	114—56

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