J. B. Root.

Screw Propeller.

No. 47,864. Patented May 23, 1865.

Fig. 1.

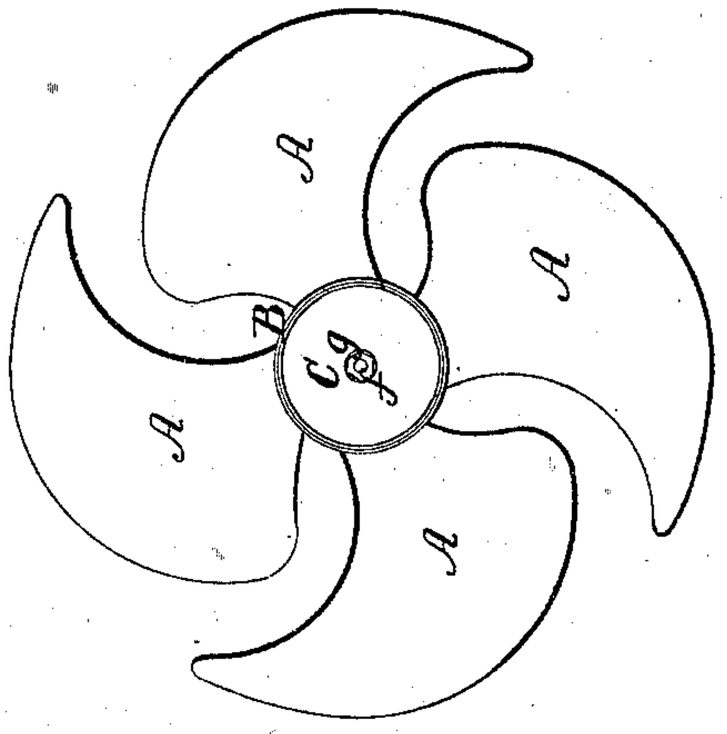


Fig. 3.

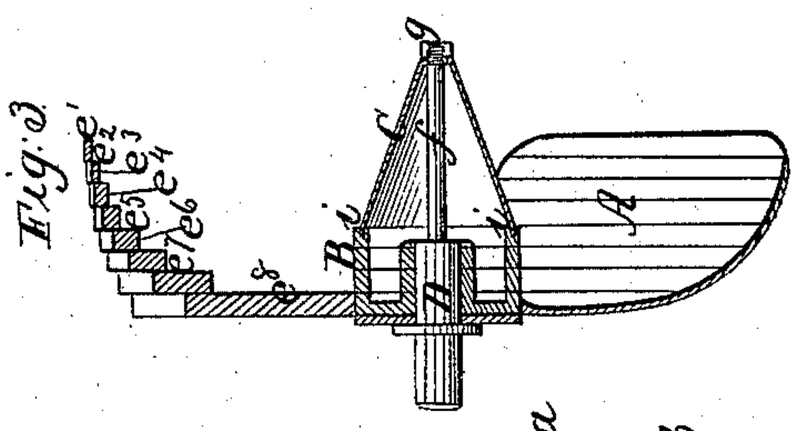


Fig. 2.

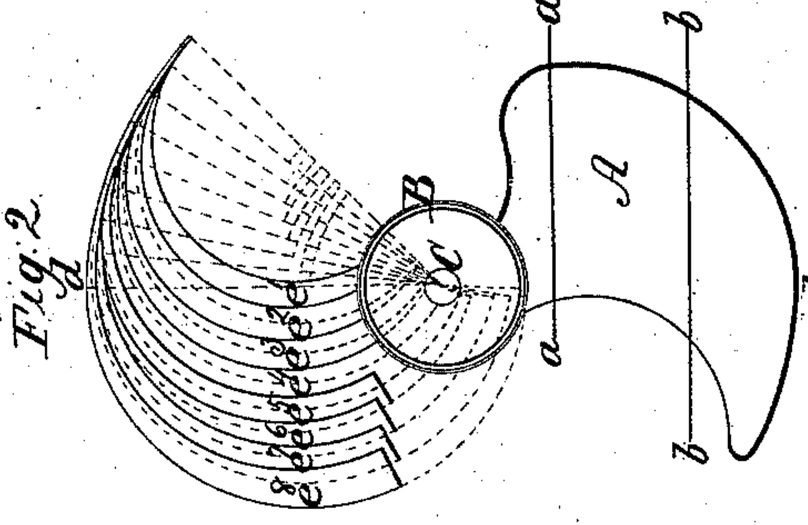


Fig. 4.

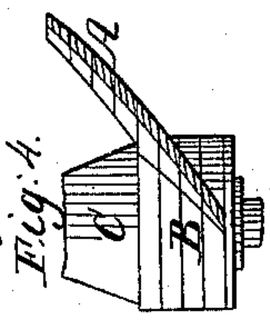


Fig. 5.

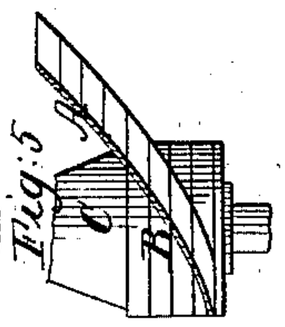


Fig. 6.

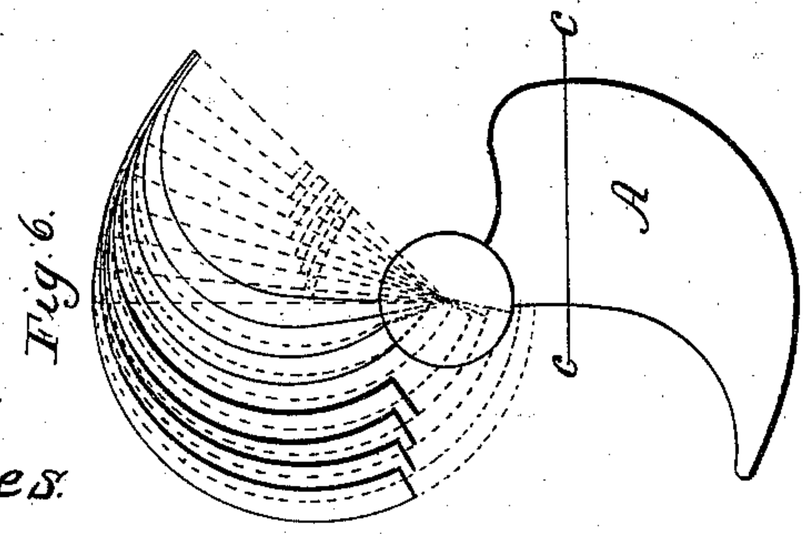
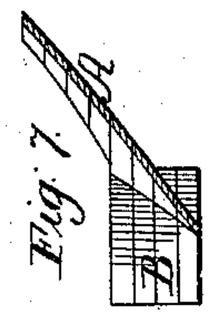


Fig. 7.



Witnesses.

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UNITED STATES PATENT OFFICE.

JOHN B. ROOT, OF NEW YORK, N. Y.

IMPROVED SCREW-PROPELLER.

Specification forming part of Letters Patent No. **47,864**, dated May 23, 1865.

To all whom it may concern:

Be it known that I, JOHN B. ROOT, of the city, county, and State of New York, have invented a new and useful Improvement in Screw-Propellers; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a face view of a propeller constructed according to my invention. Fig. 2 is a similar view of the wooden pattern from which a propeller is cast, illustrating the form and construction of the blades. Fig. 3 is an axial section in the plane indicated by the line *d d* in Fig. 2. Fig. 4 is a transverse section of one of the blades in the plane indicated by the line *a a* in Fig. 2. Fig. 5 is a transverse section of one of the blades in the plane indicated by the line *b b* in Fig. 2. Fig. 6 is a face view illustrating a modification of the blades. Fig. 7 is a transverse section of one of the blades in the plane indicated by the line *c c* in Fig. 6.

Similar letters of reference indicate corresponding parts in the several figures.

This invention relates to the construction of the operating-faces of screw-propeller blades with a hollow curvature, both in the direction of their revolution and in the direction in which the propelling force is required to be exerted, the effect of such curvature being to make the propeller collect the water from its periphery and draw it toward its axis and to discharge or deliver it in a compact column in a direction parallel with its axis, thereby preventing the formation of a vacuum in front of it and effecting the delivery of the whole of the water acted upon or set in motion by it in a direction to produce the best propulsive effect.

The improvement consists, first, in gradually diminishing the pitch of such a propeller from the periphery of the blades toward the center, in order that, as the water is drawn in toward the center, the blades may act upon it with an increasing tendency to deliver the collected column in a direction parallel with the axis.

In carrying out the first part of my invention it is desirable to make the propeller with a large hub, which receives the forward pressure which is produced by the concentration of the water toward the axis of the wheel, and to prevent the eddying of the water in rear of the said hub and allow it to pass off freely the rear portion of the hub is made of conical form; and my invention consists, secondly, in a novel and very convenient construction of and mode of fitting and attaching the conical rear portion of the hub.

To facilitate the explanation of the manner in which the pitch of the blades A A is diminished from the periphery toward the axis, one of the blades is represented in Figs. 2 and 3 divided in planes perpendicular to its axis into a series of laminæ, e' e^2 e^3 e^4 e^5 e^6 e^7 e^8. The curvature of these laminæ is in a forward direction—that is to say, in the direction in which the propeller rotates, which is indicated by an arrow in those figures and the said curvature—represented as of arc form and these arcs are described from points or centers in a number of equidistant radial lines, as shown in Fig. 2, the center from which the first one e', is struck being on the first radial line and farther from the axis of the propeller than any of the others, that from which the next one is struck being on the next radial line and nearer to the axis of the propeller; that from which the third is struck being on the third radial line and still nearer to the axis, and so on. By this construction the pitch of the inner portion of the blade is extended over a larger portion of the circumference of the hub and its degree diminished. This circumferential extension of the inner portion of the blade is illustrated in Fig. 2. The diminution of the pitch toward the center and the hollow curvature across the face of the blade, or in the direction in which the propelling force is to be exerted, are illustrated in Figs. 4 and 5, by a comparison of which it will be seen that the angle formed by the blade with the axis of the propeller is scarcely greater in the line *a a* than it is in the line *b b*, which is at twice the distance from the axis. In making the wooden pattern for the blades, the said pattern is first made of laminæ, as described, and finished by removing the edges of the said laminæ, and thereby making smooth surfaces.

It is not desirable to continue the diminution of the pitch all the way to the hub B, for the reason that it would bring the portion of the blades next the hub, where but little propulsive effect is obtained, too near perpendic-

ular to the axis of the propeller, and cause them to drag in the water. This may be obviated by making the inner portion of the blade, or the portion next the hub, tangential to the curves, by which means the said portion is prevented from being extended so far in a circumferential direction, as will be seen by a comparison of Fig. 6 with 2. Fig.

C is the conical extension of the rear of the hub, by which the formation of a drag in rear of the hub is prevented, and the free delivery of the water drawn in toward the axis of the propeller is provided for. This extension is composed of a hollow cone or conical casting.

The edges of the base of the cone are fitted into a groove, *i*, in the rear of the hub, as shown in Fig. 3, and the casting is secured in place by means of a bolt, *f*, screwed into the end of the propeller-shaft D, and a nut, *g*, screwed on to a screw-thread on the rear of the said bolt outside of the cone. By making the hub hollow and applying a water-tight packing in the groove *i''* at the junction of the conical casting with it, the hub and cone are caused to give buoyancy to the propeller and relieve the shaft in some degree of its weight.

I am aware that screw-propellers with a pitch varying or expanding in a direction lengthwise of the axis are old. I do not, however, vary the pitch in the same direction, but diminish it from the periphery toward the axis. I am also aware that screw-propellers have been made with a curvature forward or in the direction of the revolution, but I only desire to use this forward curvature in combination with such a diminishing pitch as I have described, the object being to make a propeller which has a powerful concentrating action upon the water, and at the same time to obtain a beneficial effect from such concentrating action. In other propellers—such, for instance, as Nystrom's—with the blades curved as above described, when the curvature is such as to obtain a powerful concentration of the water, a reaction takes place in the center of the propeller, which causes the water, or a portion of it, to rush out of the propeller along the hub in a forward direction, instead of all passing out in a rearward direction, as it should to produce the maximum propulsive effect upon the vessel. The cause of such reaction in concentrating propellers is that the pitch or surface of the blade as it approaches the center becomes too nearly parallel with the axis of the propeller, consequently has not sufficient obliquity of action, as regard the axis of the wheel upon the water, to discharge the large amount of water that is concentrated upon that portion of the blade in a rearward direction, and a portion of the water seeks an outlet in a forward direction. By diminishing the pitch of the blade as it approaches the center the distance which that portion of the blade would screw through the water at one revolution of the wheel is also diminished or that portion of the blade acquires a tendency to drag, as the outer portion of the blade having the greatest pitch is inclined to travel the fastest in the direction of the axis of the wheel. Now, this dragging or backward action of the inner portion of the blade by diminishing pitch seems to have been avoided heretofore in all wheels with which I am familiar, and it undoubtedly should be avoided in wheels with straight or nearly straight blades; but in curved or concentrating blades it becomes necessary, in order that the blade may have sufficient obliquity of action toward the center and when the greatest amount of water is concentrated upon it, to discharge it all in a rearward direction and with a force more directly in line with the axis of the wheel. I contend that the drag or back action which occurs against the inner portion of the forward surface of the blade, owing to the diminished pitch toward the center of the propeller, does not operate injuriously, for the reason that the gain by the more direct action of that portion of the blade nearer the center upon which a great quantity of water is concentrated and discharged astern is greater than the loss by the drag against the forward surface of the blade caused by the diminished pitch toward the center, for the drag or back action against the forward surface of the blade has a tendency to turn the wheel in the required direction, thus giving back to the wheel nearly all the power that is lost by the drag. The dragging action of the blade upon the water also has a tendency to prevent the water which passes through the wheel from acquiring a rotary motion in the direction of the revolution of the wheel, as the water is deflected in an opposite direction by the forward surface of the blade against which the dragging action takes place from that which is discharged from the after surface of the blade by its action against the water.

I do not claim the curvature of the blades of a propeller in a forward direction; nor do I claim, broadly, the conical hub; but

What I do claim as my invention, and desire to secure by Letters Patent, is—

1. A screw-propeller, the blades of which have a curvature forward, or in the direction of the revolution, combined with such a hollow curvature of the faces as is produced by a diminution of the pitch from the periphery toward the axis of the propeller, substantially as herein specified.

2. The hollow rearward conical extension C of the hub, attached to body B thereof, by being fitted into a groove, *i*, in the body, and secured by a central bolt, *f*, which passes through the said extension, and is screwed into the end of the propeller-shaft, substantially as herein described.

JOHN B. ROOT.

Witnesses:

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J. W. COOMBS.