Nov. 17, 1964 W. E. BILLIG 3,157,146

BOAT WITH HYDROFOIL AND WINGS

Filed Feb. 25, 1963 4 Sheets-Sheet 1

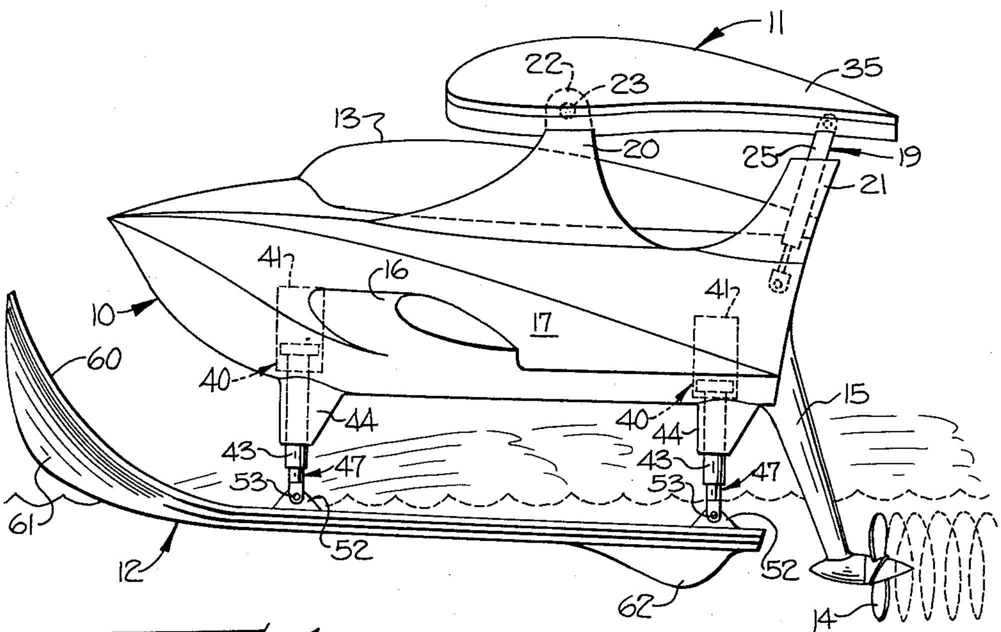

FIG-1

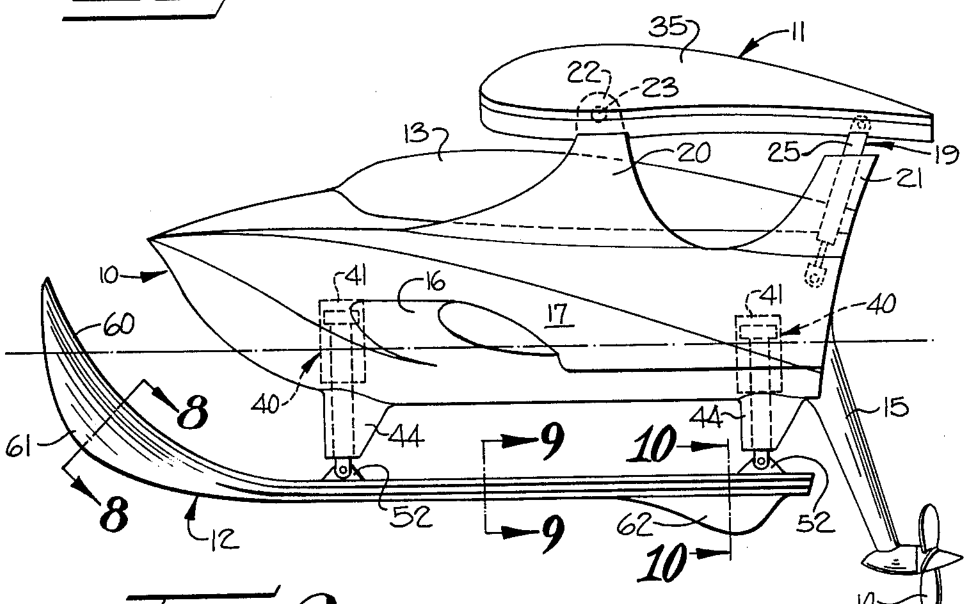

FIG-2

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BOAT WITH HYDROFOIL AND WINGS

Filed Feb. 25, 1963 4 Sheets-Sheet 2

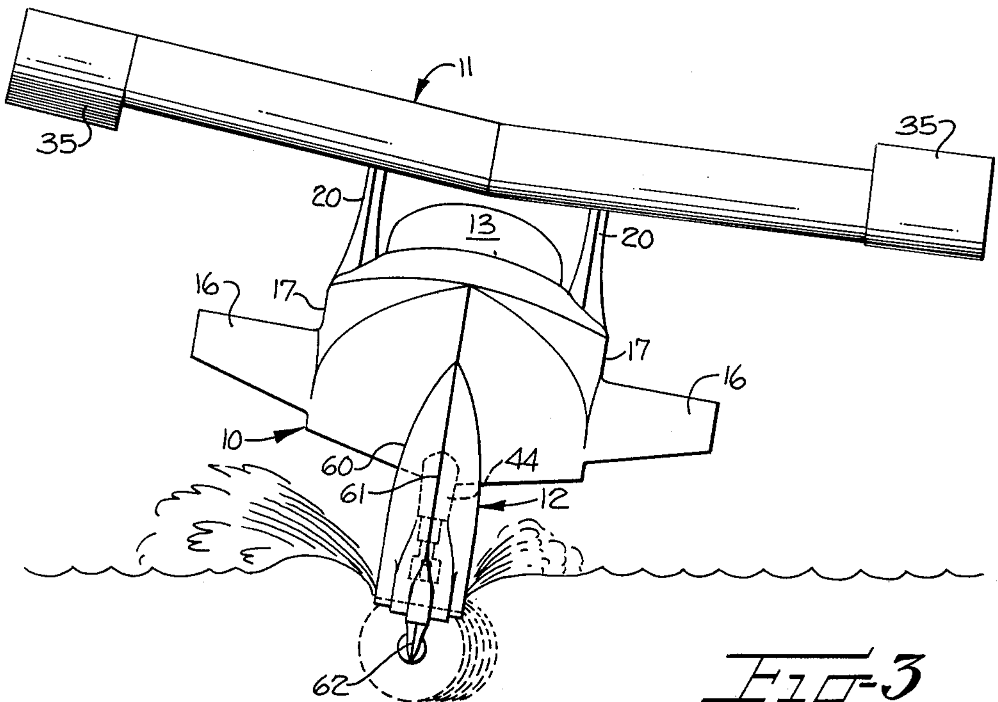

Fig-3

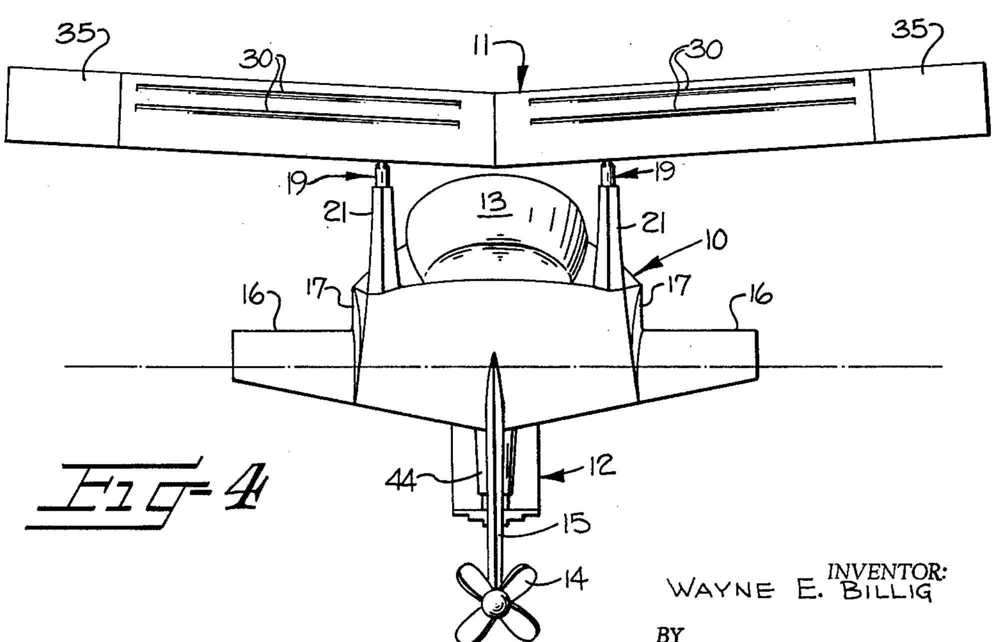

Fig-4

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BOAT WITH HYDROFOIL AND WINGS

Filed Feb. 25, 1963 4 Sheets-Sheet 3

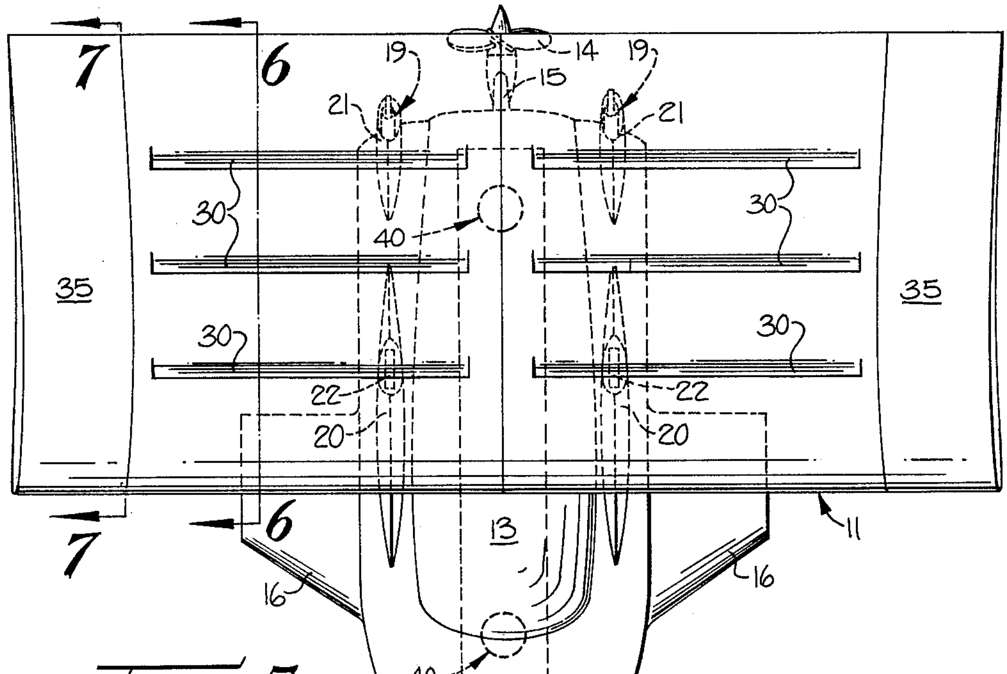
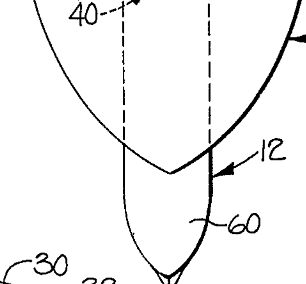

Fig-5

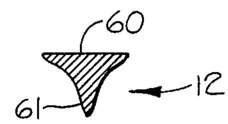

Fig-8

Fig-9

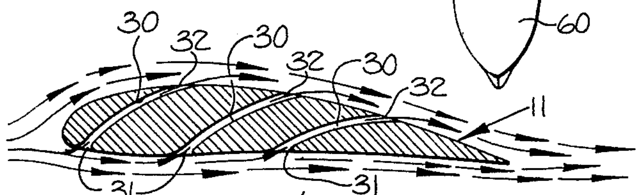

Fig-6

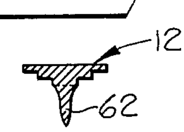

Fig-10

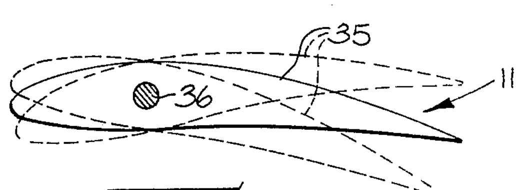

Fig-7

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BOAT WITH HYDROFOIL AND WINGS

Filed Feb. 25, 1963 4 Sheets-Sheet 4

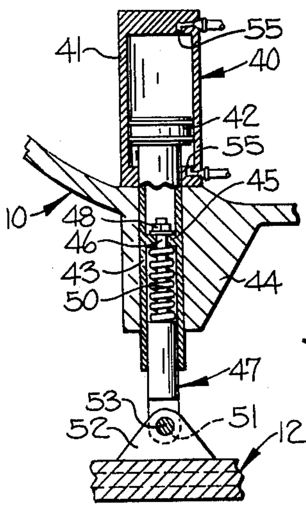

Fig-11

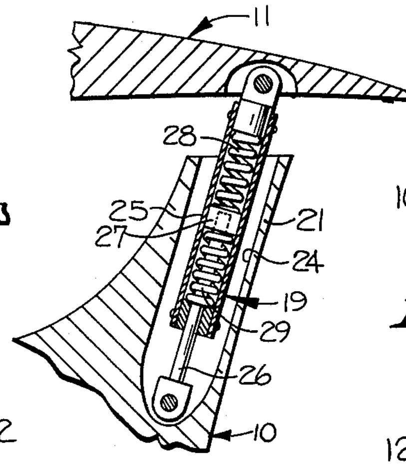

Fig-12

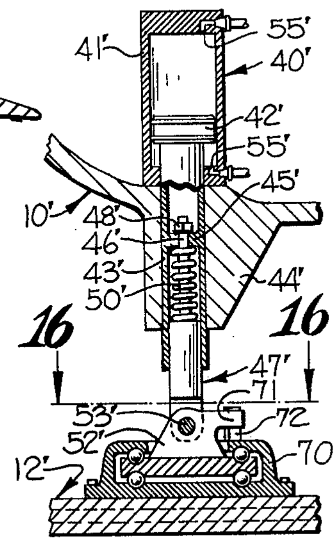

Fig-15

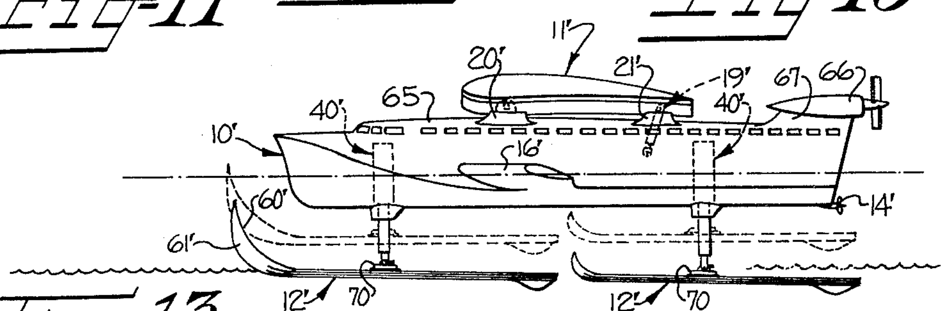

Fig-13

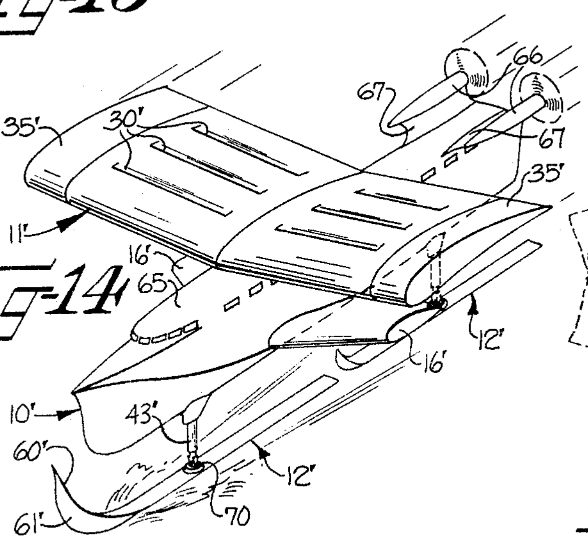

Fig-14

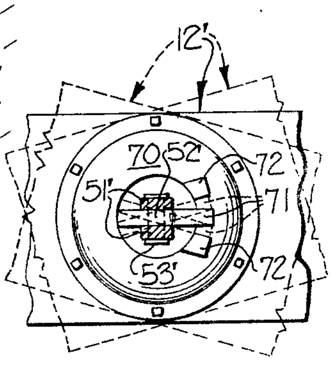

Fig-16

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3,157,146
BOAT WITH HYDROFOIL AND WINGS
Wayne E. Billig, 513 Adams St., Sumter, S.C.
Filed Feb. 25, 1963, Ser. No. 260,675
4 Claims. (Cl. 114—66.5)

The present invention relates to a novel and improved boat or watercraft capable of high forward speed. More particularly, the present invention is concerned with a novel boat construction utilizing a wing and a ski element respectively mounted above and beneath the body of the boat to reduce frictional drag on the boat by the water by causing the body thereof to be raised above the level of the water with the body being supported by the ski element which skims across the surface of the water when a high forward speed is attained so that the power requirements of a boat for attaining high forward speeds can be significantly reduced.

As is well known, the popularity of boating as a form of recreation has become widespread. With this mounting popularity, a trend toward larger boats equipped with expensive power plants to achieve greater riding comfort and additional speed has emerged. Typically, such a large boat possesses a relatively large surface area which comes into contact with the water, thereby creating a substantial frictional drag on the boat as it travels through the water which must be off-set by providing the boat with a large expensive power plant if increased speed is to be attained. However, the considerable expense in owning and operating a large boat equipped with a power plant capable of propelling the boat through the water at high speeds is prohibitive to many boating fans.

Along with the problems associated with the sporting and recreational aspects of boating, the broader field of water transportation by boat, particularly of the ocean-going type, is beset by problems of a similar nature which relate to the large operating expenses of ocean-going vessels and the relative lack of speed of such watercraft, as compared to other transportation media in the modern era, such as airplanes, for example.

It is therefore an object of the present invention to provide a novel and improved boat capable of sustained high forward speeds, even though the motor means employed to propel the boat forwardly possesses only modest power, wherein the frictional drag of the water against the boat is reduced as the forward speed of the boat increases.

It is another object of this invention to provide a novel and improved boat having a wing and a water-engaging ski element respectively mounted above and beneath the body of the boat, wherein lift is imparted to the boat by the flow of air across air foil surfaces on the wing to substantially sustain the weight of the boat at high forward speeds thereof with its body elevated above the water and the ski element skimming the surface of the water to materially decrease the frictional resistance encountered by the boat.

It is another object of this invention to provide a novel and improved boat suitable for ocean-going transportation which is capable of developing and maintaining high forward speeds with minimum power plant requirements.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which—

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FIGURE 1 is a side elevational view of the boat according to the present invention, and showing the boat as it travels across the water;

FIGURE 2 is a side elevational view similar to FIGURE 1, but showing the boat as it floats in the water in a relatively stationary position;

FIGURE 3 is a front elevational view of the boat of FIGURE 1 as it negotiates a curved course or turn in traveling across the water;

FIGURE 4 is a rear elevational view of the boat of FIGURE 1, but showing the boat as it floats in the water in a relatively stationary position;

FIGURE 5 is a top plan view of the boat of FIGURE 1;

FIGURE 6 is a transverse vertical sectional view taken along the line 6—6 in FIGURE 5 and showing the internal construction of the wing, with arrows indicating the directions of air flow across the air foil surfaces of the wing;

FIGURE 7 is a transverse vertical sectional view taken along the line 7—7 in FIGURE 5 and showing the aileron pivotally mounted on one end of the wing, with the opposite extreme positions which the aileron may assume being illustrated in phantom lines;

FIGURE 8 is a transverse sectional view taken along the line 8—8 in FIGURE 2;

FIGURE 9 is a transverse sectional view taken along the line 9—9 in FIGURE 2;

FIGURE 10 is a transverse sectional view taken along the line 10—10 in FIGURE 2;

FIGURE 11 is a fragmentary vertical sectional view of one of the mounting assemblies for connecting the ski element beneath the body of the boat in suspended relationship;

FIGURE 12 is a fragmentary vertical sectional view of one of the assemblies for attaching the trailing portion of the wing to the body of the boat;

FIGURE 13 is a side elevational view of a modified form of boat particularly adapted for ocean-going transportation;

FIGURE 14 is a perspective view of the modified boat illustrated in FIGURE 13;

FIGURE 15 is a fragmentary vertical sectional view of details of the single mounting assembly connecting one of the ski elements beneath the body of the modified boat of FIGURE 13; and

FIGURE 16 is a fragmentary transverse sectional view taken along the line 16—16 in FIGURE 15.

Referring more specifically to the drawings, and particularly to the form of the invention illustrated in FIGURES 1–12, inclusive, there is shown a boat which includes a body or hull 10, a wing 11 extending transversely to the body 10 and secured to an upper portion thereof, and an elongated water-engaging member in the form of a ski element 12 mounted beneath the body 10 for supporting the body 10 of the boat above the surface of the water when the boat travels across the water at a sufficiently high forward speed.

The body 10 is appropriately streamlined to reduce the degree of frictional resistance encountered by the boat and is provided with a transparent, smoothly contoured dome or canopy 13 which forms an enclosure over the top portion of the body 10 for accommodating a pilot and passengers. The transparent canopy 13 extends longitudinally from the rear of the body 10 to a forwardly disposed position where a cockpit having suitable controls for steering the boat is located.

The motor means or power plant for propelling the boat across the water may take any suitable form. In the form of the invention illustrated in FIGURES 1–12, inclusive, such motor means is identified as an inboard engine equipped with a rotatable screw propeller 14 which is suspended beneath the bottom of the body 10 from the rear end thereof by a tubular housing 15 containing portions of the driving mechanism for rotating the screw propeller 14.

A pair of stabilizer fins 16 are respectively secured to the opposite sides 17 of the body 10 so as to extend laterally outwardly therefrom. As best shown in FIGURE 5, each of the stabilizer fins 16 has a rearwardly tapered leading edge and a longitudinal cross-section of substantially tear-drop shape, beginning with an enlarged forward portion and tapering to a relatively thin trailing edge. As observed in FIGURES 2 and 4, the stabilizer fins 16 are secured to the opposite sides 17 of the body 10 along the approximate water line thereon so as to provide greater balance for the boat when its body 10 is floating in the water. The stabilizer fins 16 are located on the body 10 of the boat so as to lie slightly forwardly of a point intermediate the ends of the body 10 or midships throughout the major portions of their extent.

The body 10 is further provided with a wing-supporting superstructure comprising forward and rear pairs of upright support members 20 and 21 extending upwardly from the top portion of the body 10. The forward pair of support members 20 are located adjacent the sides 17 of the body 10 and approximately intermediate the ends thereof, being disposed for the most part slightly rearwardly of the stabilizer fins 16. The rear pair of support members 21 project upwardly from the stern of the boat.

The wing 11 is mounted upon the pairs of support members 20 and 21 in an elevated position above the transparent dome or canopy 13 on the body 10 so as to define an open region therebetween through which air is permitted to flow as the boat travels forwardly across the water. The wing 11 is hinged to the forward pair of support members 20 for limited pivotal movement with respect thereto. In this connection, the upper ends of the forward support members 20 terminate in apertured ears 22 which are received within the wing 11, and stub shafts 23 fixedly carried by the wing 11 are swivelly received by the apertures provided in the ears 22 of the forward support members 20 for pivotal movement therein.

As shown in FIGURE 12, each of the rear pair of support members 21 is provided with an upwardly opening, elongated, cylindrical bore 24 for reception of a vibration damping assembly 19 swivelly connected at its opposite ends to the body 10 and the wing 11. Each of the vibration damping assemblies 19 comprises a cylinder 25 swivelly connected at its upper end to the trailing portion of the wing 11 and extending downwardly into the bore 24. A plunger 26 is mounted in the bore 24 with its lower end swivelly connected to the body 10. The plunger 26 is slidably received within the cylinder 25 and has an enlarged head 27 at its upper end against which opposing springs 28, 29 bear. The distal ends of the springs 28, 29 are respectively seated on the upper and lower ends of the cylinder 25.

The pivotally mounted wing 11 is self-adjusting to maintain a substantially constant lift on the boat during forward speeds thereof across the water. In this respect, the leading portion of the wing 11 is adapted to be pivoted downwardly about the forward pair of support members 20 to increase its angle of attack with respect to the air currents, and to be pivoted upwardly to decrease its angle of attack, in adjusting to fluctuations in the air flow across the air foil surfaces thereof. The damping assemblies 19 connected between the rear support members 21 and the trailing portion of the wing 11 are effective to absorb vibrations to prevent structural damage to the wing 11. In the latter respect, each of the cylinders 25 of the damping assemblies 19 swivelly carried by the trailing portion of the wing 11 is adapted to move up or down with respect to the plunger 26 corresponding thereto, depending upon the direction of pivotal movement imparted to the wing 11 by fluctuations in the air flow across the air foil surfaces thereof, while the opposing springs 28, 29 cooperate with the enlarged head 27 on the plunger 26 to absorb vibrations caused by the movement of the wing 11 and the cylinder 25. The cylinders 25 of the damping assemblies 19 are substantially smaller in diameter than the diameter of the bores 24 to allow for limited forward and rear play of the damping assemblies 19 within the bores 24 as the wing 11 is pivoted about the forward support members 20.

The wing 11 is constructed so as to facilitate the flow of air across its air foil surfaces to reduce the turbulence of the air currents, thereby aiding in producing smooth movement of the boat on the water. To this end, a plurality of ducts 30 are formed in the wing 11, the ducts 30 extending from the lower air foil surface to the upper air foil surface of the wing 11. As shown in FIGURE 5, the ducts 30 may be arranged in two rows of parallel ducts located on either side of the center of the wing 11, with each duct 30 being positioned transversely with respect to the longitudinal extent of the boat and being of substantial width. Each of the ducts 30 is provided with an inlet 31 opening onto the lower air foil surface of the wing 11, with the duct 30 being curved rearwardly and upwardly to provide an outlet 32 opening onto the upper air foil surface of the wing 11 (FIGURE 6). The portion of the air flow across the lower air foil surface of the wing 11 which is directed into the inlets 31 and through the ducts 30 issues from the outlets 32 to combine with the air flow across the upper air foil surface, as indicated by the directional arrows in FIGURE 6, and the combined air flow across the upper air foil surface is subsequently directed to the trailing edge of the wing 11 to be united with the remaining air flow across the lower air foil surface after flowing past the trailing edge of the wing 11. By constructing the wing 11 so as to include the plurality of ducts 30 in the manner described, the air flow through the restricted open region between the wing 11 and the body 10 of the boat is not unduly obstructed and any turbulence developed in the air currents is substantially dissipated.

The opposite ends of the wing 11 may be equipped with pivotal wing extensions in the form of flaps or ailerons 35 as a means to effect turning movements of the boat in changing the direction of travel of the boat. Each of the ailerons 35 is adapted to be pivoted about a transverse axis 36 (FIGURE 7) by means of a suitable guidance system connected with a manually operable control lever (not shown) in the cockpit within the transparent canopy 13. The wing extensions or ailerons 35 are normally maintained in flush relationship with the wing 11 while the boat is traveling in a straight path across the water, but are intended to be pivoted in opposite directions, as illustrated in FIGURE 3, to assist in steering the boat along a curved course for changing the direction of travel.

The bottom of the body 10 of the boat is provided with a pair of mounting assemblies 40 adjacent to the bow and stern of the boat to connect the water-engaging ski element 12 therebeneath for vertical adjustment with respect to the body 10. In this connection, each of the mounting assemblies 40 for the ski element 12 may comprise a piston and cylinder arrangement operable by fluid pressure. As shown in FIGURE 11, each of the mounting assemblies 40 comprises a cylinder 41 seated in the bottom of the body 10 in a vertical position and a piston 42 mounted in the cylinder 41 for reciprocable movement. The piston 42 has a piston rod 43 which extends downwardly and outwardly with respect to the cylinder 41. The piston rod 43 is slidably received through a bore formed in a strut 44 depending below the bottom of the body 10. The piston rod 43 is of tubular construction and includes an apertured internal wall 45 intermediate the ends thereof for slidably receiving the reduced upper end portion or stem 46 of a plunger 47 telescopically mounted within the tubular piston rod 43. In this connection, it will be observed that the stem 46 of the plunger 47 penetrates the apertured internal wall 45 of the tubular piston rod 43 and is provided with a stop nut 48 forming an enlarged collar at its upper end above the wall 45 for abutment with the wall 45 to retain the plunger 47 in slidable telescoped relationship within the tubular piston rod 43.

A coil spring 50 is received within the tubular piston rod 43, the opposite ends of the spring 50 being seated against the enlarged lower end portion or head of the plunger 47 and the internal wall 45 of the tubular piston rod 43, with the spring 50 encircling the stem 46 of the plunger 47 below the wall 45. The enlarged head of the plunger 47 extends below the tubular piston rod 43 and is bifurcated to form a clevis 51 for straddling an upstanding lug 52 on the water-engaging ski element 12. A connector pin 53 is carried by the clevis 51 on the lower end of the plunger 47 and penetrates an aperture in the lug 52 straddled by the clevis 51 to connect the ski element 12 to the body 10 of the boat.

The cylinder 41 is a double-acting cylinder in that each of its ends is provided with a port 55 communicating with a source of fluid pressure (not shown), the ports 55 alternately admitting fluid pressure into the cylinder 41 at opposite ends thereof to induce upward or downward movement of the piston 42 in the cylinder 41. Thus, regulated movement of the pistons 42 in the cylinders 41 of the pair of mounting assemblies 40 provides for vertical adjustment of the ski element 12 with respect to the body 10 of the boat. The springs 50 seated in each of the tubular piston rods 43 between the enlarged head of the plunger 47 and the internal wall 45 of the tubular piston rod 43 serve as shock absorbers for smoothing the effects of rough waves or other turbulence in the water acting upon the ski element 12. Elongated keyways and keys or other suitable means are appropriately provided on the struts 44, the piston rods 43, and the plungers 47 to prevent relative rotation between these parts of the mounting assemblies 40, while permitting relative reciprocatory movement therebetween.

The elongated ski element 12 is thereby adjustably mounted beneath the bottom of the body 10 in vertically spaced relationship therefrom and extends lengthwise of the body 10 from a point substantially coextensive with the stern thereof to an upwardly curved forward end portion 60 disposed ahead of the bow of the body 10. The upwardly curved forward end portion 60 of the ski element 12 has a sickle-shaped downwardly tapered blade 61 providing a knife edge for cutting through the water, while a keel 62 depends from the rear end portion of the ski element 12 for added stability of the boat in the water. It will be observed by referring to the cross-sectional view of the ski element 12 in FIGURE 9 that the ski element 12 is transversely stepped for decreasing the effective water-engaging surface of the ski element 12 as the lift imparted to the boat by the wing 11 increases to further aid in reducing the degree of frictional drag imparted to the boat by the water.

In operation, the boat while relatively stationary or moving forwardly under a slow speed assumes the position illustrated in FIGURE 2, wherein the dash-dot line represents the approximate level of the water. In this position, the ski element 12 is substantially submerged in the water, while the body 10 of the boat floats upon the water with a substantial surface area thereof being contacted by the water for establishing a considerable degree of frictional resistance against forward movement of the boat. As the forward speed of the boat is increased, the flow of air across the air foil surfaces of the wing 11 correspondingly increases to enhance the degree of lift imparted to the boat by the wing 11. In this manner, the body 10 of the boat rises above the water with the boat assuming the position illustrated in FIGURE 1 at high forward speeds thereof. It will be seen, therefore, that the lift imparted to the boat by the wing 11 substantially sustains the weight of the boat at high forward speeds and the frictional contact of the boat with the water is restricted to the water-engaging surfaces of the ski element 12. As earlier described, the transverse stepped configuration of the ski element 12 permits further reduction in the degree of frictional resistance encountered by the boat as the forward speed thereof increases by providing upwardly disposed steps along the bottom surface of the ski element 12 which may be progressively raised above the water level until only the lower step on the bottom surface of the ski element 12 contacts the water as the boat skims across the surface thereof at a high rate of speed.

While the lift imparted to the boat by the wing 11 can be increased to a degree substantially sustaining the weight of the boat by correspondingly increasing the forward speed of the boat, the arrangement of the ducts 30 in the wing 11 and the resilient connection of the trailing portion of the wing 11 to the rear support members 21 of the body 10 provided by the vibration damping assemblies 19 tends to place an upper limit on the degree of lift which can be achieved by the wing 11, even though the forward speed of the boat may be further increased, to prevent the boat from becoming air-borne. In this respect, the ducts 30 are so arranged to reduce the air pressure along the lower air foil surface of the wing 11, since a portion of the air flow across the lower air foil surface is directed through the ducts 30 onto the upper air foil surface. In addition, the equilibrium positions assumed by the telescoped cylinder 25 and plunger 26 of each of the vibration damping assemblies 19 as established by the opposing springs 28, 29 in the absence of air flow cause the trailing portion of the wing 11 to be resiliently connected to the body 10 so that the wing 11 is disposed in generally parallel relation to the surface of the water in its equilibrium position. The pivotally mounted wing 11 exhibits a tendency to remain in or return to is equilibrium position. In the equilibrium position of the wing 11, its leading portion is so arranged that the angle of attack of the wing 11 is increased over that normally assumed by an airplane wing to limit the lift characteristics of the wing 11. Because of these factors, the wing 11 is not capable of imparting lift to the boat of such a significant degree as to make the boat air-borne.

The foregoing form of my invention is perhaps particularly applicable for sport and recreational purposes. In FIGURES 13–16, inclusive, a modification of the invention, wherein the boat is especially adapted to serve as a larger watercraft, such as a liner suitable for ocean-going transportation, is illustrated. Components of the modified construction shown in FIGURES 13–16, inclusive, having similar counterparts in the first form of the invention illustrated in FIGURES 1–12, inclusive, bear the same reference characters with prime notations added thereto. By way of example, the modified boat of FIGURES 13–16, inclusive, may be of a size befitting a luxury ocean liner and may include a body 10′ having an elongated cabin structure 65 provided with a plurality of windows arranged in a row along each side thereof. The cabin structure 65 may be internally partitioned into individual compartments providing quarters for the crew and passengers and for operational purposes in navigating the boat. Thus, the forward portion of the cabin structure 65 may serve as the "pilot house" of the boat 10 where the captain and crew members control the direction and speed of the boat by suitable controls. With a large watercraft, the motor means or power plant therefor preferably includes one or more air propellers for moving the watercraft. Thus, in the example illustrated in FIGURES 13 and 14, the aft portion of the boat is provided with a pair of air propellers **66** elevated above the body **10'**. The air propellers **66** are mounted on upwardly divergent motor mounts **67** which connect the air propellers **66** to the body **10'** at positions disposed rearwardly of the wing **11'**. The blades of the air propellers **66** may be constructed so as to have a reversible pitch in order to propel the boat in either a forward or a rearward direction as desired.

In place of the single elongated ski element **12** of the form of the invention illustrated in FIGURES 1–12, inclusive, the modified boat of FIGURES 13–16, inclusive, has a pair of water-engaging ski elements **12'** mounted beneath the bottom of the body **10'** by individual vertically adjustable mounting assemblies **40'**, such as those previously described. It will be noted, however, that each of the ski elements **12'** is connected to the bottom of the body **10'** by a single vertically adjustable mounting assembly **40'**, rather than a pair of such mounting assemblies.

Each of the ski elements **12'** is thereby permitted a limited degree of lateral pivoting movement about the axis of its mounting assembly **40'** which may be regulated by cables secured to the ski elements **12'** and connected to the steering mechanism (not shown) of the boat. The range of this lateral pivoting movement of each ski element **12'** is preferably of the order of 20 degrees to either side of its normal straightforward position which corresponds to the longitudinal extent of the body **10'**. Thus, in FIGURE 16, the dashed-line positions represent the opposite extremes of such lateral pivotal movement by each of the ski elements **12'**. Referring to FIGURE 15, a thrust bearing **70** is interposed between each ski element **12'** and the upstanding lug **52'** thereon for swivelly connecting the upstanding lug **52'** to the ski element **12'**. An arm **71** integral with the lug **52'** projects outwardly therefrom and cooperates with a pair of spaced upstanding stop members **72** rigidly affixed to the ski element **12'** for restraining the lateral pivotal movement of the ski element **12'** to lie within the indicated range.

The modified boat of FIGURES 13–16, inclusive, can therefore be propelled across the water with its ski elements **12'** laterally pivoted by the pilot of the boat to assume a longitudinally off-set relationship to the body **10'** of the boat for negotiating rough seas with only limited transmission of wave motions to the body **10'** of the boat. It will be understood that the modified boat of FIGURES 13–16, inclusive, is operated in a manner similar to that previously described in connection with the boat shown in FIGURES 1–12, inclusive, in that the body **10'** of the modified boat will normally assume a floating position in the water with the ski elements **12'** submerged when the modified boat is moving slowly or is relatively stationary. As the forward speed of the boat increases, the wing **11'** imparts increased lift thereto, and the body **10'** of the modified boat rises above the surface of the water to reduce the frictional drag encountered by the modified boat. At cruising speeds, only the ski elements **12'** of the modified boat will be in contact with the water along their bottom surfaces, and the boat can travel across the water at a high forward speed substantially unimpeded by any frictional drag from the water.

When the modified boat of FIGURES 13–16, inclusive, is in a harbor area, such as at the beginning or ending of a voyage, it is contemplated that relatively slow movement may be imparted to the boat by rotation of a screw propeller **14'** mounted beneath the bottom of the boat at the stern thereof and driven in a conventional manner. Where the modified boat is provided with an auxiliary motion imparting means in the form of the screw propeller **14'** to facilitate entering and leaving a harbor area under safe, slow speeds, the air propellers **66** are preferably not operated while the boat is in a harbor area, and the body **10'** of the boat assumes a floating position in the water. During this period, the ski elements **12'** may be raised to lie just beneath the bottom of the body **10'**, as shown in phantom lines in FIGURE 13, by appropriate operation of the vertically adjustable mounting assemblies **40'** for insuring clearance of the boat from the bottom or bed of the harbor and obstructions which may rise therefrom.

In the drawings and specification there have been set forth preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

I claim:

1. A boat comprising

(*a*) a body, said body being adapted to float upon the water when said boat is stationary and to be above the surface of the water when said boat is in motion,

(*b*) elongated ski means centrally mounted beneath said body, said ski means being transversely stepped along the major portion of its length and being adapted to be submerged in the water when the boat is stationary and to skim along the surface of the water when the boat is in motion,

(*c*) wing means extending transversely of said body and outwardly beyond the opposite sides thereof,

(*d*) means connecting said wing means to said body in a position elevated above said ski means for pivotal movement of said wing means about a transverse axis intermediate the forward and trailing edges of said wing means,

(*e*) resilient means disposed rearwardly of said pivotal connecting means and securing the trailing portion of said wing means to said body, said resilient means biasing said pivotally movable wing means to a position of equilibrium substantially parallel to the surface of the water,

(*f*) motor means carried by said body for propelling the boat across the water,

(*g*) said wing means having upper and lower air foil surfaces across which air is adapted to flow for imparting lift to the boat to substantially sustain the weight of the boat at high forward speeds thereof for raising said body above and said ski means to the surface of the water, and

(*h*) said wing means being self-adjusting so as to pivot about said transverse axis against the biasing effect of said resilient means in response to fluctuations in the air flow across the air foil surfaces thereof to vary its angle of attack for maintaining a substantially constant lift on said boat, whereby said boat travels across the water under high forward speeds with said ski member skimming the surface of the water.

2. A boat as in claim 1, wherein said ski means is mounted for limited pivotal movement relative to said body in a generally horizontal plane.

3. A boat as in claim 1, and further including a pair of fins attached to the opposite sides of said body and extending laterally outwardly therefrom, said fins being disposed between said ski means and said wing means and respectively terminating substantially short of the opposite ends of said wing means, said fins being adapted to be in a substantial alinement with the surface of the water when said boat is stationary and to be above the surface of the water when said boat is in motion.

4. A boat as set forth in claim 1, wherein

(*i*) said wing means is provided with a plurality of ducts arranged transversely to the longitudinal extent of said body, and

(*j*) each of said ducts extending upwardly and rearwardly through the thickness of said wing means and having

(1) an inlet opening at one end thereof disposed

on the lower air foil surface of said wing means, and

(2) an outlet at the other end thereof disposed on the upper air foil surface of said wing means.

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