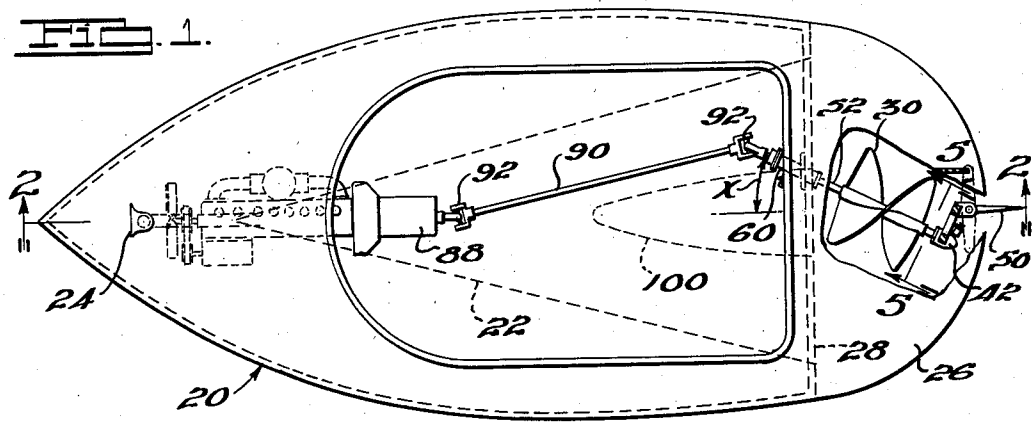
June 13, 1939. A. P. BRUSH 2,162,058

BOAT

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Fig. 1.



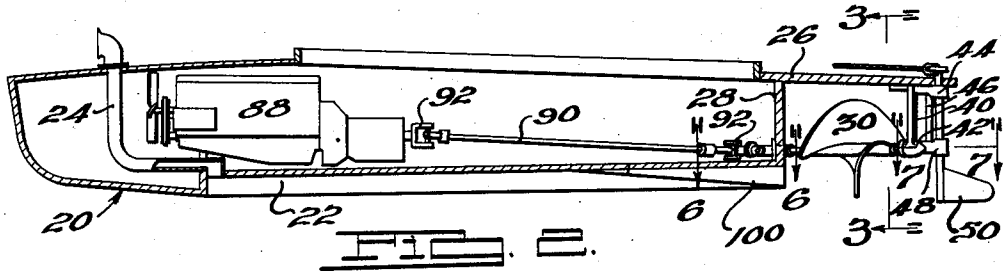
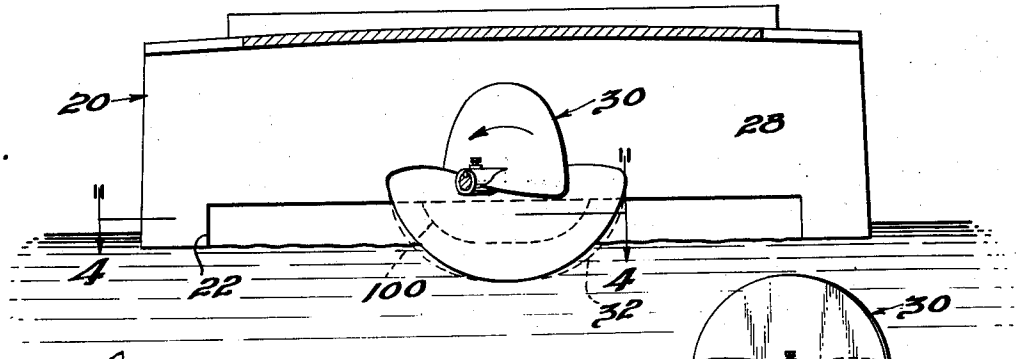


Fig. 2.

Fig. 3.



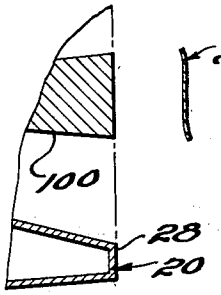


Fig. 5.

Fig. 4.

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BOAT

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FIG. 5.

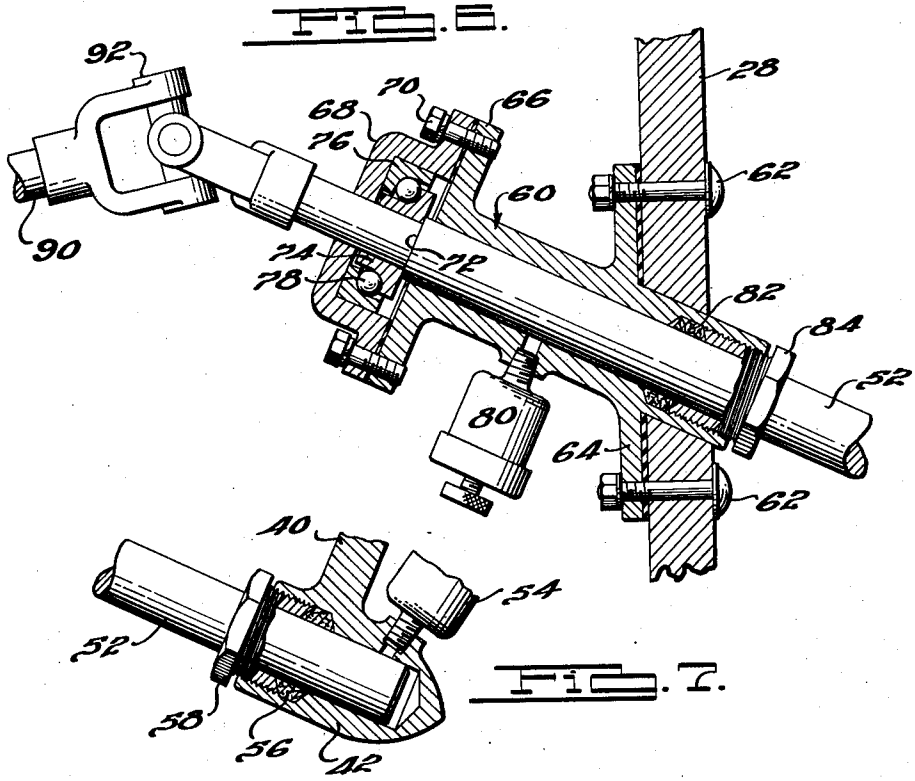


FIG. 7.

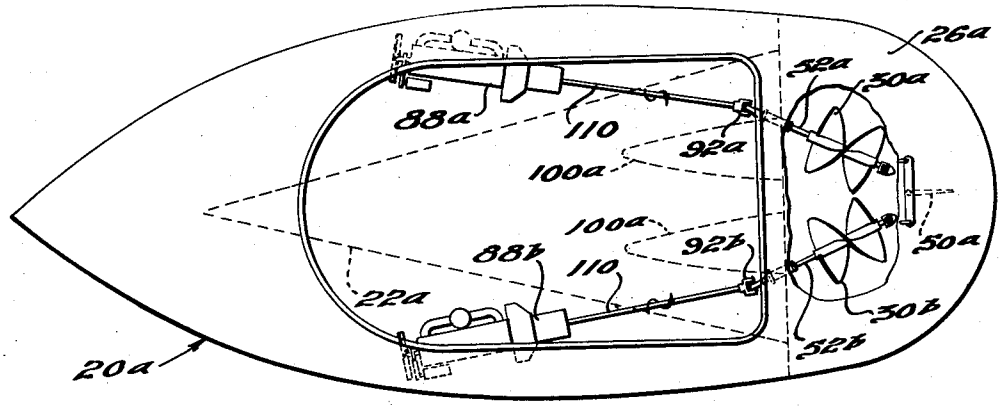


FIG. 8.

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BOAT

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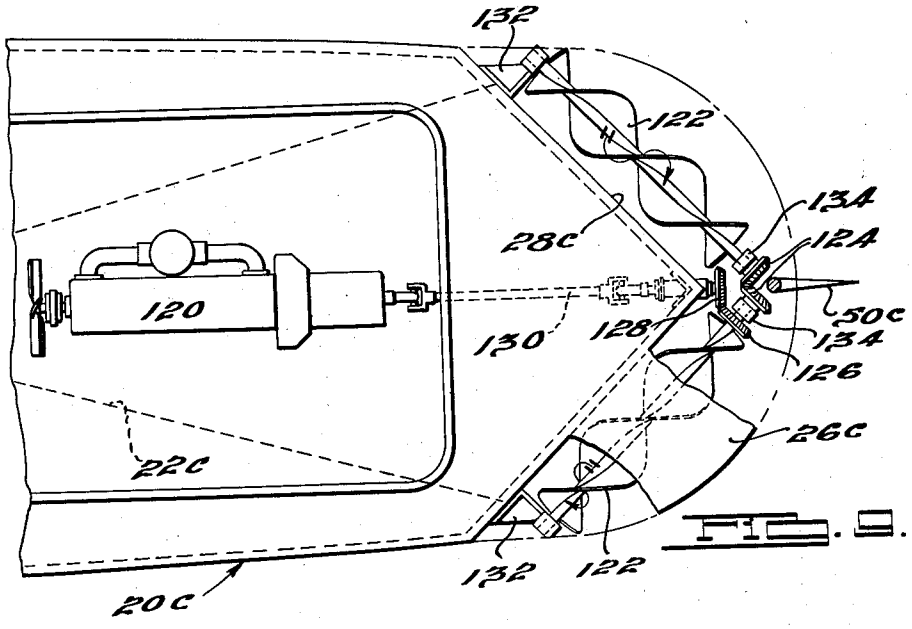


FIG. 9.

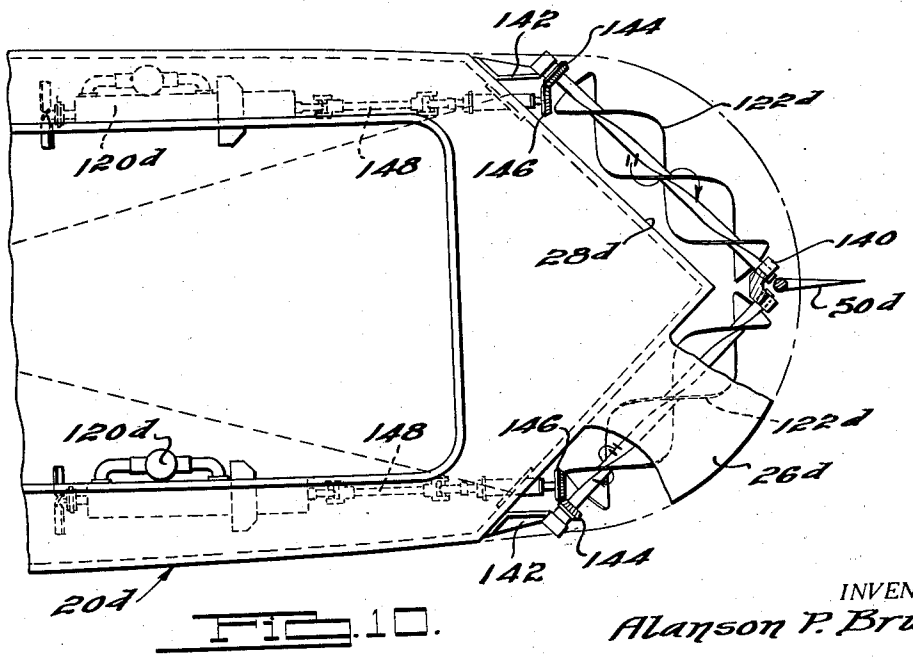


FIG. 10.

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BOAT

Alanson P. Brush, Detroit, Mich.

Application January 23, 1936, Serial No. 60,367

8 Claims. (Cl. 115—34)

This invention relates to boats and particularly to a driving means therefor, the principal objects being the provision of a novel form of screw type propelling means for boats that is capable of operating at a maximum efficiency with a minimum amount of immersion of the propelling means in the water, at the same time being ideally suitable for the propulsion of boats regardless of the draft of the boat.

Further objects of the invention include the provision of a boat having a screw type of surface propelling means associated therewith so constructed and arranged with respect to the boat that the resultant force of the propelling means upon the water is in a direction substantially parallel with the longitudinal axis of the boat; the provision of a boat and a surface type of propelling means therefor in which the axis of the propelling means is so skewed with respect to the longitudinal axis of the boat that the immersed portions of the propeller blade units are disposed in a plane perpendicular to the longitudinal axis of the boat; the provision of a boat having a propelling means as above described in which the blade elements of the propelling means overlap in axial view so as to provide a continuous water contact of the propelling means with the water; the provision of a construction as above described which admirably lends itself to utilizing a plurality of propelling units for a single boat; the provision of a boat and propelling means therefor in which the thrust of the propelling means upon the water varies directly as the draft of the boat; the provision of a boat and a propelling means therefor in which a greater amount of thrust is automatically established between the propelling means and the water under starting conditions than under running conditions.

Further objects of the invention include the provision of a planing type of boat in which the undersurface of the boat is relieved intermediate the side edges thereof at and adjacent the stern of the boat so as to provide two laterally spaced planing areas at the stern, and a surface type of screw propeller mounted at the stern of the boat for contact with the water intermediate said planing areas; the provision of a construction as above described including means on the boat adapted to mask the central portion of the propeller so as to limit the area of contact of the propeller with the water at low speeds; and the provision of a boat and a surface type of screw propelling means therefor operable to act upon the water over substantially the entire width of the boat.

The above being among the objects of the present invention the same consists in certain novel features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawings, and then claimed, having the above and other objects in view.

In the accompanying drawings which illustrate suitable embodiments of the present invention and in which like numerals refer to like parts throughout the several different views:

Figure 1 is a more or less diagrammatic plan view of a boat provided with my improved propelling mechanism, a portion of the boat being broken away to better illustrate the propelling means;

Fig. 2 is a vertical sectional view taken longitudinally and centrally through the boat shown in Fig. 1, as on the line 2—2 thereof;

Fig. 3 is an enlarged vertical sectional view taken on the line 3—3 of Fig. 2, it being a stern view of the boat shown in the previous views and of the propelling mechanism therefor;

Fig. 4 is a fragmentary, horizontal sectional view taken on the line 4—4 of Fig. 3 illustrating the relation of the submerged portion of the propelling means with respect to the boat hull;

Fig. 5 is an axial view of a propeller device shown in the previous views and taken on the line 5—5 of Fig. 1;

Fig. 6 is a fragmentary, enlarged, horizontal sectional view taken on the line 6—6 of Fig. 2 and illustrating the supporting means for the propeller mounted on the stern or transom of the boat;

Fig. 7 is an enlarged, fragmentary, horizontal sectional view taken on the line 7—7 of Fig. 2 and illustrating the construction of the outboard bearing for the propeller;

Fig. 8 is a view similar to Fig. 1 but illustrating the application of twin engines and twin propellers for a boat of the type shown in Fig. 1;

Fig. 9 is a fragmentary plan view of the stern portion of a boat having a modified form of propelling means which acts substantially over the entire width of the boat and shown as being driven by a single engine;

Fig. 10 is a view similar to Fig. 9 but illustrating the propelling unit on each side of the boat as being driven by an independent power plant.

The present invention contemplates the provision of a screw type of surface propeller which embodies all of the advantages of the conventional type of surface screw propellers and of the

conventional paddle wheel structures while eliminating the disadvantages of both thereof. In the broader aspects of the present invention this is accomplished by taking a conventional form of surface propeller and so mounting it upon the boat that its axis of rotation is skewed to such an extent with relation to the longitudinal axis of the boat that the general plane of that portion of any blade submerged in the water during normal operating conditions is perpendicular, when submerged, to the longitudinal axis of the boat. By reason of this arrangement it will be understood that during operation the thrust of the propeller upon the water will be in a direction parallel to the longitudinal axis of the boat and thereby eliminate the disadvantage of the lateral thrust inherent in conventional surface screw propeller constructions.

It will also be appreciated that because of this skewed relation of the propeller axis with respect to the longitudinal axis of the boat the path of movement of the submergible tip portion of each propeller blade, as viewed in a direction parallel with the longitudinal axis of the boat, will not be in a true circle as in conventional surface screw propeller constructions but where the propeller is of sufficient length will be elliptical with the major axis of the ellipse parallel to the surface of the water. For this reason the submergible portions of the propeller blades in passing through the water contact the water over a greater width measured in a direction parallel to the width of the boat than in the case of a surface screw propeller of conventional construction and of the same diameter. Because of this reason the surface boundary layer of the water against which the propeller is effective to produce a propelling thrust on the boat is increased in volume without an increase in wetted surface area as compared to conventional types of surface screw propellers of the same size. The result is an increase in propeller efficiency due to the fact that a greater thrust upon the water is obtained without a corresponding increase in wetted surface of the propeller.

In accordance with the present invention in increasing the length of the propeller to obtain a greater width of submersion of the tips of the blades with the water the blade elements of my improved surface type of screw propeller are preferably extended circumferentially of the propeller axis so that such blade elements overlap each other in axial view. As a further result of this feature continuous contact between the propeller and the water is provided which not only provides a constant and uniform thrust of the propeller upon the water but eliminates the shock, jars and vibrations common in conventional surface screw propeller types of constructions due to the intermittent contact of the blades with the water.

The construction thus provides all of the advantages of a paddle wheel type of propelling mechanism in that it exerts its thrust in a direction parallel to the longitudinal axis of the boat being driven thereby but includes the advantage over the paddle wheel type of construction in that each of the blades acts at a constant depth on the water during its passage therethrough, it eliminates the usual slapping action of paddle wheel paddles or blades on the water and the vibration resulting therefrom, it is relatively more economical to build and service than paddle wheels, and may be made of considerably smaller diameter and may be rotated at relatively greater speeds than paddle wheel types of construction, thereby lending itself for use in connection with high speed boats where paddle wheel types of construction are not practical under present conditions. Additionally, as will hereinafter be more fully explained, the present invention may be so modified or expanded as to permit it to operate upon the surface boundary of the water over substantially the entire width of the boat as is possible in paddle wheel constructions, but impossible in surface screw propeller types of conventional constructions, thereby admirably lending itself to any use to which conventional paddle wheel constructions are particularly adapted under conditions existing heretofore.

I have found that the use of submerged types of screw propellers is particularly disadvantageous when employed in connection with a type of hydroplane provided with laterally separated planing areas at the stern of the boat and which stern is spaced from the surface of the water between such areas, such for instance as the boat illustrated in my United States Letters Patent No. 1,880,371, issued October 4, 1932 for Boat. This is due to the fact that where a submerged type of screw propeller is used in connection with such constructions it is necessary for the propeller shaft, in extending from the engine to the submerged propeller, to pass through that portion of the bottom of the boat which is spaced from the surface of the water when the boat is at speed. In such case the propeller shaft in passing through free air before entering the water tends to cause cavitation on the upper or rear surface of the propeller shaft and which in turn permits air to be drawn into the propeller and permits cavitation of the water surrounding it. This effect may be eliminated by submerging the propeller to a suitable depth and providing an anti-cavitation plate above it, but the necessity of this added submersion of the propeller and the use of the cavitation plate embodies disadvantages which are obvious. By employing a propeller of the surface type in connection with such a boat hull the above described disadvantages of the submerged type of screw propellers are entirely eliminated as may be readily appreciated and this whether the propeller is of the conventional surface type of screw propeller or one constructed in accordance with that phase of the present invention previously described, and, accordingly, it is a further feature of the present invention to provide such type of boat with a surface type of screw propeller.

In accordance with the still further feature of the present invention I have found, however, that where a surface type of screw propeller is employed with a hull of the general type above described, because of the depth to which the stern of the boat is submerged when at rest and at relatively low speed before its planing effect is materially active, unless otherwise guarded against the propeller may be submerged to such an extent as to prevent the engine from gaining a sufficient speed to bring the boat to a proper planing condition particularly where the factor of engine power to boat size and weight is relatively low. In accordance with a further phase of the present invention means are provided in conjunction with the boat hull of the type described employing a surface type of screw propeller to free the propeller of contact with a material amount of the water which it would otherwise have contact with at low boat speeds, there-

by permitting the engine to be speeded up to such an extent as to realize the full or substantially full power thereof in order to bring the boat up to a proper planing speed, the construction permitting a choice of design in the amount of water which the propeller is permitted to contact with at low boat speed so that if desired a greater than normal planing speed thrust may be obtained for starting purposes.

Referring now to the accompanying drawings and particularly to Figs. 1 to 7, inclusive, thereof a boat hull is indicated generally at **20**. It will be understood that in the broader aspects of the present invention the particular type, shape or form of construction of the hull **20** is immaterial, but inasmuch as in a narrower phase of the present invention the same is particularly adapted to a special form of boat hull, the hull **20** shown is substantially identical to that covered by my United States Letters Patent No. 1,880,371, issued October 4, 1932 for Boat and as shown in Figs. 1 to 6 thereof. Accordingly, the hull **20** is of the planing type of boat commonly known as a hydroplane and the bottom surface thereof is provided with a rearwardly opening upwardly extending V-shaped recess **22** therein the margins of which form a step extending over the greater length of the hull **20** and providing, when the boat is at speed, a contact planing area between the hull and the water of V-shape formation of a substantially constant length approximately commensurate with the length of the hull and of approximately constant width commensurate with the width of the hull. The width of water contact of the sides of this V-shaped planing area varies inversely as the speed of the boat but remains substantially constant in length and width regardless of the speed under planing conditions. It will be understood, of course, that when the hull **20** is at speed the bottom of the boat within the recess **22** is in spaced relation with respect to the surface of the water and means are preferably provided for aiding the entrance of air to the recess **22** particularly under starting conditions. Such means may, by way of illustration, comprise a duct **24** extending from the forward end of the recess **22** preferably to a point above the deck of the boat. Unlike the disclosure in my prior patent above referred to, the deck of the hull **20** at the rear end thereof is preferably extended as at **26** beyond the transom **28** of the hull to facilitate the provision of an ouboard bearing for the propelling means, as well as a spray shield as will hereinafter be more fully described.

In the construction shown in Figs. 1 to 6, inclusive, the hull **20** is provided with a single surface type of screw propeller **30**, it being noted that the axis of the propeller as best brought out in Figs. 2 and 3 is positioned above the normal level of the water with respect to the hull **20** so that the outer marginal portions only of the blades of the propeller have contact with the water. The axis of the propeller **30**, as viewed in side elevation, is preferably horizontal when the boat is at speed but, as will be obvious, it may be inclined to the horizontal in side elevation to a greater or lesser extent particularly when designed to meet such condition. It will be particularly noted that the propeller **30** is so mounted that its axis in plan view is skewed with respect to the longitudinal axis of the hull **20**. In other words the axis of the propeller **30** in plan view of the hull **20** is skewed with respect to the longitudinal axis of the hull **20** equal to an angle **X**. The angle **X** is preferably such or approximately such that that portion of the margin of each blade of the propeller **30** immersed at any particular instance in the water when the boat hull **20** is at speed is included in an approximately vertical plane arranged perpendicularly with respect to the longitudinal axis of the hull **20**. This is particularly brought out in Figs. 2 and 4 and particularly the latter figure which is a horizontal section taken through the propeller **30** when the boat is at speed at the surface of the water within the recess **22**. As will be readily appreciated the result of this skewing of the axis of the propeller **30** and particularly where the amount of skew is such that the plane of the submerged portion of the blades of the propeller **30** lie substantially entirely in a plane exactly perpendicular to the longitudinal axis of the hull **20**, is that the thrust of the submerged portions of the blades of the propeller **30** upon the water will be parallel to the longitudinal axis of the hull **20** and consequently no lateral thrust of the propeller **30** upon the water will result. In this connection it will be recognized, of course, that where a single propeller is employed as illustrated in Figs. 1 to 6, inclusive, it will be necessary to position the propeller as nearly central of or in alignment with the longitudinal axis of the hull **20** as possible in order that the thrust of the propeller will be in line with the longitudinal axis of the hull so as to eliminate any tendency of the thrust of the propeller on the water from urging the hull out of its true directed course in a straight line.

As previously mentioned in accordance with a further phase of the present invention the individual blades of the propeller **30** are preferably extended circumferentially of the propeller to such an extent that they overlap in axial view. Where the propeller is provided with two blades as shown in Figs. 1 to 6, inclusive, as a matter of illustration, it will thus be necessary, as indicated in Fig. 5, for each of the individual blades to extend slightly in excess of 180° of rotation about the axis of the propeller in order to realize this effect, the minimum circumferential extent of each propeller blade in this respect being governed, of course, by the number of blades employed on the propeller. It may be noted, however, in this connection that ordinarily it will be preferable to employ two or more blades, particularly where the propeller is to be rotated at relatively high speed, in order that a desired dynamic balancing effect of the propeller as a whole may be obtained.

It will be noted that where the blades of the propeller **30** are circumferentially extended into overlapping relation as illustrated in Fig. 5 a constant and uniform thrust will be exerted by the propeller upon the water during each complete rotation of the propeller and consequently the intermittent action of conventional types of surface screw propellers upon the water is eliminated as well as the inevitable pounding and vibration caused thereby. It will also be noted that unlike the operation of the blades of a paddle wheel each blade of the propeller **30** almost immediately upon contact with the water is submerged therein to its full depth and maintains its full and constant depth of contact with the water until its trailing edge is removed therefrom. Furthermore, it will be appreciated that whereas in the conventional type of surface screw propellers the width of contact of the propeller with the water can never be greater than the correspond-

ing width of contact of the circle diameter of the propeller with the water, because of the skewed relation of the propeller 30 with respect to the longitudinal axis of the hull 20 in plan view and because of the length of the propeller the width of water contact between the blades of the propeller 30 and the water will actually be in excess of such width. This is brought out in Fig. 3 in which the dotted line 32 indicates the actual path of the peripheral edge of the propeller blades in their passage through the water and from which it will be apparent that the width of such contact with the water is actually greater than the actual maximum width of the area of contact of such blade with the water at any particular instant.

The result is that a propeller constructed in accordance with the invention will actually set in motion a greater width of the surface boundary of the water than is possible with the conventional surface screw type of propeller of the same diameter and consequently a correspondingly greater amount of thrust of the propeller upon the water may be obtained. In this connection it should be kept in mind that in connection with the surface type of propeller, whether it be a screw type or paddle wheel type, as soon as the contacted portion of the surface boundary of the water is once put in motion rearwardly with respect to the boat the effective thrust of the propeller upon such portion of the water is materially reduced and, consequently, where a greater amount of such surface boundary can be set into motion without a corresponding increase in the wetted surface of the propeller the efficiency of the propeller is bound to be increased. This feature of a propeller constructed in accordance with the present invention being capable of acting upon a greater width, with respect to the boat hull of the surface boundary of the water than in conventional constructions, while apparently not so great in the construction illustrated in Figs. 1 to 6, inclusive, will be seen to be greatly extended over the corresponding diametrical width of the propeller where each blade of the propeller is extended circumferentially of the propeller in excess of 360° as in the constructions shown in Figs. 9 and 10 and to be hereinafter more fully described.

It will be particularly noted from an inspection of Figs. 1 and 2 that the propeller 30 is positioned below the rearward extension 26 of the deck of the hull 20 and this is for the reason that because of their nature surface screw propellers are particularly susceptible to flinging a spray of water vertically into the air. By placing the propeller 30 below the deck extension 26 the spray is prevented from being thrown upwardly beyond the extension 26 where otherwise it might on occasion wet the passengers of the boat. Although any suitable means may be provided for mounting the propeller 30 on the hull 20, the deck extension 26 provides a means whereby a strut 40 carrying an outboard bearing 42 for the propeller 30 may be fixed with respect to the hull 20. It also provides means whereby a bracket 44 and strut 46 carrying a bearing 48 may be provided for properly supporting the rudder 50.

As best illustrated in Figs. 6 and 7 the propeller 30 is non-rotatably supported upon a propeller shaft 52 the rear end of which is rotatably received within the bearing 42 carried by the strut 40 and forming an outboard bearing for the propeller 30. Means such as the grease cup 54 may be provided for lubricating the bearing 42 and if desired a suitable packing 56 and cooperating packing nut 58 may be provided in conjunction therewith for preventing entrance of water to the interior of the bearing 42 and for preventing the ready escape of lubricant therefrom.

The forward end of the propeller shaft 52 is shown as being rotatably supported in a bearing bracket indicated generally at 60 fixed to the transom 28 of the hull 20 by means of bolts 62 passing through a flange 64 preferably formed integrally with the bearing bracket 60. The forward end of the bearing bracket 60 is preferably outwardly flanged as at 66 and provided with a hollow cap 68 secured thereto by means of screws such as 70. The shaft 52 is shouldered as at 72 within the hollow cap 68 and received thereon within the hollow cap 68 and against the shoulder 72 is one race 74 of a thrust bearing including a second race 76 seated against the forward end of the cap 68, and ball bearings 78. It will be appreciated that this structure serves to transmit the driving thrust of the propeller 30 to the transom 28. Means such as the grease cup 80 may be provided for lubricating the shaft 52 within the bearing bracket 60 and packing 82 and packing nut 84 may be provided at the rear end of the bearing bracket 60 for preventing the escape of lubricant therefrom as well as preventing the entrance of water thereto.

The boat 20 is, of course, provided with a suitable power plant indicated generally at 88 for driving the propeller 30 and although any suitable means may be provided for interconnecting the power plant 88 with the propeller shaft 52, as a matter of illustration in Figs. 1 to 6, inclusive, the power plant 88 is shown with its axis aligned with the axis of the boat 20 in plan view and as being drivingly connected with the propeller shaft 52 by means of a shaft section 90 and a pair of universal joints 92.

As previously referred to, it will be understood that where a submerged type of screw propeller is employed with a boat hull of the type illustrated and the propeller is positioned centrally of the hull, the propeller shaft extending between the engine and the propeller must necessarily pass through the recess 22 and consequently when the boat is at speed the portion of the propeller shaft between the bottom of the boat within the recess 22 and the surface of the water therebelow must necessarily be exposed to the air. It will be appreciated that because the propeller shaft in such case will be exposed to the air, when the boat is travelling at an appreciable speed the water will tend to cavitate along the rear upper surface of the propeller shaft and unless the propeller is submerged to an unusual extent will actually be carried down to the propeller and cause cavitation of water at the propeller with consequent loss of thrust of the propeller upon the water. Experiments have shown that such cavitations may occur to such an extent as to positively prevent the boat from maintaining its top speed for more than a moment. It will also be appreciated that this phenomenon is effectively eliminated where a surface type of propeller is employed with the type of boat shown and although cavitation of the water with respect to the forward face of the blades of a surface propeller occurs, this is a natural result of using the surface type of propeller and not only is expected and considered as a factor in the designing of the propeller but is actually an advantage in surface types of propellers because it reduces the

area of wetted surface contact between the propeller and the water.

However, where a surface type of propeller is employed with a boat hull of the type shown and described, it will be apparent that when the boat is at rest it will ordinarily have an unusually large amount of draft at the stern and this large amount of draft will continue to a greater or lesser extent until the boat reaches a speed at which a material planing effect between it and the water occurs with resulting raise of the stern of the boat with respect to the water. In those cases where the power of the engine employed for driving such a boat is not greatly in excess of that required to maintain the boat at a suitable planing condition, however, it may occur that the depth of the immersion of the surface propeller in the water before the boat attains a speed sufficient to materially raise the stern portion thereof with respect to the surface of the water is so great that it prevents the engine from rotating at a sufficient speed to exert the required amount of power to place the boat in a planing condition. In accordance with a further phase of the present invention in order to permit a surface propeller to be employed in this type of boat without requiring a power plant of a size not greatly in excess of that required to maintain the boat in planing relation with respect to the water once such planing relation has been established, I provide means for masking off a material portion of the propeller 30 from contact with the water as soon as the boat gains material headway with respect to the water. In the case shown this masking means comprises a protuberance indicated generally at 100 on the bottom of the hull 20 within the recess 22. This protuberance 100 is preferably elongated in the direction of length of the boat and is preferably of wedge-like formation in side elevation as illustrated in Fig. 2, its thickness being a minimum at its forward end and increasing gradually to or adjacent the transom 28 where it is preferably of a depth equivalent to the depth of the recess 22 at that point. As illustrated in Fig. 1 the protuberance 100 may be of minimum width at the forward end thereof and gradually increase in width to its rear end, the width preferably being such, as illustrated in Fig. 3, that its rear end elevation will lie in substantial parallelism with the path of movement of the periphery of the blades of the propeller 30 as illustrated by the dotted line 32, thus exposing a material but limited amount of area of the blades of the propeller 30 outwardly therefrom as viewed in Fig. 3. With this construction it will be appreciated that as soon as the boat gains material headway in starting up, the protuberance 100 will create a trough in the water rearwardly therefrom, the axis of the propeller lying centrally of such trough and the central portion of the propeller thus being free of contact with the water. This permits the area of contact of the propeller with the water under starting conditions to be reduced to such extent as to permit the power plant 88 to deliver sufficient power to quickly bring the boat up to its proper planing speed at which the effects of the mask 100 being unnecessary, such effects disappearing entirely.

In Fig. 8 a modification of the construction illustrated in the previous views is shown. In this case instead of using a single propeller and a single power plant, dual propellers are employed each of which is driven by an independent power plant. In this figure the propellers are illustrated at 30*a* and 30*b* respectively, and the power plant for the propeller 30*a* is illustrated at 88*a* and that for the propeller 30*b* at 88*b*. The hull 20*a* is shown as of substantially the identical construction as the hull 20 and as being provided with a recess 22*a* corresponding to the recess 22 previously described. It will be noted that the propellers 30*a* and 30*b* are positioned equidistant on each side of the longitudinal center line of the hull 20*a* and are skewed in opposite directions and such that the forward end of the propeller shafts 52*a* and 52*b* extend toward the corresponding side of the hull 20*a*. Because of this arrangement it is possible to position the power plant 88*a* and 88*b* closely adjacent their corresponding sides of the hull 20*a* and at an angle with respect to the longitudinal axis of the hull so that it is only necessary to employ one universal joint 92*a* or 92*b* as the case may be in the connection between the forward end of the corresponding propeller shafts 52*a* or 52*b* and the driving shaft 110 for the corresponding power plant 88*a* or 88*b*. The shafts 110 in this case are located in axial alignment with the crank shaft of the corresponding power plant. This arrangement not only reduces the angularity of the driving connection between the propeller shafts and the corresponding engine driven shaft 110 as compared to the previously described constructions, but it eliminates the necessity of an additional universal joint in each driving connection and makes the central portion of the boat more readily available for passenger carrying or other uses. It will be understood, of course, that where this modification of the present invention is applied to a boat hull of the type shown it is preferable in accordance with one phase of the present invention as previously described, to provide a mask 100*a*, similar to the mask 100 previously described, for each of the propellers 30*a* and 30*b*.

In Fig. 9 a construction is shown in which a single engine 120 is employed to drive two propellers 122 each constructed and arranged in accordance with the present invention. In this case each of the propellers 122 is of such length as to act upon the water over substantially half the width of the hull 20*c* and as a result of the extended length of the propellers 122 in this case each blade of the propeller extends for more than 360° of the circumference thereof so that continuous contact of each blade of each propeller is assured at all times. With this construction it will be apparent that the two propellers 122 combined to operate upon a length of water, measured in the direction of the width of the hull 20*c*, substantially equal to the width of the hull, and because of their skewed relation with respect to the longitudinal axis of the hull their combined actual length of water contact is in excess of the width of the hull. Due to this arrangement the propellers 122 are capable of obtaining the same width of thrust upon the water as a paddle wheel extending the full width of the boat and are capable of engaging the same depth of water boundary surface, but unlike a paddle wheel the blades of the propellers 122 will be immersed at a constant depth throughout their length from the time they enter the water until the time they leave it and thus are able to exert a greater thrust upon the water than a paddle wheel for the same maximum depth of immersion. Furthermore, because the propellers 122 are relatively small in diameter as compared to conventional paddle wheel structures and are of a considerably more sturdy construction they are considerably more eco-

nomical to manufacture, may be turned at relatively greater rotational speeds, and occupy a considerably smaller amount of space than conventional paddle wheel structures.

It may be noted at this point that a propeller arrangement constructed in accordance with the present invention has the same advantage as paddle wheel structures when applied to towing or freight carrying vessels in that when loaded a greater thrust is obtained upon the water, when such thrust is desirable, than when empty when the lighter load requires less thrust and permits greater rotational speeds of the engine in order to obtain greater speeds of the boat over the water.

Although any suitable means may be employed for driving the propellers **122** in Fig. 9 from the engine **120**, one more or less diagrammatic showing of a suitable means is illustrated. This comprises a pair of bevelled gears **124** one mounted upon the rear end of each of the propellers **122** and lying in meshing relationship with respect to each other. One of the propellers **122** is provided with an additional bevel gear **126** which lies in mesh with another bevel gear **128** suitably supported in the stern of the boat hull **20***c* and connected by a line of shaftings **130** with the engine **120** for receiving driving movement therefrom. It will be understood, of course, that in actual practice the gears **124**, **126** and **128** will be suitably housed in a water tight and grease tight housing. Although any suitable means may be provided for mounting the propellers **122** upon the hull **20***c* that shown by way of illustration comprises bracket members **132** secured to the stern of the boat adjacent the outer edges thereof and rotatably supporting the outer forward ends of the propellers **122**. Bearing brackets **134** are provided for the inner rearward ends of each of the propellers **122** and these may be supported from the deck extension **26***b* and in a manner similar to that illustrated in connection with Figs. 1 to 6, inclusive.

In Fig. 9 the pitch of the propellers **122** is shown such that the axes of the propellers **122** must be disposed at an angle of substantially 45° with respect to the longitudinal axis of the hull **20***c* in order that the submergible portions of the blades of the propellers will lie in a vertical plane substantially perpendicular to the longitudinal axis of the boat in accordance with this feature of the present invention heretofore more fully described. Where the propellers are arranged as illustrated in Fig. 9 it may be desirable in some cases at least to arrange the transom **28***c* of the boat hull **20***c* in a V-like formation parallel with the axes of the propellers as shown, thereby facilitating the mounting and driving of the propellers.

In Fig. 10, an arrangement of the propellers similar to that shown in Fig. 9 is illustrated. In other words two propellers **122***d* are arranged in inwardly and rearwardly converging relation with respect to each other on opposite sides of the hull **20***d*. In this case, however, instead of employing a single engine for both propellers **122***d*, one engine **120***d* is provided for each propeller, the engines preferably rotating in opposite directions, and the propellers are mounted for independent rotation by means of a common bracket **140** at their rearward inner ends and which brackets may be supported by the deck extensions **26***d* in a manner similar to that illustrated in Fig. 2. It will be noted that it is not essential that the propellers rotate in opposite directions and this for the reason that the thrust of both propellers is always parallel to the longitudinal axis of the boat regardless of direction of rotation. The outer ends of each of the propellers **122** may be suitably supported in bearing brackets **142** suitably secured to the transom **28***d* at the corresponding sides of the hull. In this case the forward outer ends of each of the propellers **122***d* is provided with a bevelled gear **144** which lies in mesh with a suitable bevelled gear **146** in turn directly driven from the corresponding engine **120***d* by means of a line of drive shafting **148**. This construction embodies all of the advantages of the construction shown in Fig. 9 as far as reaction between the propellers and the water is concerned but leaves the central portion of the boat more available for passenger or cargo carrying purposes than the construction shown in Fig. 9 and, additionally, by suitable control of the speed of rotation of the respective power plants **120***d* may be of aid in the process of steering the boat.

It will be understood from the above that the design of a propeller constructed and arranged in accordance with the present invention, in the broader aspects of the invention, leaves a relatively wide discretion in the designer as to the particular relationship desired in any particular case. It will also be recognized that the use of the present invention provides a propelling means for boats embodying the advantages that both submerged and surface types of screw propellers and of so-called paddle wheel constructions without the corresponding disadvantages of any of them and at the same time provides additional advantages not possible in any of them.

It will also be appreciated that the various modifications of the present invention herein shown and described are but illustrative of a great many different modifications to which the present invention is subject and, accordingly, it will be understood that formal changes may be made in the specific embodiments of the invention described without departing from the spirit or substance of the broad invention, the scope of which is commensurate with the appended claims.

What I claim is:

1. In combination with a boat hull of the planing type having a V-shaped recess in the bottom surface thereof opening on to the transom thereof and with the point of the V disposed toward the bow of the hull, the bottom of said hull over the area of said recess being generally spaced with respect to the surface of the water when said hull is at speed, a surface type of screw propeller supported adjacent the transom of said hull to engage the surface of said water between the lateral limits of said recess at said transom, blades on said propeller each circumferentially overlapping its neighbor when viewed axially of said propeller to provide continuous water contact, and means for rotating said propeller.

2. In combination, a boat hull of the planing type having a pair of planing surfaces diverging from each other toward the stern of the hull and said hull being upwardly relieved between said planing surfaces, a surface type of screw propeller mounted on said hull at the stern thereof for driving said hull and being arranged in closely adjacent relationship to said stern whereby said planing surfaces predetermine the depth of immersion of said propeller in the water when said hull is at speed regardless of load, the axis of said propeller being skewed with respect to the longitudinal centerline of said hull, and the angle of

said skew being such in relation to the pitch of said propeller that the immersed portions of said propeller when said hull is at speed lie approximately in a vertical plane lying perpendicular to the longitudinal axis of said hull.

3. In combination, a boat hull of the planing type having a pair of planing surfaces diverging from each other toward the stern of the hull and said hull being upwardly relieved between said planing surfaces, a surface type of screw propeller mounted on said hull at the stern thereof for driving said hull and being arranged in closely adjacent relationship to said stern whereby said planing surfaces predetermine the depth of immersion of said propeller in the water when said hull is at speed regardless of load, the axis of said propeller being skewed with respect to the longitudinal centerline of said hull, the angle of said skew being such in relation to the pitch of said propeller that the immersed portions of said propeller when said hull is at speed lie approximately in a vertical plane lying perpendicular to the longitudinal axis of said hull, and the length of said propeller being such in relation to the angle of said skew that the length of water contact of said propeller when viewed axially of said hull is greater than the length of water contact of said propeller when viewed axially of said propeller.

4. In combination, a boat hull of the planing type having a pair of planing surfaces diverging from each other toward the stern of the hull and said hull being upwardly relieved between said planing surfaces, a surface type of screw propeller mounted on said hull at the stern thereof for driving said hull and being arranged in closely adjacent relationship to said stern whereby said planing surfaces predetermine the depth of immersion of said propeller in the water when said hull is at speed regardless of load, the axis of said propeller being skewed with respect to the longitudinal centerline of said hull, the angle of said skew being such in relation to the pitch of said propeller that the immersed portions of said propeller when said hull is at speed lie approximately in a vertical plane lying perpendicular to the longitudinal axis of said hull, and means secured to said hull within said recess cooperating with said propeller to predetermine the amount of immersion of said hull when said hull is moving at an appreciable speed less than normal running speed.

5. In combination, a boat hull of the planing type having a pair of planing surfaces diverging from each other toward the stern of the hull and said hull being upwardly relieved between said planing surfaces, a surface type of screw propeller mounted on said hull at the stern thereof for driving said hull and being arranged in closely adjacent relationship to said stern whereby said planing surfaces predetermine the depth of immersion of said propeller in the water when said hull is at speed regardless of load, and means secured to said hull within said recess cooperating with said propeller to predetermine the amount of immersion of said hull when said hull is moving at an appreciable speed less than normal running speed.

6. For use with a boat hull adapted to be propelled by a surface type of propelling element and having a bottom surface adapted to predetermine the depth of immersion of the blades of such element; a propelling element carried by said hull in back of said surface with its axis of rotation skewed with respect to the longitudinal center line of the hull, the running depth of immersion of said element being substantially less than one-half its diameter, a plurality of blades on said element so constructed and arranged that the immersed portions thereof are arranged approximately in a plane perpendicular to the line of travel of the hull, and the length of said element being such in relation to the angle of said skew that the length of contact of said blades with the water when the hull is at speed, measured in a direction perpendicular to the line of travel of the hull, is greater than the diameter of the propelling element.

7. For use with a boat hull adapted to be propelled by a surface type of propelling element and having a bottom surface adapted to predetermine the depth of immersion of the blades of such element; a propelling element carried by said hull in back of said surface with its axis of rotation skewed with respect to the longitudinal center line of the hull, and substantially parallel to a corresponding trailing edge portion of said bottom surface, the running depth of immersion of said element being substantially less than one-half its diameter, a plurality of blades on said element so constructed and arranged that the immersed portions thereof are arranged approximately in a plane perpendicular to the line of travel of the hull, and the length of said element bein such in relation to the angle of said skew that the length of contact of said blades with the water when the hull is at speed, measured in a direction perpendicular to the line of travel of the hull, is greater than the diameter of the propelling element.

8. The combination of a boat hull, a helical bladed surface type propelling rotor located at the stern of said hull, a bottom surface of said hull determining the operating immersion of said rotor blades, the axis of said rotor positioned at an angle to the direction of travel of said hull, said angle being such that the immersed portions of said helical blades extend in a direction substantially at right angle to the direction of travel of said hull, the axial length of said propelling rotor being greater than its diameter, whereby, continuous and substantially uniform propelling reaction between the water and said helical rotor blades is secured throughout a reactance span longer than the diameter of said rotor.

ALANSON P. BRUSH.