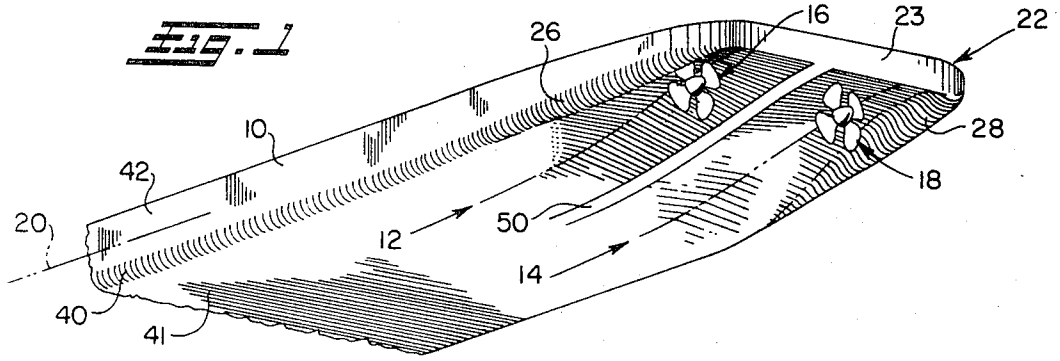
June 17, 1969 C. M. BEST, JR 3,450,090

HULL FORM FOR BOATS

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Fig. 1



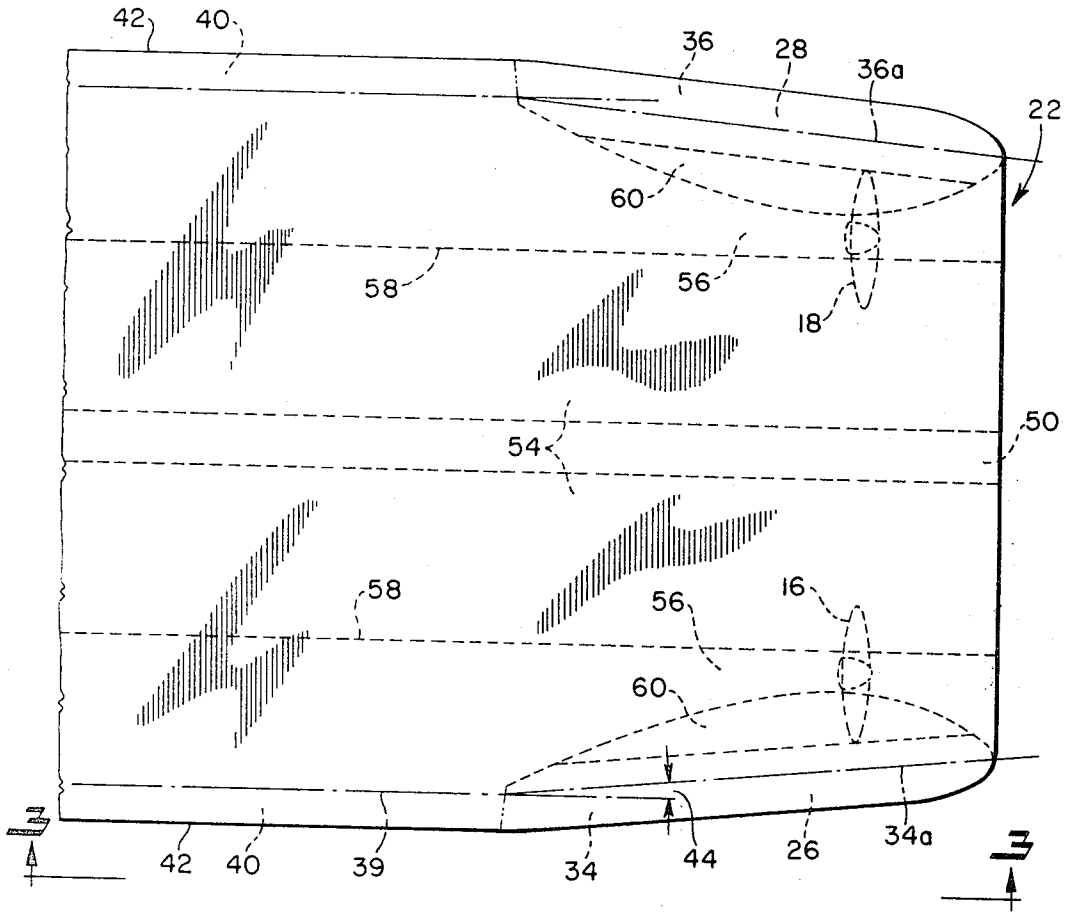


Fig. 2

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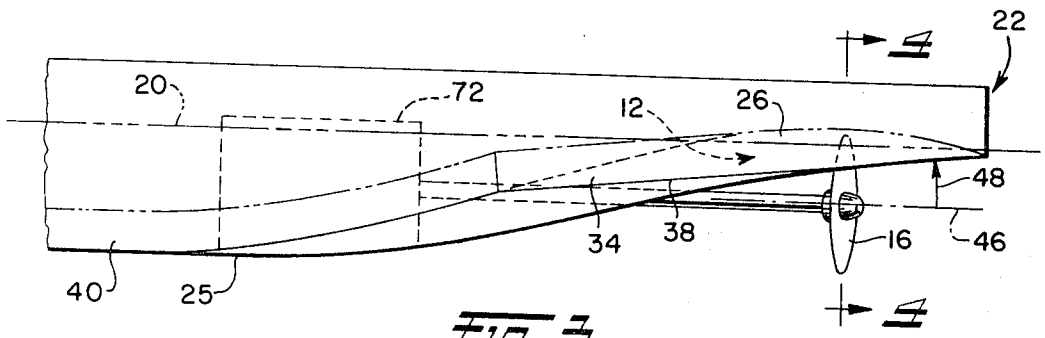


Fig. 3

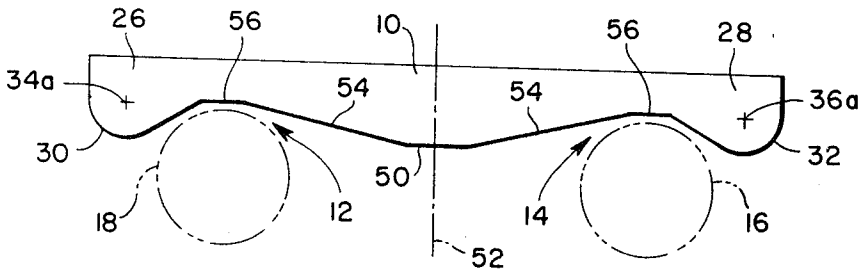


Fig. 4

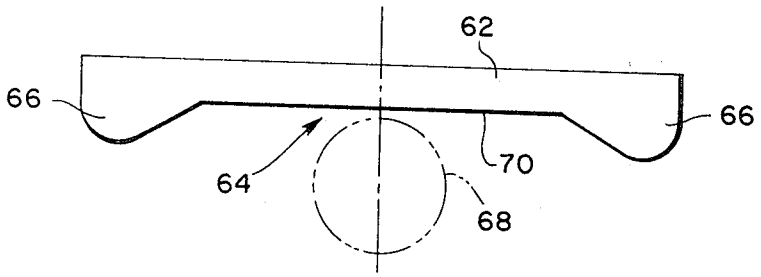


Fig. 5

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HULL FORM FOR BOATS

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8 Claims

ABSTRACT OF THE DISCLOSURE

A hull form for the stern of a flat bottom boat consisting of a longitudinally extending dual tunnel configuration for partially shrouding the twin driving propellers of the boat, the tunnels formed in part by appendages located at the outer portions of the hull, and the entire hull construction formed of a combination of cylindrical, conical and flat plate members.

This invention relates to the hull configuration for boats and more particularly to a novel stern construction wherein improved performance characteristics are obtained and yet wherein a simplified design affords a more economical construction.

This invention applies to propeller driven vessels and although the invention is described in relation to a double screw flat bottom vessel, it is not to be considered as limited to such specific showing as the teachings of this invention are applicable to many types of water driven craft. In many boats, in the development of higher power, it has become a common expedient in order to obtain satisfactory propulsive efficiency, to use propellers of larger diameter. This causes the tip of the propeller to be located higher relative to the water line and in some cases, above the water line. A result is that air is drawn into the propellers, sometimes causing excessive vibration and at least causing some cavitation effects where in collapsing air bubbles form a partial vacuum and reduce the thrust of the propeller.

On some conventional boats wherein a flat bottom hull is required for low draft purposes it has been common in the past to reduce the propeller diameter so as to maintain the propeller beneath the stern and yet above the base line of the vessel. This often results in reduced efficiency, in towboats in particular, and increases the possibility that air will come in from the side of the boat especially in restricted seaways and the like to cause cavitation effects. Additionally, in such a construction a small section modulus of hull girder will be realized just forward of the propellers thereby limiting the capacity of the vessel and reducing the strength of the stern section.

In flat bottom vessels, it has become common in the art in order to allow an increase in the diameter of the propeller and still retain an adequate size of stern section, to create a tunnel-like configuration for the bottom surface of the hull. Thus, as water is drawn along the bottom of the ship, it will be directed in an upward direction to completely submerge the propeller of the vessel, thereby utilizing the complete available area of the propeller.

This invention relates to an improvement in the bottom configuration of the hull wherein a more efficient tunnel design is realized and additional other advantages are obtained.

Therefore, an object of this invention is to increase the propulsive thrust of the propellers by altering the configuration of the hull in the addition of an appendage at the sides of the hull.

Another object of this invention is to provide increased displacement of the hull for a vessel of a particular capacity.

A further object of this invention is to provide an improved hull configuration which prevents air from entering into the propellers from the sides of the vessel and causing propeller cavitation.

Still another object of this invention is to increase the strength of the hull by increasing the depth of the aft portion of the hull.

A still further object of this invention is to provide a novel hull construction which requires a combination of only flat plate and simple curve surfaces which simplifies the design and reduces the cost of the construction.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a perspective view of the stern section of the hull of a twin screw vessel embodying the principles of this invention;

FIG. 2 is a plan view of a portion of the stern section of the hull of such a twin screw vessel;

FIG. 3 is an elevational view of a portion of the stern section of the hull of the vessel shown in FIG. 2;

FIG. 4 is a transverse section of the hull, at the propeller line, of the twin screw vessel taken along the lines 4—4 of FIG. 3; and

FIG. 5 is a transverse section of the hull, at the propeller line, of a single screw vessel utilizing the principles of this invention.

Referring now to FIG. 1, a portion of the hull **10** of a twin screw vessel embodying the teachings of this invention is shown whereby the relationship between the hull **10**, the tunnels **12, 14** the propellers **16, 18** and the water line **20** may be visualized. Although this description is given in reference to a twin screw vessel the teachings of this invention are applicable as well to single or multiple screw vessels as will be pointed out in greater detail hereinafter. In vessels of this type, it is common to locate the propellers **16, 18** in an elevated position in relation to the hull **10** of the vessel so as to reduce the draft of the vessel to alleviate clearance problems in inland waterways, locks and the like. Such elevation of the propeller **16, 18** necessitates a corresponding elevation of the stern bottom plates in order to provide adequate clearance for the propellers **16, 18**, and this transition in elevation in part forms the longitudinally extending tunnels **12, 14**. Aft of the propellers **16, 18** the stern bottom plates curve downward to intersect with the essentially vertical transom plate **23** at an elevation below the water line **20**, to complete the extent of the tunnels **12, 14**. It is common in these vessels that a portion of the propellers **16, 18** may be above the normal water line **20** and it has been the expedient in the past to so design the bottom configuration of the hull **10** to provide tunnels **12, 14** which effect a water flow over the complete area of the propellers **16, 18** and a more efficient operation. The advantage of the tunnel arrangement is clearly seen in FIG. 3 where it is noted that the diameter of the propeller **16** would be severely restricted if it were limited between the lowest point of the stern **22** and the extended base line **25** of the vessel.

However, one of the problems involved in this type of hull configuration is that unless a sufficient supply of water is afforded to the propellers **16, 18** under certain conditions of operation as, for example, the various speeds

of the vessel, or operation in restricted waterways such as in seaways and the like, there is a tendency for air to come in from the sides of the hull **10** to cause the propellers **16, 18** to cavitate, thereby reducing the efficiency of the propellers. The teachings of this invention apply to streamlining the configuration of the hull **10** of the vessel and particularly to adding appendages **26, 28** to the outer portions of the hull **10** to direct the flow of water in the tunnels **12, 14** and to eliminate the effects of cavitation.

Referring now to FIG. 4, it may be seen that the bottom configuration of this vessel consists of the combination of longitudinally extending cylindrical surfaces together with a plurality of intersecting plates which may be flat or formed of flat plates which are shaped into simple curves. The outer portions of the hull **10** as viewed in FIG. 4 comprise the appendages **26, 28** which form a portion of the tunnels **12, 14**. In cross section, it may be visualized that the appendages **26, 28** consist of a combination of circular and linear curves at any cross section along their longitudinal extent, the cross section of FIG. 4 being taken at the propeller line of the vessel. The circular curves **30, 32** are portions of cylindrical surfaces **34, 36** extending longitudinally of the vessel, the surfaces **34, 36** having centerlines **34***a*, **36***a* which are angled generally inwardly and upwardly to streamline the stern **22** of the vessel and to form the tunnel configurations. As seen in FIGS. 2 and 3, the location of the cylindrical surface **34** may be determined by reference to the centerline **34***a* and the straight line **38** forming the profile of the lowermost portion of the cylindrical surface **34**. A second line **39** depicts the center line of the bilge radius of the vessel, the bilge **40** forming the curved portion between the bottom **41** and the vertical sides **42** of the forward section of the hull.

Referring to FIG. 2 at a point aft of the middle section of the vessel, where the appendage **26** is located line **34***a* departs from line **39** at an angle **44** of approximately 10° in a rearward and inward direction. The angle **44** between lines **34***a* and **39** is shown as only one embodiment of this invention and in fact, angle **44** may vary from approximately 3°–15° and depends on the design and speed of the vessel. Appendage **28**, on the opposite side of the vessel and forming the tunnel **14**, is similarly inwardly sloped as indicated by cylindrical surface **36** and centerline **36***a*. The inward slope of appendages **26, 28** provides a streamlining effect for the stern **22** of the vessel to reduce the turbulence of the water behind the vessel and to assist in directing the flow of water into the area of the tunnels **12, 14**.

Referring now to FIG. 3, line **38** depicting the bottom of the appendage **26** is shown in elevation in relation to a dashed line **46** which is an arbitrary horizontal line approximately parallel to the surface of the water and the base line **25** of the vessel. Line **38** departs from line **46** in an upward vertical direction at an angle **48** of approximately 10° and this angle **48** also may vary from between 3°–15° depending on the design and speed of the vessel. Thus, if the vessel is intended to be used primarily for transportation where relatively fast speeds are employed and where maximum efficiency is desired at such speed, then the angle between lines **38** and **46** will be shallower and less deflection of the water will be required in order to completely immerse the propeller **16** for optimum efficient use of the screw.

It is apparent that the angle **48** of elevation of line **38** in the vertical plane affects the elevation of the hull **10** at the stern **22** of the vessel and it is clear affects the height of the tunnel **12** for the flow of water through the propeller **16**. Since line **38** is the bottom-center of the cylindrical member **34** forming a portion of the appendage **26** of the hull **10**, it will be observed that such cylindrical member **34** will lie generally in an inwardly sloping direction with relation to the side **42** of the vessel and in an upwardly sloping direction in relation to the bottom **41** of the vessel or to the surface of the water.

The cylindrical member **34** may be formed at a constant radius thereby depicting one embodiment of this invention. However, the principles of this invention apply as well if the radius of curvature of this member varies from front to back of the vessel and in fact, such member may take the configuration of a cone having a virtual apex located aft of the vessel. The significance of such cylindrical or conical member is that the member may be readily formed by rolling a flat piece of material in a single direction which provides a substantial improvement over prior art hull designs which often employ a complex bending of a flat plate.

The usual hull **10** configuration of a flat bottom vessel consists of a keel section **50** which is essentially horizontal as seen in cross-section in FIG. 4, extending a short distance on either side of the center line **52** of the vessel. Such keel section **50** is longitudinally vertically elevated in the aft portion of the vessel and slopes from a point amidship to provide an elevated stern **22** for the vessel.

The keel section **50** intersects, on either side of the centerline **52** of the vessel, with angularly disposed plate portions **54** forming the inner sides of the tunnels **12, 14**. The plate portions **54** may be formed of flat plates twisted in a simple curve in a longitudinal direction or may be built up of smaller welded plates and they extend essentially horizontally near the center of the vessel, blending into the plane of the flat bottom **41** of the vessel. Toward the stern **22** of the vessel the plate portions **54** intersect with the keel section **50** at an angle, reaching a maximum near the location of the propellers **16, 18**.

The tops **56** of the tunnels **12, 14** are also formed of flat plates which laterally, are horizontally disposed but inclined longitudinally from a blend with the flat bottom **41** near the middle of the vessel to a maximum elevation at the propellers **16, 18** and then inclined downwardly to an intersection with the vertical transom plate **23** forming the stern **22** of the vessel. As may be seen in FIGURES 1 and 3, the lower portion of the stern **22** and transom plate **23** and thus the rearwardmost portion of the tunnels **12, 14** are located beneath the water line **20**.

As seen in FIGURE 2, the tops **56** of the tunnels **12, 14** intersect with the plate portions **54** on the inner sides of the tunnels in essentially straight longitudinal lines **58** even though the tops **56** of the tunnels form a ramp-like configuration. The outer sides of the tops **56** intersect with the bilge **40** near the middle of the ship and with the appendages **26, 28** near the stern **22**.

The appendages **26, 28** each further include a flat plate **60** disposed for a distance between the cylindrical members **34, 36** and the tops **56** of the tunnels **12, 14**, each plate **60** tangentially intersecting the cylindrical members **34, 36** and angularly intersecting the tops **56** of the tunnels **12, 14** at approximately 20–40°, to form a part of the outer portion of the tunnels.

Although some variation is possible in the configuration of the tunnel and appendage design, it is preferable to maintain such dimensions as to allow the appendage to shroud between 10–50% of the diameter of the propellers **16, 18** for the most effective results. This shroud effect is best seen in the elevational view of FIG. 3 where the appendage **26** obscures the view of the upper portion of the propeller **16**.

As pointed out previously, the principles of this invention are applicable as well to single or multiple screw vessels, the showing in FIGURE 5 describing in particular, a single screw vessel **62**. Here is a cross-sectional view is taken at the propeller line to show that a similar tunnel **64** and appendage **66** configuration may be realized. The appendages **66** are again formed of cylindrical or conical sections. However, here the appendages **66** form both sides of the tunnel **64** in which the propeller **68** is located and intersect with a horizontal plate **70**, curved in the longitudinal direction to form the top of

the tunnel 64. The cylindrical sections are again angled inwardly and upwardly to achieve the preferred tunnel configuration in a manner similar to that previously described for the dual-screw vessel.

The tunnel and appendage configuration of this invention for all embodiments allows water to flow to the propellers primarily from the sides of the vessel and not from the bow thereby increasing the stability and controllability of the vessel. Further, the construction increases the depth of the vessel at the sides thereby decreasing the draft and protecting the propellers from floating objects or from drawing nets and the like into the screws. Still further this configuration allows the engine 72 and propeller to be mounted horizontally and still maintain efficient operation of the screw, thereby further reducing the cost of the construction.

Other modes of applying the principles of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I, therefore, particularly point out and distinctly claim as my invention:

1. A hull configuration for a ship for shrouding and directing the flow of water to the propeller comprising a tunnel extending longitudinally of the ship, originating at a location near the middle of the hull, increasing in elevation to a maximum near the stern at the propeller location and decreasing in elevation to the stern of the ship, the tunnel being formed of plate sections curved at most in a single direction and comprising a flat transverse top surface and an appendage depending from the top surface to form the outer portion of the tunnel, the appendage comprising a simple curve surface, and a flat plate member which intersects the top surface.

2. A ship's hull configuration as set forth in claim 1 wherein the appendage comprises a cylindrical surface, the flat plate being located between the cylindrical surface and the top surface, tangentially intersecting the cylindrical surface and angularly intersecting the top surface.

3. A ship's hull configuration as set forth in claim 1 wherein the appendage comprises a conical surface having a virtual apex located behind the stern of the ship, the flat plate tangentially intersecting the conical surface and angularly intersecting the top surface.

4. In the hull of a ship having a tunnel configuration for shrouding and directing water flow to the propeller

wherein the tunnel extends longitudinally of the ship, being of a ramp configuration having a planar top surface and being curved in the longitudinal direction from a location near the middle of the ship to a maximum elevation at the propeller screw, the improvement comprising an appendage depending from the top surface of the tunnel at the outer portion thereof for shrouding a portion of the propeller diameter, the appendage comprising the combination of a generally longitudinally extending simple curved surface and a plate section, the curved surface being tangent with the sides of the ship at the outer portion and with the plate within the tunnel, the plate angularly intersecting the top surface of the tunnel.

5. The improvement as set forth in claim 4 wherein the appendage depends from the top surface of the tunnel a distance to shroud between 10–50% of the diameter of the propeller.

6. A generally flat-bottomed ship's hull having a longitudinal recess in its underside extending toward the stern and a propeller mounted within the recess for increased propulsive effectiveness, characterized by gradually increasing height of the recess toward the stern of said hull with the height gradually decreasing substantially for a short distance closely adjacent the stern, the propeller being located within the recess in a region of substantially greatest height of the latter, and the outer sides of the recess being formed by a ridge of downwardly convex cross-section.

7. The hull of claim 6, further characterized by the provision of two longitudinal recesses parallel to each other, with a propeller in each recess, and a longitudinally extending downwardly projecting ridge therebetween, the recesses originating in the after portion of the hull and being defined by transversely flat hull surfaces except for the curved ridges at their outer sides.

8. The hull of claim 6, wherein the ridges at the outer sides of the recess taper toward the respective outer sides of the hull in a forward direction.

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ANDREW H. FARRELL, *Primary Examiner.*

U.S. Cl. X.R.

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