

H. C. RICHARDSON.
HYDROVANE BOAT.
APPLICATION FILED MAR. 1, 1911.

1,095,166.

Patented Apr. 28, 1914.

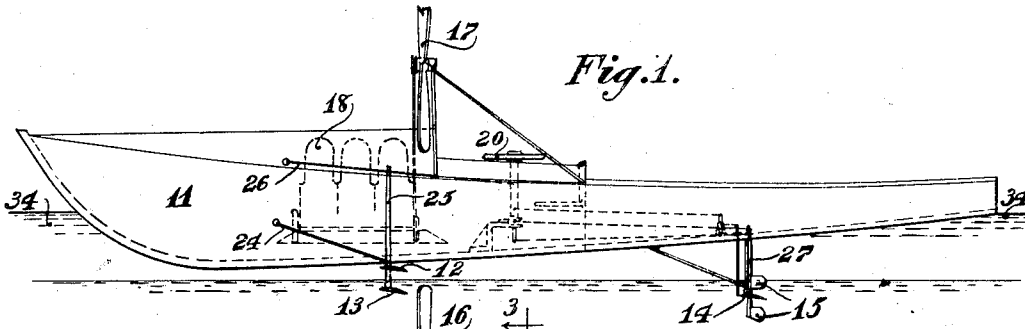


Fig. 1.

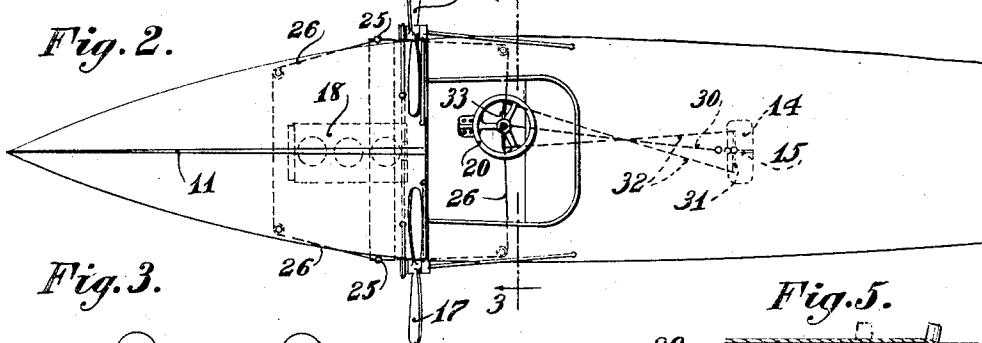


Fig. 2.

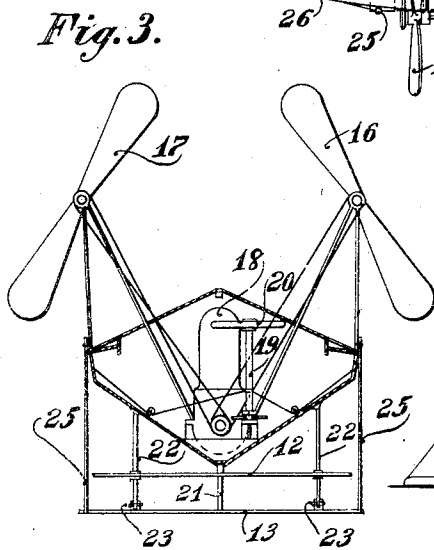


Fig. 3.

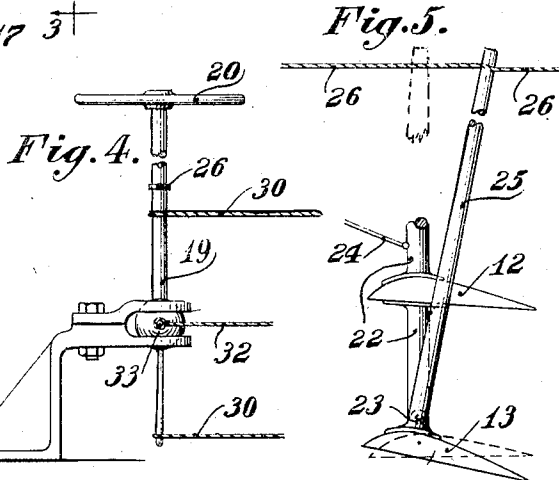
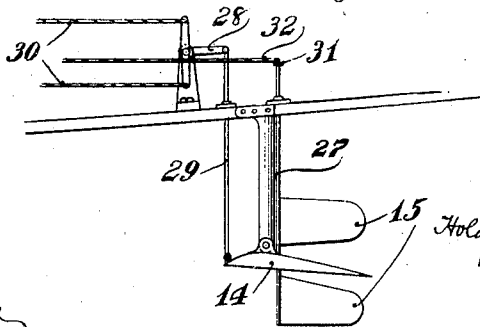


Fig. 4.

Fig. 5.

Fig. 6.



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HYDROVANE-BOAT.

1,095,166.

Specification of Letters Patent.

Patented Apr. 28, 1914.

Application filed March 1, 1911. Serial No. 611,664.

To all whom it may concern:

Be it known that I, HOLDEN C. RICHARDSON, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia, State of Pennsylvania, have invented a new and useful Hydrovane-Boat, of which the following is a specification.

My invention relates to improvements in hydro-vanes.

10 My object is to provide a hydro-vane boat, or hull, designed for use as a speed-boat, and also for purposes of instruction, in the method and principles of control and practice of same, as used in aeroplanes of various
15 types, and applicable to the practice in control, and investigation of any present or proposed type of aeroplane. It being practicable to duplicate on a reduced scale, due to increased unit pressures in the water, the
20 main features of the disposition of areas, the warping of supporting surfaces, the use of ailerons, vertical and horizontal rudders, and other recognized stabilizing devices, embracing the types of control embodied in the
25 Wright, Farman, Curtis, Bleriot, Antoinette and other types. My device is adapted to secure a degree of safety in these investigations or such instruction far superior to that existing with actual full sized aeroplanes.
30 While restricted in amplitude, every feature of actual aerial flight may be simulated, including fore and aft and lateral stability, and control of course or change of same, together with the control of the prime-mover, thus al-
35 lowing the novice to become familiar with all features of control necessary to the actual control of an aeroplane in moderate weather.

As a speed boat, the reduction of supporting areas and the increase of engine power
40 allow of unusual speed possibilities.

Referring to the drawings, illustrating for example suitable means for realizing my invention—Figure 1 is a side elevation of a hydro-vane boat. Fig. 2 is a plan view.
45 Fig. 3 is a section on line 3—3 of Fig. 2. Fig. 4 is a detail in elevation on an enlarged scale of the controlling means. Fig. 5 is a detail in elevation on an enlarged scale of the warping means. Fig. 6 is a detail in ele-
50 vation of the steering means.

Similar numerals refer to similar parts throughout the several views.

The hull or boat 11 is provided with the superimposed vanes 12 and 13, providing the

main supporting surface and the divided 55 vertical rudder 15. The aerial propellers are indicated at 16 and 17. Submerged propeller or propellers may be added or substituted if desired, but are not shown in the drawings as they may be of any of the well
60 known types. Any suitable prime-mover may be used as for example, an internal combustion engine. The controlling shaft is indicated at 19, provided with the hand wheel
65 20. The vanes 12 and 13 are rigidly connected with the center line strut 21. The vane 12 is also rigidly connected with the out-board struts 22, while vane or member 13, which is preferably flexible, is pivotally connected with the out-board struts 22.
70

The center line strut is secured to the keel in any suitable way, care being taken to give the connecting means between the strut and keel and vanes, good "stream line" form so as to reduce to a minimum the wave and
75 eddy making due to the necessary obstruction formed by the strut and connecting flanges. The strut should be substantially formed to resist fore and aft and side thrust as well as to carry the load to the vanes.
80

The out-board struts are shown connected to a part of the bilge at about the normal water line. These struts being of greater extension than the center line strut, are suitably stayed, as indicated at 24, Fig. 5, to
85 take the fore and aft thrusts, the same precaution should be taken as to good "stream line" section.

As above indicated, the outer ends of vane 13 are secured to the out board struts 22 by
90 pivotal connections as indicated at 23 to allow for warping at the tips. The warping levers 25 are attached to the outer ends or tips of vane 13, well to the forward side of the same as clearly shown in Fig. 5. These
95 levers are also carefully shaped to stream line section. The upper ends of levers 25 are controlled in a fore and aft sense by guy wires 26 leading to the universal control, and are made interacting by suitable cross
100 connections opposing the guy wires.

The after strut 27, suitably shaped to good stream line section supports the horizontal member or rudder 14 and the vertical rudder
105 15 together with the rudder post and tiller. The horizontal rudder 14 is pivotally connected with the strut 27 and is operated by a suitable bell crank 28 and connecting rod

29. The bell crank 28 is actuated by guy wires 30 from the universal control.

The tiller is operated by two wires 32 equidistant from the center of motion, these wires cross each other and are connected at one end with cross bar 31 connected with the tiller, and at their other ends with the cross bar 33 attached to the shaft 19.

At rest, with full load, the hull is designed to float at the water line shown at 34. Immediately, head way is gained, the course may be controlled by the vertical rudder 15, and the fore and aft trim, by the horizontal rudder 14, and the supporting vanes 12, 13 and 14 tend to lift, thereby reducing the displacement and wetted surface of the hull, and thus decreasing the resistance due to wetted surface at the corresponding speed, at the same time the water lines become finer and the wave making is reduced.

The power of the propellers being in excess of that required for intermediate speeds, the hull rapidly emerges with a consequent reduction in skin friction and wave making due to same, and the fore-and-aft and lateral stability are provided for by the use of ailerons, or by warping vanes and by the horizontal rudder. Thus by stages the load is transferred from the displacement of the hull to the supporting vanes, the latter being suitably located with reference to the center of gravity of the whole, so that the stability is under control. Finally the displacement hull becomes emerged at some intermediate speed, for which the supporting vanes 12, 13 and 14 and additional superposed vanes if required, (multivanes or monovane) are designed, thus reducing the wetted surface to that of the vanes and rudders and necessary struts and controls for the same. The power still being in excess of that required to overcome the wave making, eddy-making, skin friction resistance, and the fore-and-aft component of the normal pressure on the vanes, the speed may be accelerated, till one or more, or all of the superposed surfaces emerge, thus reducing the immersed vanes to those of the requisite area for support at that speed, and thus enabling the limit of speed for a given power to be reached for that design.

From actual experience with a model, I have discovered that, a horizontal vane of large aspect ratio, has high inherent lateral stability due to the operation of the following features, and I therefore claim to be the inventor of this type of vane.

As the vane, inclined to the plane of translation, rises toward the surface, the flow of water over the back of same is clean and continuous, provided the vane is well shaped and of good stream-line section, and this film or stream becomes thinner as the surface is approached. Up to a certain point the lift is fairly constant, but as the film over the

back of the vane gets thinner, its supporting value decreases, until the continuity of flow over the back of the vane is broken, when the supporting value is much diminished. Thus any tendency, when near the surface, to depress one end and elevate the other, leads to an increase in the supporting power of the lowering end, and a decided decrease of the supporting power of the rising end, and particularly when emersion of that end takes place its supporting value is practically nothing (if we ignore the air pressure). This results in a rapid shift of the center of pressure laterally, which tends to preserve equilibrium.

The use of horizontal vanes, instead of vanes at a dihedral angle prevents the formation of any but a minor system of lateral waves, and thus conserves the energy expended to the useful work of supporting the load and raising the unnecessary wetted surface clear of the water.

The above principles together with the use of warping vanes or of ailerons provides means of retaining stability when turning.

A similar combination of hull and vanes is suitable in connection with aeroplanes and allows of their lighting on or rising from the surface of the water. For this purpose the presence of large aero-plane surfaces and regular controls, engines and propellers, would allow of the modification of the above design in the following particulars. The hull displacement would require to be adequate to support the aeroplane well clear of the water, and should have either by means of catamarans or other similar devices, or inherent in itself, provision for lateral and horizontal stability at rest. The hydro-vane supporting surface could be much reduced, as the aeroplane surfaces would relieve them of part of their functions, and the aeroplane power-plant and controls should be adequate without duplication in the hydro-vane hull. To turn, for example, to starboard, the hand wheel 20 is rotated in a clockwise direction, (looking down on it) and this puts the "helm" to "port" and tends to swing the bow to "starboard" and vice versa. To "trim down by the stern," or "to increase the angle of attack," that is to lower 14 with respect to 13, the operator, seated abaft the wheel pulls same toward him, this causes the forward edge of 14 to be depressed so that the rudder 14 loses supporting power or even derives a down thrust; and vice versa. The "lateral stability" is controlled by the tip control or warping tips of 13. To incline to the right, the wheel is drawn to the right, this hauls aft, the upper end of the port warping lever 25, and hauls forward the upper end of the starboard lever 25, thus increasing the supporting power of the port end and decreasing that of the starboard

end, with a consequent shift in a lateral direction (to "port"); of the center of pressure, with a consequent tendency to "heel" to the right and vice versa. Either of these controls can be obtained independently by moving the control in the corresponding way thus, rotate wheel to steer; move forward or aft for change of "trim"; move laterally for change of "keel." By any combination of the above motions a combination of the corresponding controls will result. It will be noted, that by moving the wheel to any position the tendency of the controls is such as to cause the hydro-vane to proceed to assume the attitude of the wheel; for example if the front edge of the wheel is made to rise the tendency is to make the bow rise, if a lateral edge is made to rise, that side of the hydro-vane tends to rise, or if the wheel is turned to starboard the boat tends to turn to starboard. As a complete example, suppose the wheel is pulled aft, and to port and turned to starboard, the following effects would be felt, there would be a tendency to raise the bow and the starboard side and to turn to starboard. (This is only an example of a combination, for it would undoubtedly result in a spill.) The proper corresponding helm would be to turn the wheel to the left, and the hydro-vane would tend to "bank" and turn to "port."

I have discovered in the course of my investigation of the problem of design, that for any particular speed there is a particular unit pressure which is most suitable for that particular speed and which will result in the greatest efficiency, and this particular unit pressure, occurs at a certain definite angle for the speed in question, and further, for high speeds the angle is fairly uniform over a considerable range of speed. (15-60 knots per hour.)

Concentration of the load practically entirely on the forward vane (using a portion only on 14 to assure a normal positive angle) and 14 being adjustable in attitude prevents interference of the wave systems set up by 13 and 14, which might otherwise occur at certain speeds due to the fixed fore-and-aft distance between them and the varying wave lengths corresponding to varying speeds.

What I claim is:—

1. In a hydro-vane boat, the combination of supporting vanes, vane-warping levers, a horizontal rudder, a vertical rudder, said rudders being independently operative from a common source of control, and a manually operated universal control comprising a pivoted member operatively connected with the warping levers and with the horizontal and vertical rudders.

2. In a hydro-vane boat having suitable means of propulsion, the combination with the hull, of a normally submerged sup-

porting vane and means for warping said vane to control the supporting effect of the water thereon.

3. In a hydro-vane boat, the combination with the hull, of normally submerged and immersible horizontally disposed inclined hydro-vanes arranged one above another, and vane tip moving means for simultaneously warping oppositely disposed vane tips.

4. In a hydro-vane boat having suitable means of propulsion, the combination with the hull, of a single main supporting group of forwardly disposed hydro-vanes arranged one above another, and means for simultaneously moving the opposite ends of a superimposed normally submerged vane in opposite directions to control the supporting effect of the water upon the vane upon the movement of the vane-ends in close proximity to or away from the surface of the water.

5. In a hydro-vane boat, the combination with the hull, of a submerged supporting vane, vertical and horizontal rudders, means for moving the same, means for moving the vane tips to vary the supporting power afforded the vane by the water at opposite sides of the hull, and a controlling member connected with the rudder and vane tip moving means and adapted to effect the movement of the boat in the direction in which the controlling member is moved by the operator.

6. In a hydro-vane boat, the combination of a normally submerged hydro-vane, warping means therefor, a rudder and means connected with the vane warping means for actuating the rudder.

7. In a hydro-vane boat, the combination of a normally submerged hydro-vane, warping means therefor, a horizontal rudder, a vertical rudder, and a universal control for effecting simultaneously or independently the warping of the hydro-vane and the actuation of the rudders.

8. In a hydro-vane boat, the combination of a strut, a hydro-vane movably connected therewith and having movable tips, said tips being movable simultaneously in opposite directions, a controlling shaft and connecting means between said shaft and the tips for moving said tips.

9. In a hydro-vane boat, the combination of a flexible hydro-vane, a pivotally mounted member, a common controlling shaft warping, means between the flexible hydro-vane and the controlling shaft and connecting means between the pivotally mounted member and said shaft.

10. In a hydro-vane boat, the combination of a single main supporting group of inclined horizontally disposed hydro-vanes rigidly connected with the hull, struts between one of said vanes and the hull, said vane having flexible tips movably connected

with the struts, a control, and lever mechanism between the control and the vane tips.

11. In a hydro-vane boat, the combination of a single main supporting group of 5 inclined horizontally disposed hydro-vanes, one of said hydro-vanes being rigidly connected with the hull and having a permanent relative relationship therewith from end to end and another of said hydro-vanes 10 having movable tips, a rearwardly disposed member adapted to be moved about a horizontal axis, and a divided vertical rudder.

12. In a device of the character described, the combination of a forwardly disposed 15 supporting member having movable tips, a rearwardly disposed member adapted to be moved about a horizontal axis, a rudder, a universal control, comprising a rotatable member pivoted intermediate its two ends 20 and adapted to be rocked either from side to side or forward and back, and connecting means between said control and the movable tips of said supporting member and be-

tween the control and said rearwardly disposed member and between the control and 25 the rudder.

13. In a hydro-vane boat, the combination with the hull, of parallel supporting vanes arranged one above another, one of 30 said vanes being normally submerged, and means for warping said vane independently of another vane.

14. In a hydro-vane boat, the combination with a hull provided with suitable 35 means of propulsion, of a normally submerged hydro-vane having relatively movable tips movable into planes inclined to the horizontal, the axes of each of said movements being located to one side of the longitudinal center of the vane, and controlling 40 means for said tips to vary simultaneously the supporting effect of the water thereon.

HOLDEN C. RICHARDSON.

Witnesses:

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