No. 617,527. Patented Jan. 10, 1899.

A. HOWARD.

SCREW PROPELLER.

(Application filed June 6, 1898.)

(Model.) 2 Sheets—Sheet 1.

Fig. I.

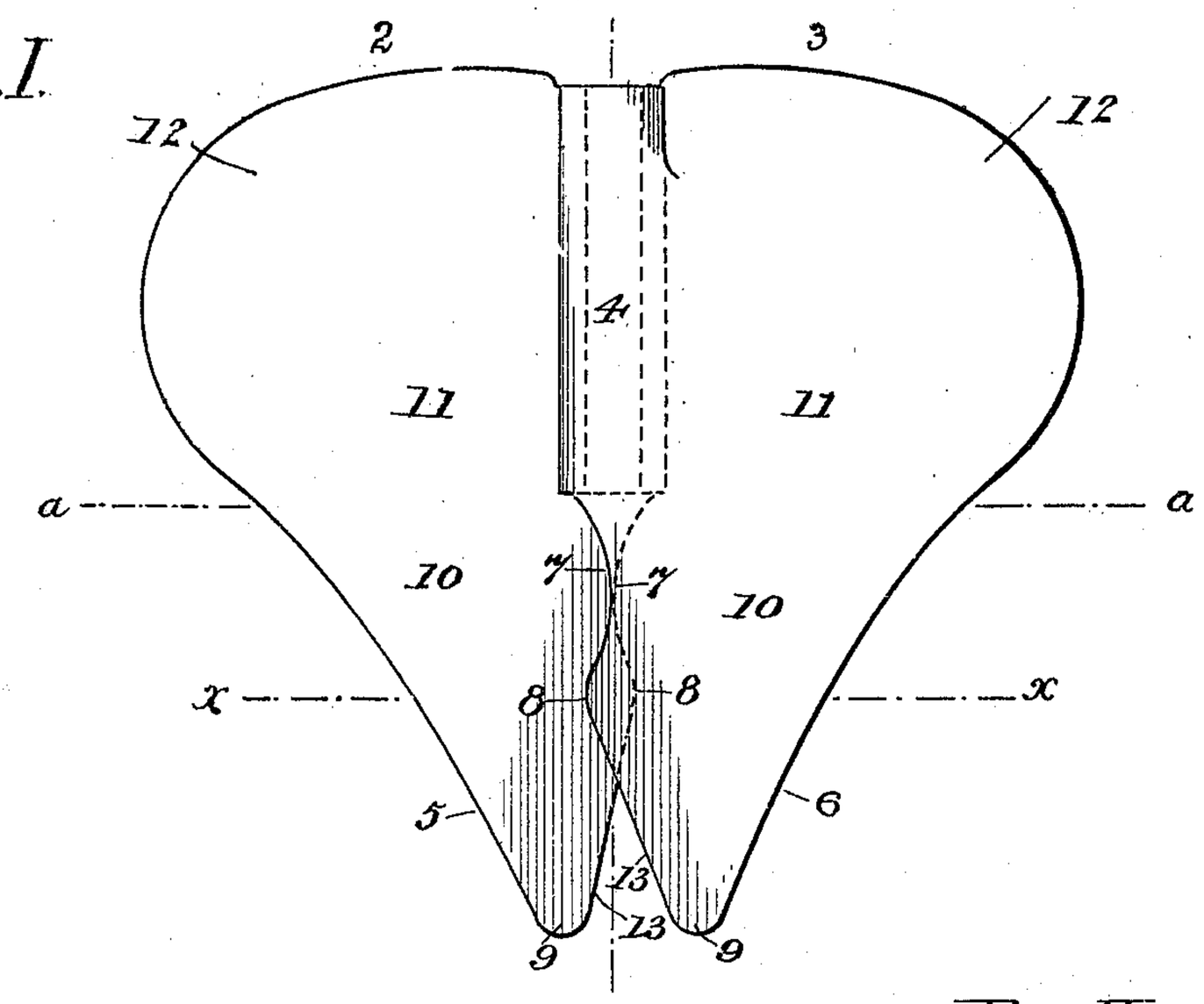


Fig. II.

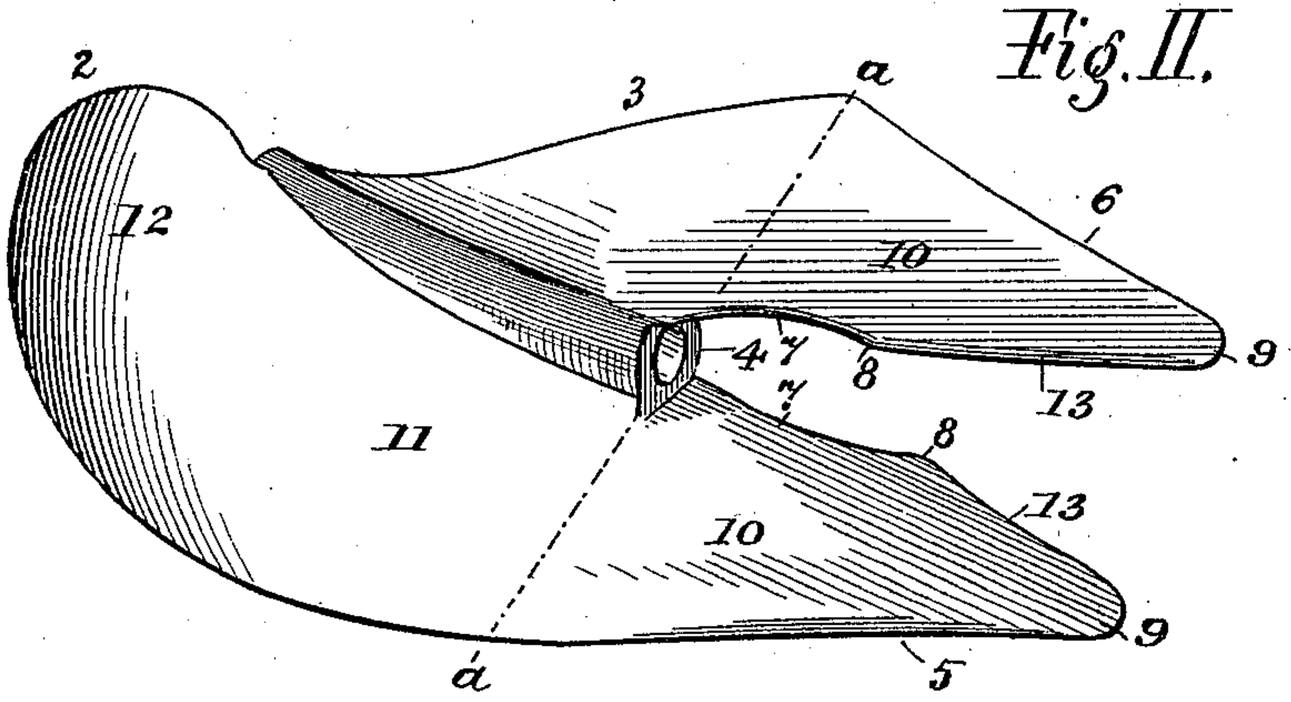
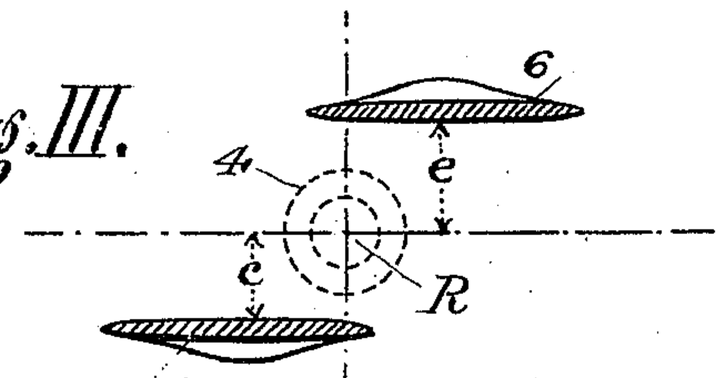


Fig. III.



Witnesses.

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Fig. 5.

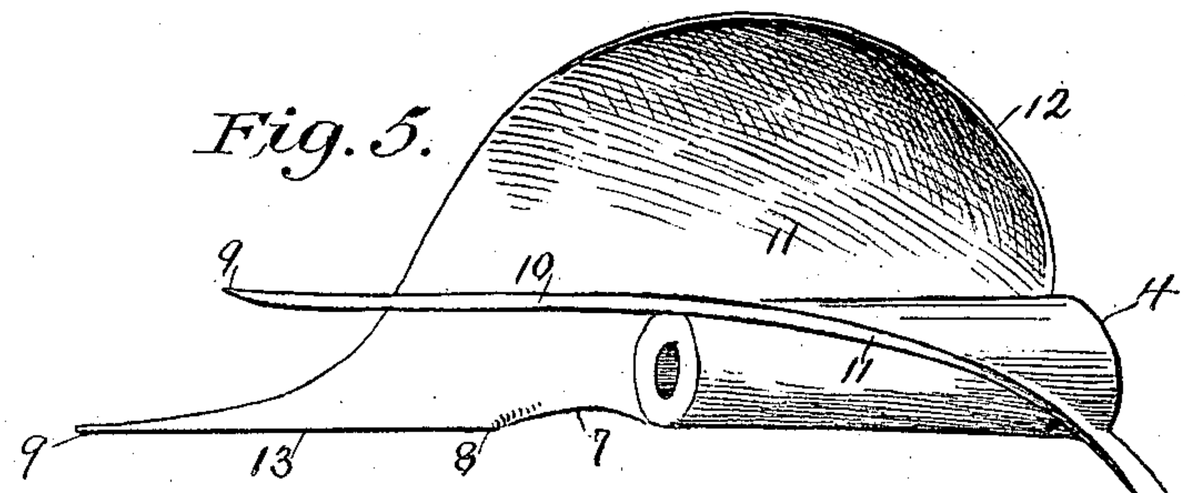


Fig. 4.

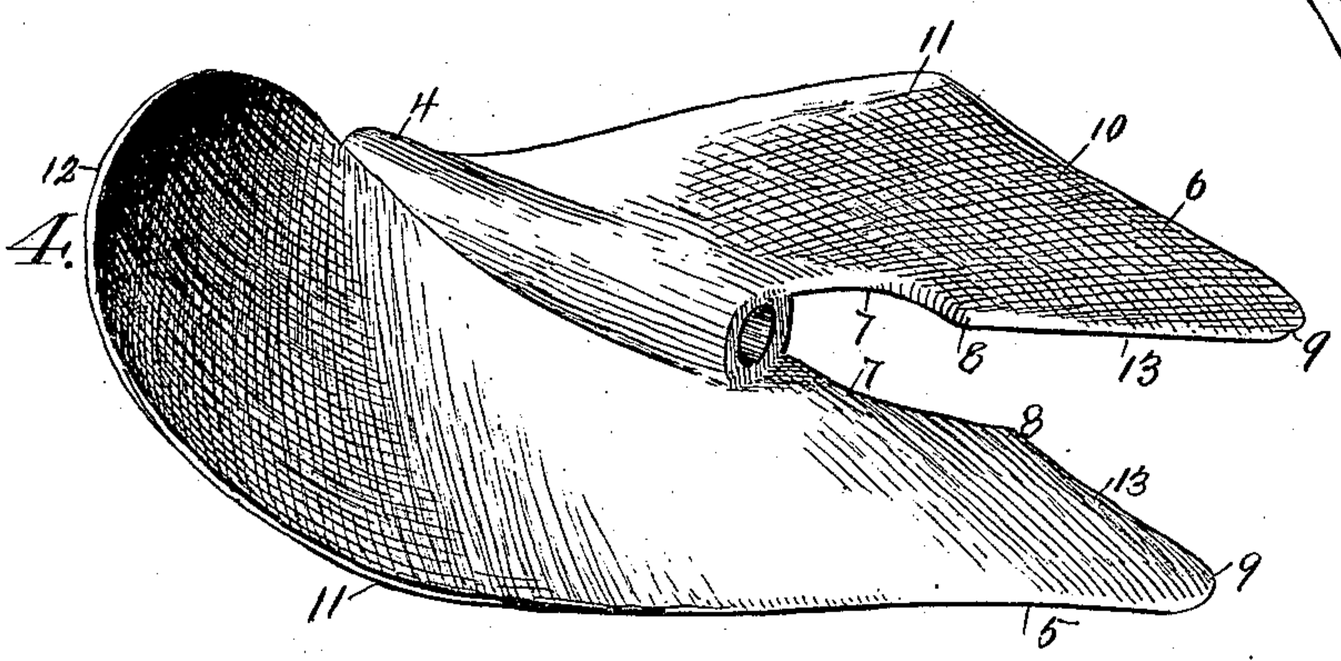


Fig. 6.

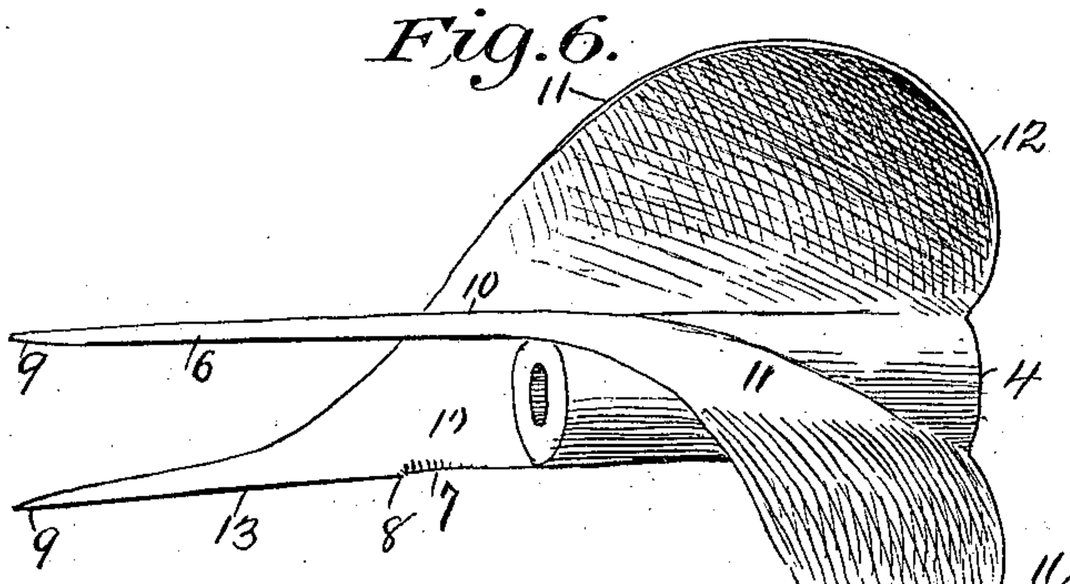
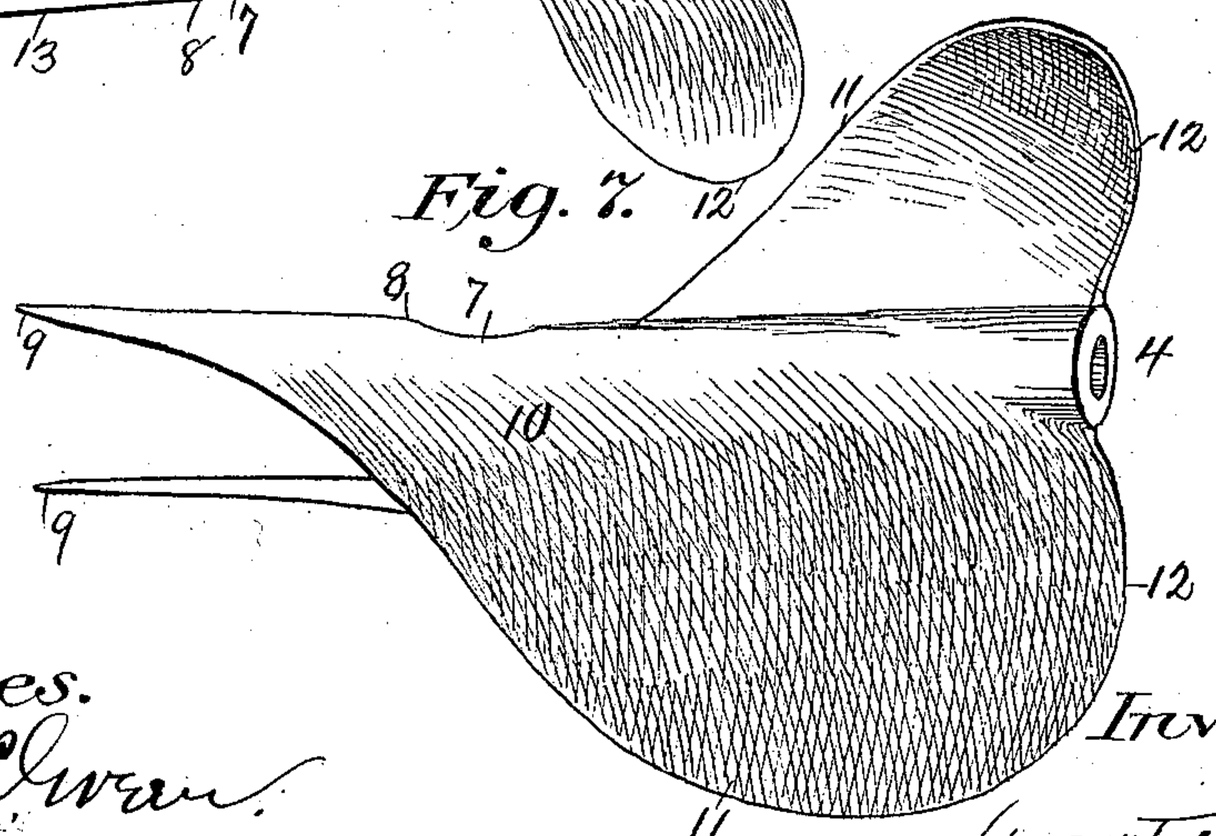


Fig. 7.



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UNITED STATES PATENT OFFICE.

AUGUSTUS HOWARD, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR TO WILLARD REED GREEN, OF DENVER, COLORADO.

SCREW-PROPELLER.

SPECIFICATION forming part of Letters Patent No. 617,527, dated January 10, 1899.

Application filed June 6, 1898. Serial No. 682,640. (Model.)

To all whom it may concern:

Be it known that I, AUGUSTUS HOWARD, a subject of the Queen of Great Britain, residing at San Francisco, county of San Francisco, and State of California, have invented certain new and useful Improvements in Propellers; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to propellers for the propulsion of vessels and which may be used for other purposes—such, for instance, as moving air.

The object of my invention is to more effectually utilize the driving power applied to the propeller.

My improvements consist of providing an improved form and arrangement of the vanes composing such propeller and which act more effectively upon the water actually engaged thereby and with less disturbance of the surrounding portions of water.

Referring to the drawings, Figure 1 shows an elevation of one embodiment of my invention, the view presented being a projection of an outline of the same taken across or through the widest diameter or lateral extension of the vanes relatively to the axis thereof. Fig. 2 is a perspective view of an embodiment of my said invention, taken diagonally from the rear toward the front, showing the rear of the boss and indicating some of the curvature of the vanes. Fig. 3 is a transverse section on the line *x x*, Fig. 1, looking toward the rear, R being the axis of rotation. Fig. 4 is a view similar to that shown in Fig. 2 and intended to indicate by shading more fully the lines of curvature of that embodiment of the invention. Fig. 5 is a view of an embodiment of the invention when viewed laterally across the vanes and at an acute angle directed forward to the axis. Fig. 6 is a similar view from a point more nearly at right angles to said axis. Fig. 7 is a view at right angles to the flat sides of the vanes, intended to indicate the curvature of some portions thereof.

It should be borne in mind that the views presented of a given propeller will vary greatly with the point of view from which they are taken and that the lines of curvature are necessarily somewhat altered with the size and purpose and working conditions of the propeller, and hence that to correctly represent a given propeller the conditions stated must be known.

In the drawings, 4 represents the boss of the propeller, to which are fixed the vanes 2 and 3, which may be made integral with said boss or may be attached thereto, as desired. Said vanes are fixed to said boss by the inner edge of their forward portions and are so attached throughout approximately one-half their longitudinal extension and opposite the portion of their greatest width. Said vanes are attached to said boss at an inclination with the axis thereof equal to approximately the diameter of said boss. The leading or forward edge of said vane joins the forward end of said boss at a point practically at right angles with the plane of the flat portion of said vane, and said line of juncture follows said boss around the circumference thereof to a point on the circumference of said boss at its rear end in the plane of said flat portion of the vane and practically at the opposite side or diameter from the point of beginning, thus completing practically one-half a revolution around said boss and forming a corresponding curve therewith. This line of juncture and the resulting curvature will depend upon and be varied with the purposes, working conditions, and size of the propeller; but the form indicated best embodies the invention and is a preferable form. Thus a vane is provided having its main working or propulsion surface 11 substantially in the plane of the axis or at a small angle thereto and having its forward or entering end or section 12 curved in the direction of rotation.

To the rearward of the boss 4 of said propeller the vanes 2 and 3 continue as substantially flat projections 10, but may be thickened or reinforced, if desired, upon the backs thereof, to suit conditions. It will be observed that owing to the manner in which said vanes leave the rear extremity of the boss they lie in planes practically parallel and separated from each other by a distance equal to practically the diameter of the boss and may be more or less, to suit conditions. Said vanes

continue in their rearward projections in practically said planes, the degree of inclination of which to each other may be nothing or parallel or may be separated, as desired, and may be at unequal angles with the axis of the propeller. The said vanes may at the point of separation at the rear of the boss overlap, as shown in Figs. 2 and 3, or leave said boss at points in their planes beyond the intersection of said planes with a plane of the axis at right angles to their planes, whereby said vanes will appear as superimposing, as indicated in Figs. 1 and 3, and the degree of this lap or overhang may vary as desired, its purpose being hereinafter explained. Immediately after leaving the rearward end of the boss the inner edges of the vanes are cut away or concaved, as indicated at 7, and this may be to a degree and for a longitudinal distance desired, depending upon working conditions. To the rearward of the point 8 in Fig. 1 or the rearward extremity of the concave portion said vanes taper to their ends, as indicated at 9 in Fig. 1. The degree and variation of this reduction of width will vary with given conditions and for different purposes and may be of unequal or varying degree in the two vanes, with the result that said vanes will have different forms and width and will stand laterally at different distances from the axis of the propeller, both as to the distance of their planes from said axis and the distance at which their inner edges stand with a line or plane drawn at right angles through said axis and through their said planes, and said vanes may be of unequal length. The object of this arrangement is that the said rearward portions of the vanes may not travel in exactly the same path around the axis of rotation, but may have different paths and may to some extent intersect and act upon different water and also counteract currents and any vortex formed by each in its revolution. It will thus be seen that while the two vanes 2 and 3 are not exactly like in their contour outlines they are generally similar. It will also appear that the curvature of the forward portion of the vanes out of the plane of the main working surface of said vane in the direction of rotation and toward the axis of rotation may vary, and the degree and nature of this curvature will vary with the conditions of working, the size of the vessel to which it is applied, and the desired speed. It will thus be seen that a vane is provided the greatest length of which extends longitudinally with the line of progression of the propeller and also lies mostly in a plane substantially parallel with the axis of rotation of the propeller or at a small angle thereto. It will also appear that a vane is provided consisting of sections different in their formation, their functions, and their objects, and the actions of which constitute a series of effects resulting in a rearward impulsion of the water. Also a propeller is provided the largest diameter of which is toward the forward or entering end and of which the diameter diminishes toward the rear end.

The purposes of the form and disposal of the different portions of the vane are as follows: The middle portion or section of the vane is intended to be the main working or propulsion surface. It is not adapted by its form to enter and cut off the water, but to act upon the same after it has been engaged by the forward section, and it is seen that this surface lies in a plane more or less in the line of progression, and consequently in its rotation will act upon the water at an angle more or less a right angle to the axis or the line of progress and will impact said water at a relative angle, the resultant of its progress and its rotation. The forward section or entering end of the vane is intended by its curvature to cut off or engage the water to be acted upon in the advance of the propeller, and said curve is given a pitch or curvature adapted to so enter and intersect and cut off said water and to throw said water to the rearward and upon and into the pathway of the following propulsion-surface, and, as stated, the said curvature will have a relation to the depth at which the propeller is working, the immersed section of the vessel, the desired speed, and the power to be applied. The object of the rearward continuation or section of the vane is to continue the propulsion effect, to prevent the formation of a vortex at the end of the boss, to provide an open clearance or freeway for the waters in the central portion of the propeller, and to gradually smooth down and release the waters acted upon. The object of the separation of the planes of the vanes in their rearward continuations and the concaved portions mentioned is to provide freeway by which water passing directly along the axis may find ready outlet with a minimum of revolution.

The actions and functions of the different parts or sections of the vanes are as follows: Upon the rotation of the propeller the forward or entering curved section of the vane enters the water upon which the propeller is advancing and engages or cuts off the water for a given rotation or stroke of the vane. The water thus cut off by the curved or entering section is by the curvature of said section projected rearward upon and into the pathway of the main working or middle section of the vane and which is then advancing upon said water with a direction of impact or pressure, the resultant of its forward progress in a line parallel with the axis and its rotation at a right angle thereto, and which, all things being equal, will cause said vane to engage said water at an angle of approximately forty-five degrees, depending upon the speed of the vessel and the rate of rotation, and which will result in the rearward propulsion of said water. The curved line of diminishing radius of the vane being such

that the most of the water after offering its greatest resistance to the impact of the vane is allowed to escape to the rearward immediately back of the widest part of the vane or the greatest diameter of the propeller, the operation of the propeller is freed from secondary or interfering effects from the greater portion of the water acted upon. The water occupying and engaged by the middle longitudinal zone of the propeller, though acted upon by the leverage of a shorter radius, is under its influence longer in its longer longitudinal travel with the vanes' continuations and with corresponding advantage. The remaining portion of the water, or that from the central portion of the propeller and which is ordinarily disposed to form a vortex at the tail of the axis, is given a vent by the separation of the planes of the vanes at the rear of the boss and by the concaving of the inner edges of the vanes and the freeway offered thereby to the passage of water from the central portions of the propeller is kept open by the action of the flat continuations of the vanes, which continuations, owing to said separation of planes, act upon said water obliquely, intersecting it with their edges and with their flat sides forming a tubular outlet or passage, preventing the influences tending to form a vortex, the tapering blades or rear ends of the vanes offering a gradually-diminishing influence of the propeller upon the water and gradually permitting it to come to rest.

I claim and desire to secure by Letters Patent—

1. A propeller consisting of a central boss 4, serving as the axis of said propeller and having vanes of greater longitudinal dimension than the length of said boss, placed thereon and fixed thereto by the inner edges of the forward portion only of said longitudinal dimensions and the rearward extension of which vanes is in lines practically parallel with the axis of said propeller.

2. A propeller consisting of a central boss or axis, 4, and vanes of greater length than the radius of said propeller, placed thereon and fixed to said boss upon the inner edges of their longest dimension and the rearward extension of which vanes is in lines practically parallel with the axis of said propeller.

3. A propeller consisting of a central boss or axis 4, and vanes of greater length than the radius of said propeller, placed thereon and fixed to said boss upon the inner edges of their longest dimensions, the said vanes diminishing in width upon their outer edges in their rearward continuation, whereby a propeller is formed the greatest diameter of which is at its forward or entering end and of which the diameter diminishes toward its rear.

4. A propeller consisting of a central boss or axis, 4, and vanes of greater length than the radius of said propeller, placed thereon and fixed to said boss upon the inner edges of their longest dimension, the said vanes diminishing in width upon their outer edges in their rearward continuation, and the outer edges of said vanes forming a contour of diminishing radius of said propeller, whereby the water engaged is acted upon for a time inversely proportioned to the radius engaging said water.

5. A propeller consisting of a central boss or axis 4, and vanes of greater length than the radius of said propeller placed thereon and fixed to said boss upon the inner edges of their longest dimensions, the said vanes diminishing in width upon their outer edges in their rearward continuation, and the outer edges of which vanes form a contour curve of diminishing radius of said propeller, whereby the area of the working surfaces of said propeller is in proportion to the radius and the impact thereof upon the water engaged.

6. A propeller consisting of a central boss 4, serving as the axis of said propeller and having vanes 2 and 3, of greater longitudinal dimension in line parallel with the boss than the length of said boss, placed upon said boss and fixed thereto upon the inner edges of the forward portion only of said longitudinal dimension and the rearward continuation of which vanes beyond the rear of said boss lie in planes substantially parallel with and clear of the axis of said propeller, whereby free way is provided through the central portion of said propeller.

7. A propeller, having a central boss 4, constituting the axis of said propeller and vanes 2 and 3 fixed thereon, the greatest length of which propeller lies in planes practically parallel to its axis of rotation and whose greatest curvature is at the forward or entering end of said vanes.

8. A propeller having a boss 4, constituting the axis thereof and vanes 2 and 3, fixed to said boss throughout approximately the forward half of their inner edges only and the greatest length or extension of which vanes is rearward and of which the pitch or curvature diminishes as they extend rearward, and gradually merges into and continues in planes parallel with the axis of rotation.

9. A propeller having a boss 4 and vanes 2 and 3 fixed thereon and continuing beyond the rear of said boss in substantially parallel planes upon opposite sides of the rear of said boss and the inner edges 7, 8, of which continuations overlap and are not of equal distance from the axis of said propeller whereby said rearward continuations of said vanes do not travel in the same path of revolution around the axis.

10. A propeller consisting of a boss 4 and vanes 2 and 3 fixed thereon, said vanes being substantially longitudinal and of diminishing curvature as they progress rearward and merging into parallel planes passing the rear of said boss on opposite sides thereof and

lying at different distances from the axis of said propeller and whose inner edges 7, 8, and 13 partially superimpose or lap.

11. A propeller consisting of a boss 4 and vanes 2 and 3, fixed thereto, which vanes 2 and 3, have flat continuations or sections 10 extending beyond the boss of said propeller and lying in substantially parallel planes on opposite sides of said boss and which continuations 10 diminish in width in their rearward progression by substantially similar contour lines of diminution but not exactly equal in degree, whereby the inner edges 7 and 8 of said sections 10 may stand at different distances from a plane intersecting the axis of said propeller at right angles to said vanes and portions of said edges may lie upon opposite sides of said intersecting plane, and whereby said sections 10 will not travel in the same path around the axis of revolution of said propeller.

12. A propeller consisting of the boss 4 and vanes 2 and 3 thereon, said vanes being divided into entering, middle and rearward sections or planes 12, 11 and 10, of diminishing curvature and diminishing width upon their outer edges in their rearward progression, whereby said vanes act as continuous propulsion-surfaces while performing different functions upon the water acted upon by different portions of their length and the least disturbance is produced upon said water and its greatest movement is rearward.

13. The herein-described propeller, consisting of the boss 4, and the vanes 2 and 3, mounted thereon, the entering, middle and rearward sections 12, 11, and 10 composing said vanes, the lines of curvature determining the same upon their outer and inner edges, all related and coacting substantially as described.

14. In a propeller, a vane whose greatest length is longitudinal in a line parallel to the axis of rotation of said propeller and longer than the boss of said propeller and is joined to said boss upon the inner edge of its forward portion only, and the rearward continuation of which vane extends beyond the rear of said boss substantially in a plane with the circumference of said boss at the point of passing beyond the same.

15. In a propeller, a vane whose greatest length is longitudinal in a line parallel to the axis of rotation of said propeller and longer than the boss of said propeller and is joined to said boss upon the inner edge of its forward portion only, and the line of juncture of which vane with said boss forms a varying curve around the circumference of said boss from the front to the rear thereof equal to approximately one-half a turn around said boss and the degree of which curve in its rearward progression is determined by the intended speed and working conditions of said propeller.

16. In a propeller, a vane of which the greatest dimension is longitudinal in a line parallel with the axis of the propeller and of which the greatest width is toward the forward end and which is joined to the boss of said propeller along the inner edge of the forward portion of said vane and opposite to and at right angles with the line of its greatest width.

17. In a propeller, a vane the greatest dimension of which is longitudinal in a line parallel with the axis of said propeller, said vane having its greatest width toward the forward or entering end thereof and diminishing toward its rearward end, the reduction in the width of said vane being made in the outer edge thereof beyond the radius of the boss of said propeller.

18. In a propeller, a vane of which the greatest dimension is its length longitudinal in a line parallel with the axis of said propeller, and the greatest portion of which length lies in a plane more or less parallel with the axis of rotation.

19. In a propeller, a vane of greater longitudinal dimension than the boss of said propeller, joined to said boss of said propeller along the inner edge of its forward end and the rearward portion of the edge of which vane passes beyond the boss of said propeller in its rearward continuation at a point on the circumference of said boss approximately one hundred and eighty degrees from the point of juncture of the forward portion of said vane with said boss, following a line of varying curvature in its travel around the circumference of said boss, the degree of curvature of which line is greater toward the forward end of said propeller.

20. In a propeller, a vane of which the greatest dimension is longitudinal in a line parallel with the axis of said propeller and substantially along the line of juncture of said vane with the boss of said propeller and the length of which propeller decreases as the radius thereof increases.

21. In a propeller, a vane the greatest extent of which is longitudinal in a line parallel with the axis of said propeller, and the length of which vane is divided into entering, middle and rearward sections or planes of varying curvature, and of which the middle section 11 of the largest area, consists of a plane lying approximately parallel with the axis of said propeller, and constitutes the main working or propulsion surface of said propeller: the forward section 12 consisting of a plane curved in the direction of rotation of said propeller and constituting the entering edge or surface of said propeller: and the rearward section 10 consisting of a flat plane lying substantially parallel to the axis of rotation and constituting the smoothing and quieting section of said vane, the said sections merging each into the other and coacting, whereby the forward or entering section 12 cuts off and engages the water to be acted upon and projects the same rearward upon and into position to receive the impact of the

middle section 11, which engages the same with a resultant pressure in a rearward direction where it is latterly engaged by the section 10 and given an increased longitudinal speed by the longer extension of said section 10 in proportion to its diminishing radius.

22. In a propeller, a vane having greater length than the boss of said propeller to which it is joined upon the inner edge of its forward portion and throughout the length of said boss, said vane having a greatest width equal to approximately one-half its length and diminishing toward the rear of said vane, the larger portion of the surface of said vane lying in a plane substantially parallel with the axis of said propeller, and constituting the main working or propulsion surface of said vane, said vane bearing upon its forward portion an entering section curved in the direction of rotation adapted to enter and cut off the water upon which said propeller is advancing, whereby said middle or main working surface is enabled to engage and act upon the water through which said propeller is progressing.

23. In a propeller a vane extending rearward beyond the rear of the boss of said propeller in a plane parallel with the circumference of said boss, the inner edge of which vane extends beyond a line at right angles with said vane and the axis of said propeller and which vane upon its said inner edge is concaved or cut away for a portion of said vane immediately adjoining the rear of said boss, whereby the free way through said propeller and along the circumference of said boss is increased and the said vane at the place so concaved coöperates with an opposite vane in the said propeller to counteract and prevent the formation of a vortex.

In testimony whereof I affix my signature in presence of two witnesses.

AUGUSTUS HOWARD.

Witnesses:
WALTER B. PAYNE,
ALEXANDER S. STEUART.